Oracle® REST Data Services Installation, Configuration, and Development Guide





Oracle REST Data Services Installation, Configuration, and Development Guide, Release 20.4

F37790-04

Copyright © 2011, 2021, Oracle and/or its affiliates.

Primary Authors: Mamata Basapur, Chuck Murray

Contributors: Colm Divilly, Sharon Kennedy, Ganesh Pitchaiah, Kris Rice, Elizabeth Saunders, Jason Straub, Vladislav Uvarov

This software and related documentation are provided under a license agreement containing restrictions on use and disclosure and are protected by intellectual property laws. Except as expressly permitted in your license agreement or allowed by law, you may not use, copy, reproduce, translate, broadcast, modify, license, transmit, distribute, exhibit, perform, publish, or display any part, in any form, or by any means. Reverse engineering, disassembly, or decompilation of this software, unless required by law for interoperability, is prohibited.

The information contained herein is subject to change without notice and is not warranted to be error-free. If you find any errors, please report them to us in writing.

If this is software or related documentation that is delivered to the U.S. Government or anyone licensing it on behalf of the U.S. Government, then the following notice is applicable:

U.S. GOVERNMENT END USERS: Oracle programs (including any operating system, integrated software, any programs embedded, installed or activated on delivered hardware, and modifications of such programs) and Oracle computer documentation or other Oracle data delivered to or accessed by U.S. Government end users are "commercial computer software" or "commercial computer software documentation" pursuant to the applicable Federal Acquisition Regulation and agency-specific supplemental regulations. As such, the use, reproduction, duplication, release, display, disclosure, modification, preparation of derivative works, and/or adaptation of i) Oracle programs (including any operating system, integrated software, any programs embedded, installed or activated on delivered hardware, and modifications of such programs), ii) Oracle computer documentation and/or iii) other Oracle data, is subject to the rights and limitations specified in the license contained in the applicable contract. The terms governing the U.S. Government's use of Oracle cloud services are defined by the applicable contract for such services. No other rights are granted to the U.S. Government.

This software or hardware is developed for general use in a variety of information management applications. It is not developed or intended for use in any inherently dangerous applications, including applications that may create a risk of personal injury. If you use this software or hardware in dangerous applications, then you shall be responsible to take all appropriate fail-safe, backup, redundancy, and other measures to ensure its safe use. Oracle Corporation and its affiliates disclaim any liability for any damages caused by use of this software or hardware in dangerous applications.

Oracle and Java are registered trademarks of Oracle and/or its affiliates. Other names may be trademarks of their respective owners.

Intel and Intel Inside are trademarks or registered trademarks of Intel Corporation. All SPARC trademarks are used under license and are trademarks or registered trademarks of SPARC International, Inc. AMD, Epyc, and the AMD logo are trademarks or registered trademarks of Advanced Micro Devices. UNIX is a registered trademark of The Open Group.

This software or hardware and documentation may provide access to or information about content, products, and services from third parties. Oracle Corporation and its affiliates are not responsible for and expressly disclaim all warranties of any kind with respect to third-party content, products, and services unless otherwise set forth in an applicable agreement between you and Oracle. Oracle Corporation and its affiliates will not be responsible for any loss, costs, or damages incurred due to your access to or use of third-party content, products, or services, except as set forth in an applicable agreement between you and Oracle.

Contents

Preface

Audience	xviii
Documentation Accessibility	xviii
Related Documents	xix
Conventions	xix
Changes in This Release for Oracle REST Data Services Installation, Configuration, and Development Guide	
Changes in Oracle REST Data Services Release 20.4	xx
Introduction to Oracle REST Data Services	
About Oracle REST Data Services	1-1
Understanding the Installation Process	1-1
Supported Java EE Application Servers	1-2
Supported Oracle Application Express (APEX) Versions	1-2
System Requirements	1-2
About Installing Oracle REST Data Services	1-3
Configuring and Installing Oracle REST Data Services	1-3
About Using the Command-Line Interface	1-4
About the Database Users Used by Oracle REST Data Services	1-4
Privileges Required for Oracle REST Data Services	1-5
Downloading, Configuring and Installing Oracle REST Data Services	1-7
ORDS Installer Privileges Script	1-8
Advanced Installation Using Command-Line Prompts	1-8
ORDS Parameter File	1-14
Simple Installation Using a Parameter File	1-27
Silent Installation Using a Parameter File	1-28
Changing Default Configuration from the Command Line	1-29
Validating the Oracle REST Data Services Installation	1-30
If You Want to Reinstall or Uninstall (Remove) Oracle REST Data Services	1-31
Using SQL Developer Oracle REST Data Services Administration (Optional)	1-32



About SQL Developer Oracle REST Data Services Administration	1-32
Configuring an Administrator User	1-33
Using OAuth2 in Non-HTTPS Environments	1-33
Running in Standalone Mode	1-34
Starting in Standalone Mode	1-34
Converting a Private Key to DER (Linux and Unix)	1-35
Stopping the Server in Standalone Mode	1-36
Configuring a Doc Root for Non-Application Express Static Resources	1-36
Deploying to Oracle WebLogic Server	1-37
About Oracle WebLogic Server	1-37
Downloading, Installing, and Configuring Oracle REST Data Services	1-38
Configuring Oracle Application Express Images	1-38
Launching the Administration Server Console	1-38
Installing the Oracle WebLogic Server Deployment	1-39
Configuring WebLogic to Handle HTTP Basic Challenges Correctly	1-40
Verifying the State and Health of ords and i	1-42
Deploying to Apache Tomcat	1-42
About Apache Tomcat	1-42
Downloading, Installing, and Configuring Oracle REST Data Services	1-42
Configuring Oracle Application Express Images	1-42
Installing the Apache Tomcat Deployment	1-43
Monitoring ORDS	1-43
Enabling the ORDS Instance API	1-44
Authorization for Using the ORDS Instance API	1-44
API Document	1-44
Using the Instance API	1-44
Upgrading Oracle REST Data Services	1-4
Using a Bequeath Connection to Install, Upgrade, Validate, or Uninstall Oracle REST Data Services	1-40
Authorizing Oracle REST Data Services to Access Oracle Data Guard Protected	
Users	1-46
Configuring Oracle REST Data Services (Advanced)	
Configuring Multiple Databases	2-1
About the Request URL	2-1
Configuring Additional Databases	2-2
Routing Based on the Request Path Prefix	2-3
Example of Routing Based on the Request Path Prefix	2-3
Routing Based on the Request URL Prefix	2-
	2-4
Example of Routing Based on the Request URL Prefix	



2

rring Security, Caching, Pre- and Post Process	ing, Environment, and Excel	2-5
ring REST-Enabled SQL Service Settings		2-6
ring the Maximum Number of Rows Returned	from a Ouerv	2-6
iring the Custom Error Pages	nom a Query	2-7
oing RESTful Services for Use with Oracle RE	ST Data Services	2-7
ng ORDS Administrator Privilege		2-7
visioning ORDS ADMINISTRATOR ROLE to	a User	2-8
provisioning ORDS_ADMINISTRATOR_ROLE		2-8
ng ORDS Runtime Privilege		2-8
visioning ORDS_RUNTIME_ROLE to a User		2-9
provisioning ORDS_RUNTIME_ROLE from a U	Jser	2-9
ling and Configuring Customer M nomous Database	lanaged ORDS on	
Customer Managed Oracle REST Data Service	es on Autonomous Database	3-1
ading Wallet and Verifying Connection to Auto	nomous Database	3-2
g Customer Managed Oracle REST Data Serv	rices User Role	3-3
	vicos	3-4
ading and Configuring Oracle REST Data Ser	vices	_
ading and Configuring Oracle REST Data Ser ng and Starting ORDS	vices	3-5
		3-5
ng and Starting ORDS The Multitenant Architecture with		3-5 vices
ng and Starting ORDS The Multitenant Architecture with Up ORDS in a CDB Environment		3-5 vices 4-1
ng and Starting ORDS The Multitenant Architecture with Up ORDS in a CDB Environment tallation Enabling Multiple Releases		3-5 vices 4-1 4-2
ng and Starting ORDS The Multitenant Architecture with Up ORDS in a CDB Environment tallation Enabling Multiple Releases Command Line Installation		3-5 rvices 4-1 4-2 4-2
ng and Starting ORDS The Multitenant Architecture with Up ORDS in a CDB Environment tallation Enabling Multiple Releases Command Line Installation Advanced Installation	ı Oracle REST Data Ser	3-5 rvices 4-1 4-2 4-2 4-2
the Multitenant Architecture with Up ORDS in a CDB Environment tallation Enabling Multiple Releases Command Line Installation Advanced Installation Silent Installation grading Oracle REST Data Services in a CDB Migrating Oracle REST Data Services in the G	o Oracle REST Data Ser	3-5 vices 4-1 4-2 4-2 4-3
the Multitenant Architecture with Up ORDS in a CDB Environment tallation Enabling Multiple Releases Command Line Installation Advanced Installation Silent Installation grading Oracle REST Data Services in a CDB Migrating Oracle REST Data Services in the GReleases	Oracle REST Data Ser Environment CDB to Enable Multiple	3-5 vices 4-1 4-2 4-2 4-3 4-4
the Multitenant Architecture with Up ORDS in a CDB Environment tallation Enabling Multiple Releases Command Line Installation Advanced Installation Silent Installation grading Oracle REST Data Services in a CDB Migrating Oracle REST Data Services in the G	Oracle REST Data Ser Environment CDB to Enable Multiple ata Services	3-5 rvices 4-1 4-2 4-2 4-3 4-4
the Multitenant Architecture with Up ORDS in a CDB Environment callation Enabling Multiple Releases Command Line Installation Advanced Installation Silent Installation grading Oracle REST Data Services in a CDB Migrating Oracle REST Data Services in the G Releases king All PDBs Addressable by Oracle REST D	Oracle REST Data Ser Environment CDB to Enable Multiple ata Services	3-5 rvices 4-1 4-2 4-3 4-4 4-4 4-4
the Multitenant Architecture with Up ORDS in a CDB Environment tallation Enabling Multiple Releases Command Line Installation Advanced Installation Silent Installation grading Oracle REST Data Services in a CDB Migrating Oracle REST Data Services in the CReleases king All PDBs Addressable by Oracle REST Data Services in a CDB	Environment CDB to Enable Multiple ata Services B Environment	3-5 rvices 4-1 4-2 4-2 4-3 4-4 4-4 4-4
the Multitenant Architecture with Up ORDS in a CDB Environment tallation Enabling Multiple Releases Command Line Installation Advanced Installation Silent Installation grading Oracle REST Data Services in a CDB Migrating Oracle REST Data Services in the G Releases king All PDBs Addressable by Oracle REST D Installing Oracle REST Data Services in a CDB Up ORDS in an Application Container	Environment CDB to Enable Multiple ata Services B Environment	3-5 rvices 4-1 4-2 4-3 4-4 4-4 4-4 4-4
the Multitenant Architecture with Up ORDS in a CDB Environment callation Enabling Multiple Releases Command Line Installation Advanced Installation Silent Installation grading Oracle REST Data Services in a CDB Migrating Oracle REST Data Services in the CReleases king All PDBs Addressable by Oracle REST D Installing Oracle REST Data Services in a CDB Up ORDS in an Application Container Irrequisites for Creating ORDS in an Application	Environment CDB to Enable Multiple ata Services B Environment Container	3-5 rvices 4-1 4-2 4-2 4-3 4-4 4-4 4-4 4-5
the Multitenant Architecture with Up ORDS in a CDB Environment tallation Enabling Multiple Releases Command Line Installation Advanced Installation Silent Installation Grading Oracle REST Data Services in a CDB Migrating Oracle REST Data Services in the Grading All PDBs Addressable by Oracle REST D installing Oracle REST Data Services in a CDB Up ORDS in an Application Container Greating an Application Root Container	Environment CDB to Enable Multiple ata Services B Environment Container	3-5 vices 4-1 4-2 4-2 4-3 4-4 4-4 4-4 4-5 4-6
the Multitenant Architecture with Up ORDS in a CDB Environment callation Enabling Multiple Releases Command Line Installation Advanced Installation Silent Installation Grading Oracle REST Data Services in a CDB Migrating Oracle REST Data Services in the Gradeses king All PDBs Addressable by Oracle REST D Installing Oracle REST Data Services in a CDB Up ORDS in an Application Container Grequisites for Creating ORDS in an Application Creating an Application Root Container Greating ORDS in the Application Root Container	Environment CDB to Enable Multiple ata Services B Environment Container	3-5 vices 4-1 4-2 4-2 4-3 4-4 4-4 4-6 4-6
the Multitenant Architecture with Up ORDS in a CDB Environment tallation Enabling Multiple Releases Command Line Installation Advanced Installation Silent Installation Grading Oracle REST Data Services in a CDB Migrating Oracle REST Data Services in the Releases king All PDBs Addressable by Oracle REST D installing Oracle REST Data Services in a CDB Up ORDS in an Application Container requisites for Creating ORDS in an Application Root Container talling ORDS in the Application Root Container talling an Application Seed	Environment CDB to Enable Multiple ata Services B Environment Container	3-5 vices 4-1 4-2 4-2 4-3 4-4 4-4 4-5 4-6 4-7
the Multitenant Architecture with Up ORDS in a CDB Environment tallation Enabling Multiple Releases Command Line Installation Advanced Installation Silent Installation Grading Oracle REST Data Services in a CDB Migrating Oracle REST Data Services in the Gradeses king All PDBs Addressable by Oracle REST Dressable by Oracle REST Dressable in a CDB Up ORDS in an Application Container requisites for Creating ORDS in an Application Creating an Application Root Container talling ORDS in the Application Root Container aring an Application Seed teating an Application PDB from the Application	Environment CDB to Enable Multiple ata Services B Environment Container	3-5 vices 4-1 4-2 4-2 4-3 4-4 4-4 4-5 4-6 4-7 4-8



Creating the ORDS Configuration Files for the Application Root Container	4-10
Making all Application PDBs in an Application Root Container Addressable	4 44
by ORDS	4-11
Running ORDS	4-11
Validating ORDS in the Application Root Container	4-12
Upgrading ORDS in the Application Container	4-13
Uninstalling ORDS from the Application Container	4-14
Verifying ORDS in the Application Container	4-15
Making All PDBs Addressable by Oracle REST Data Services (Pluggable Mapping)	4-15
Developing Oracle REST Data Services Applications Introduction to Relevant Software	5-2
About Oracle Application Express	5-2
About RESTful Web Services	5-2
Getting Started with RESTful Services	5-2
RESTful Services Terminology	5-3
About Request Path Syntax Requirements	5-4
"Getting Started" Documents Included in Installation	5-4
About cURL and Testing RESTful Services	5-5
Automatic Enabling of Schema Objects for REST Access (AutoREST)	5-5
Examples: Accessing Objects Using RESTful Services	5-6
Filtering in Queries	5-17
Auto PL/SQL	5-25
Manually Creating RESTful Services Using SQL and PL/SQL	5-31
About Oracle REST Data Services Mechanisms for Passing Parameters	5-32
Using SQL/JSON Database Functions	5-42
About Working with Dates Using Oracle REST Data Services	5-52
About Datetime Handling with Oracle REST Data Services	5-53
About Setting the Time Zone	5-54
Exploring the Sample RESTful Services in Application Express (Tutorial)	5-55
Configuring Secure Access to RESTful Services	5-59
Authentication	5-60
First Party Cookie-Based Authentication	5-60
Third Party OAuth 2.0-Based Authentication	5-60
About Privileges for Accessing Resources	5-61
About Users and Roles for Accessing Resources	5-61
About the File-Based User Repository	5-62
Tutorial: Protecting and Accessing Resources	5-62
OAuth Flows and When to Use Each	5-63
Assumptions for This Tutorial	5-63
Steps for This Tutorial	5-64



About Oracle REST Data Services User Roles	5-74
About Oracle Application Express Users and Oracle REST Data Services Roles	5-75
Granting Application Express Users Oracle REST Data Services Roles	5-75
Automatically Granting Application Express Users Oracle REST Data	
Services Roles	5-75
Controlling RESTful Service Access with Roles	5-76
About Defining RESTful Service Roles	5-76
Associating Roles with RESTful Privileges	5-77
Authenticating Against WebLogic Server User Repositories	5-77
Authenticating Against WebLogic Server	5-77
Creating a WebLogic Server User	5-78
Verifying the WebLogic Server User	5-79
Integrating with Existing Group/Role Models	5-79
About role-mapping.xml	5-79
Parameterizing Mapping Rules	5-80
Dereferencing Parameters	5-80
Indirect Mappings	5-81
Integrating Oracle REST Data Services and WebLogic Server	5-81
Configuring ORDS to Integrate with WebLogic Server	5-82
Using the Oracle REST Data Services PL/SQL API	5-82
Creating a RESTful Service Using the PL/SQL API	5-83
Testing the RESTful Service	5-84
Oracle REST Data Services Database Authentication	5-85
Installing Sample Database Scripts	5-85
Enabling the Database Authentication	5-86
Configuring the Request Validation Function	5-87
Testing the Database Authenticated User	5-88
Uninstalling the Sample Database Schema	5-88
Overview of Pre-hook Functions	5-88
Configuring the Pre-hook Function	5-89
Using a Pre-hook Function	5-89
Processing of a Request	5-89
Identity Assertion of a User	5-89
Aborting Processing of a Request	5-90
Ensuring Pre-hook is Executable	5-90
Exceptions Handling by Pre-hook Function	5-90
Pre-hook Function Efficiency	5-91
Pre-Hook Examples	5-91
Installing the Examples	5-91
Uninstalling the Examples	5-94
Generating Hyperlinks	5-95
U /I	



	Primary Key Hyperlinks	5-95
	Composite Primary Keys	5-97
	Arbitrary Hyperlinks	5-97
	About the related Link Relation	5-99
	URL Resolution	5-99
	About HTTP Error Responses	5-102
	About error.responseFormat	5-102
	HTML Mode	5-103
	json Mode	5-103
	auto Mode	5-103
6	REST-Enabled SQL Service	
	REST-Enabled SQL Service Terminology	6-1
	Configuring the REST-Enabled SQL Service	6-2
	Using cURL with REST-Enabled SQL Service	6-2
	Getting Started with the REST-Enabled SQL Service	6-3
	REST-Enabling the Oracle Database Schema	6-3
	REST-Enabled SQL Authentication	6-4
	REST-Enabled SQL Endpoint	6-4
	REST-Enabled SQL Service Examples	6-5
	POST Requests Using application/sql Content-Type	6-5
	Using a Single SQL Statement	6-6
	Using a File with cURL	6-7
	Using Multiple SQL Statements	6-8
	POST Requests Using application/json Content-Type	6-11
	Using a File with cURL	6-11
	Specifying the Limit Value in a POST Request for Pagination	6-13
	Specifying the Offset Value in a POST Request for Pagination	6-14
	Defining Binds in a POST Request	6-16
	Specifying Batch Statements in a POST Request	6-20
	Example POST Request with DATE and TIMESTAMP Format	6-23
	Data Types and Formats Supported	6-25
	REST-Enabled SQL Request and Response Specifications	6-29
	Request Specification	6-29
	Response Specification	6-32
	Supported SQL, SQL*Plus, and SQLcl Statements	6-38
	Supported SQL Statements	6-38
	Supported PL/SQL Statements	6-38
	Supported SQL*Plus Statements	6-39
	Set System Variables	6-39



	Show System Variables Supported SQLcl Statements	6-40 6-42
7	Migrating from mod_plsql to ORDS	
	Oracle HTTP Server mod_plsql Authentication	7-1
	Example Oracle HTTP Server DAD file	7-2
	Mapping mod_plsql Settings to ORDS	7-3
	Example ORDS Configuration Files	7-8
	Example Configuration File for Basic Authentication	7-8
	Example Configuration File for Basic Dynamic Authentication	7-8
	Example Configuration file for Custom Authentication	7-9
	Example ORDS URL Mapping	7-10
	Example ORDS Default Configuration	7-10
	ORDS Authentication	7-11
	Basic Authentication	7-11
	Basic Dynamic Authentication	7-11
	Custom Authentication	7-12
	ORDS Features	7-12
	Request Validation Function	7-13
	Pre Process Feature	7-13
	Post Process Feature	7-13
	File Upload Feature	7-14
	Cross-Origin Resource Sharing Feature	7-14
8	Oracle REST Data Services PL/SQL Package Reference	
	ORDS.CREATE_ROLE	8-1
	ORDS.CREATE_SERVICE	8-1
	ORDS.DEFINE_HANDLER	8-4
	ORDS.DEFINE_MODULE	8-6
	ORDS.DEFINE_PARAMETER	8-7
	ORDS.DEFINE_PRIVILEGE	8-9
	ORDS.DEFINE_SERVICE	8-11
	ORDS.DEFINE_TEMPLATE	8-14
	ORDS.DELETE_MODULE	8-16
	ORDS.DELETE_PRIVILEGE	8-16
	ORDS.DELETE_ROLE	8-17
	ORDS.DROP_REST_FOR_SCHEMA	8-17
	ORDS.ENABLE_OBJECT	8-18
	ORDS.DROP_REST_FOR_OBJECT	8-19



	ORDS.PUBLISH_MODULE	8-20
	ORDS.RENAME_MODULE	8-21
	ORDS.RENAME_PRIVILEGE	8-22
	ORDS.RENAME_ROLE	8-22
	ORDS.SET_MODULE_ORIGINS_ALLOWED	8-23
	ORDS.SET_URL_MAPPING	8-24
	ORDS.SET_SESSION_DEFAULTS	8-24
	ORDS.RESET_SESSION_DEFAULTS	8-25
9	Oracle REST Data Services Administration PL/SQL Package Reference	
	ORDS_ADMIN.CREATE_ROLE	9-1
	ORDS_ADMIN.DEFINE_HANDLER	9-2
	ORDS_ADMIN.DEFINE_MODULE	9-4
	ORDS_ADMIN.DEFINE_PARAMETER	9-5
	ORDS_ADMIN.DEFINE_PRIVILEGE	9-7
	ORDS_ADMIN.DEFINE_SERVICE	9-10
	ORDS_ADMIN.DEFINE_TEMPLATE	9-13
	ORDS_ADMIN.DELETE_MODULE	9-14
	ORDS_ADMIN.DELETE_PRIVILEGE	9-15
	ORDS_ADMIN.DELETE_ROLE	9-15
	ORDS_ADMIN.DROP_REST_FOR_SCHEMA	9-16
	ORDS_ADMIN.ENABLE_OBJECT	9-17
	ORDS_ADMIN.DROP_REST_FOR_OBJECT	9-18
	ORDS_ADMIN.ENABLE_SCHEMA	9-19
	ORDS_ADMIN.PUBLISH_MODULE	9-20
	ORDS_ADMIN.RENAME_MODULE	9-20
	ORDS_ADMIN.RENAME_PRIVILEGE	9-21
	ORDS_ADMIN.RENAME_ROLE	9-22
	ORDS_ADMIN.SET_MODULE_ORIGINS_ALLOWED	9-23
	ORDS_ADMIN.SET_URL_MAPPING	9-23
	ORDS_ADMIN.ENABLE_HOUSEKEEPING_JOB	9-24
	ORDS_ADMIN.DROP_HOUSEKEEPING_JOB	9-25
	ORDS_ADMIN.PERFORM_HOUSEKEEPING	9-25
	ORDS_ADMIN.SET_SESSION_DEFAULTS	9-26
	ORDS_ADMIN.RESET_SESSION_DEFAULTS	9-26
	ORDS_ADMIN.PROVISION_ADMIN_ROLE	9-27
	ORDS_ADMIN.PROVISION_RUNTIME_ROLE	9-27

ORDS.ENABLE_SCHEMA



8-19

10 Implicit Parameters

implier diameters	
List of Implicit Parameters	10-1
About the :body parameter	10-5
About the :body_text Parameter	10-6
About the :content_type Parameter	10-6
About the :current_user Parameter	10-6
About the :status_code Parameter	10-6
About the :forward_location Parameter	10-7
About the Pagination Implicit Parameters	10-8
About the :page_offset Parameter	10-9
About the :page_size Parameter	10-9
About the :row_offset Parameter	10-10
About the :row_count Parameter	10-10
About the :fetch_offset Parameter	10-10
About the :fetch_size Parameter	10-10
About Automatic Pagination	10-10
About Manual Pagination	10-11
OAUTH PL/SQL Package Reference DAUTH.CREATE_CLIENT	11-1
OAUTH.DELETE_CLIENT	11-2
OAUTH.GRANT_CLIENT_ROLE	11-3
OAUTH.RENAME_CLIENT	11-4
OAUTH.REVOKE_CLIENT_ROLE	11-4
OAUTH.UPDATE_CLIENT	11-5
Enabling ORDS Database API	
Basic Setup to Enable ORDS Database API	12-1
Advanced Setup to Enable the ORDS Database API	12-2
Pluggable Database Lifecycle Management	12-3
Disabling PDB Lifecycle Management	12-3
Creating a Default Administrator	12-4
Configuration of Database API Environment Services	12-5
Configuration of Database API with Open Service Broker API Compatible Platforms	12-5



Oracle Built-in Types	A-1
Handling Structural Database Types	A-3
Oracle Geospacial Encoding	A-5
Enabling Database Mapping Support	A-5
About the Oracle REST Data Services Confi	guration Files
Locating Configuration Files	B-1
Setting the Location of the Configuration Files	B-1
Understanding the Configuration Folder Structure	B-1
Understanding the Configuration File Format	B-2
Understanding the url-mapping.xml File Format	B-2
Understanding Configurable Parameters	B-3
Troubleshooting Oracle REST Data Services	5
Enabling Detailed Request Error Messages	C-1
ORDS User Defined Service	C-1
Configuring Application Express Static Resources with Oracle	REST Data Services C-13
Creating an Image Gallery	
Creating an Image Gallery Before You Begin	
	D-1 D-1
Before You Begin	
Before You Begin About URIs About Browser Support	D-1
Before You Begin About URIs	D-1 D-2
Before You Begin About URIs About Browser Support Creating an Application Express Workspace	D-1 D-2 D-2
Before You Begin About URIs About Browser Support Creating an Application Express Workspace Creating the Gallery Database Table	D-1 D-2 D-2 D-2
Before You Begin About URIs About Browser Support Creating an Application Express Workspace Creating the Gallery Database Table Creating the Gallery RESTful Service Module Trying Out the Gallery RESTful Service	D-1 D-2 D-2 D-2 D-3
Before You Begin About URIS About Browser Support Creating an Application Express Workspace Creating the Gallery Database Table Creating the Gallery RESTful Service Module Trying Out the Gallery RESTful Service Creating the Gallery Application	D-1 D-2 D-2 D-2 D-3 D-4
Before You Begin About URIs About Browser Support Creating an Application Express Workspace Creating the Gallery Database Table Creating the Gallery RESTful Service Module Trying Out the Gallery RESTful Service	D-1 D-2 D-2 D-2 D-3 D-4 D-5
Before You Begin About URIS About Browser Support Creating an Application Express Workspace Creating the Gallery Database Table Creating the Gallery RESTful Service Module Trying Out the Gallery RESTful Service Creating the Gallery Application Trying Out the Gallery Application Securing the Gallery RESTful Services	D-1 D-2 D-2 D-2 D-3 D-4 D-5 D-8
Before You Begin About URIS About Browser Support Creating an Application Express Workspace Creating the Gallery Database Table Creating the Gallery RESTful Service Module Trying Out the Gallery RESTful Service Creating the Gallery Application Trying Out the Gallery Application Securing the Gallery RESTful Services Protecting the RESTful Services	D-1 D-2 D-2 D-3 D-4 D-5 D-8 D-8
Before You Begin About URIS About Browser Support Creating an Application Express Workspace Creating the Gallery Database Table Creating the Gallery RESTful Service Module Trying Out the Gallery RESTful Service Creating the Gallery Application Trying Out the Gallery Application Securing the Gallery RESTful Services Protecting the RESTful Services Modifying the Application to Use First Party Authentication	D-1 D-2 D-2 D-2 D-3 D-4 D-5 D-8 D-8 D-8 D-9
Before You Begin About URIS About Browser Support Creating an Application Express Workspace Creating the Gallery Database Table Creating the Gallery RESTful Service Module Trying Out the Gallery RESTful Service Creating the Gallery Application Trying Out the Gallery Application Securing the Gallery RESTful Services Protecting the RESTful Services Modifying the Application to Use First Party Authentication Accessing the RESTful Services from a Third Party Application	D-1 D-2 D-2 D-3 D-4 D-5 D-8 D-8 D-8 D-9 D-11
Before You Begin About URIS About Browser Support Creating an Application Express Workspace Creating the Gallery Database Table Creating the Gallery RESTful Service Module Trying Out the Gallery RESTful Service Creating the Gallery Application Trying Out the Gallery Application Securing the Gallery RESTful Services Protecting the RESTful Services Modifying the Application to Use First Party Authentication Accessing the RESTful Services from a Third Party Application Creating the Third Party Developer User	D-1 D-2 D-2 D-2 D-3 D-4 D-5 D-8 D-8 D-8 D-9 D-11 D-12
Before You Begin About URIS About Browser Support Creating an Application Express Workspace Creating the Gallery Database Table Creating the Gallery RESTful Service Module Trying Out the Gallery RESTful Service Creating the Gallery Application Trying Out the Gallery Application Securing the Gallery RESTful Services Protecting the RESTful Services Modifying the Application to Use First Party Authentication Accessing the RESTful Services from a Third Party Application Creating the Third Party Developer User Registering the Third Party Application	D-1 D-2 D-2 D-2 D-3 D-4 D-5 D-8 D-8 D-8 D-9 D-11 D-12 D-12
Before You Begin About URIS About Browser Support Creating an Application Express Workspace Creating the Gallery Database Table Creating the Gallery RESTful Service Module Trying Out the Gallery RESTful Service Creating the Gallery Application Trying Out the Gallery Application Securing the Gallery RESTful Services Protecting the RESTful Services Modifying the Application to Use First Party Authentication Accessing the RESTful Services from a Third Party Application Creating the Third Party Developer User Registering the Third Party Application Acquiring an Access Token	D-1 D-2 D-2 D-2 D-3 D-4 D-5 D-8 D-8 D-8 D-9 D-11 D-12 D-12 D-12
Before You Begin About URIS About Browser Support Creating an Application Express Workspace Creating the Gallery Database Table Creating the Gallery RESTful Service Module Trying Out the Gallery RESTful Service Creating the Gallery Application Trying Out the Gallery Application Securing the Gallery RESTful Services Protecting the RESTful Services Modifying the Application to Use First Party Authentication Accessing the RESTful Services from a Third Party Application Creating the Third Party Developer User Registering the Third Party Application	D-1 D-2 D-2 D-2 D-3 D-4 D-5 D-8 D-8 D-8 D-9 D-11 D-12 D-12



Configuring a RESTful Service for Cross Origin Resource Sharing	D-15
Acquiring a Token Using the Authorization Code Protocol Flow	D-15
Registering the Client Application	D-16
Acquiring an Authorization Code	D-16
Exchanging an Authorization Code for an Access Token	D-17
Extending OAuth 2.0 Session Duration	D-18
About Securing the Access Token	D-19
Third-Party License Information	
jackson-annotations 2.10.3	E-1
jackson-databind 2.10.3	E-5
jackson-dataformat-xml 2.10.3	E-10
jackson-core 2.10.3	E-18
Google Guava 29.0	E-22
Jetty 9.4.28	E-28
Javassist 3.27	E-90
avsc 5.4.21	E-93
babel-polyfill 7.8.7	E-94
CodeMirror 5.53.2	E-134
Dexie.js 3.0.1	E-134
SheetJS 0.15.5	E-139
jQuery 3.5.1	E-144
Index	



List of Examples

1-1	Parameters to configure for Application Express and APEX RESTful Services and	
	run in standalone mode	1-24
1-2	Parameters to run in standalone mode using http	1-26
1-3	Parameters to run in standalone mode using https and providing the ssl certificate paths	1-27
1-4		1-29
1-5		1-30
1-6		1-30
2-1	Configuring custom error page for "HTTP 404" status code	2-7
2-2	Using Grant command	2-8
2-3	Using ORDS_ADMIN package method	2-8
2-4	Using REVOKE command	2-8
2-5	Using ORDS_ADMIN package method	2-8
2-6	Using Grant command	2-9
2-7	Using ORDS_ADMIN package method	2-9
2-8	Using REVOKE command	2-9
2-9	Using ORDS_ADMIN package method	2-9
4-1	Configuring ORDS for Application Express	4-10
4-2	Configuring ORDS only	4-10
5-1	Enabling the PL/SQL Function	5-27
5-2	Enabling the PL/SQL Procedure	5-27
5-3	Generating an Endpoint for the Stored Procedure	5-30
5-4	Package Procedure and Function Endpoints	5-30
5-5	Nested JSON Purchase Order with Nested LineItems	5-43
5-6	PL/SQL Handler Code Used for a POST Request	5-44
5-7	GET Handler Code using Oracle REST Data Services Query on Relational Tables for	
	Generating a Nested JSON object	5-49
5-8	PL/SQL API Call for Creating a New test/:id Template and GET Handler in the demo	
	Module	5-50
5-9	Setting the Duser.timezone Java Environment Variable in Standalone Mode	5-54
5-10	Setting the Duser.timezone Java Environment Variable in a Java Application Server	5-55
5-11	Setting Enabled for all Pools	5-87
6-1	Example cURL Command	6-2
6-2	Binds in POST Request	6-16
6-3	Complex Bind in POST Request	6-18
6-4	Batch statements	6-20



ô-5	Batch bind values	6-21
6-6	Oracle REST Data services Time Zone Set as Europe/London	6-23
6-7	PL/SQL Statement	6-38
7-1	dads.conf file	7-2
7-2	ords_conf/ords/conf/basic_auth.xml	7-8
7-3	ords_conf/ords/conf/basic_dynamic_auth.xml	7-8
7-4	ords_confs/ords/conf/custom_auth.xml	7-9
7-5	ords_conf/ords/url-mapping.xml	7-10
7-6	ords_conf/ords/defaults.xml	7-10
7-7	security.requestValidationFunction	7-13
7-8	procedure.preProcess	7-13
7-9	procedure.postProcess	7-13
7-10	Table upload	7-14
7-11	Procedure upload	7-14
7-12	Curl command for file upload	7-14
10-1	Example	10-5
11-1	Example to Add Multiple Privileges	11-6



List of Figures

5-1	Selecting the Enable REST Service Option	5-28
5-2	Auto Enabling the PL/SQL Package Object	5-29
5-3	Adding an Anonymous PL/SQL Block to the Handler for the PUT Method	5-34
5-4	Setting the Bind Parameter I_salarychange to Pass for the PUT Method	5-34
5-5	Obtaining the URL to Call from the Details Tab	5-35
5-6	Displaying the Results from a SQL Query to Confirm the Execution of the PUT Method	5-36
5-7	Creating a Template Definition to Include a Route Pattern for Some Parameters or	
	Bind Variables	5-37
5-8	Adding a SQL Query to the Handler	5-38
5-9	Using Browser to Show the Results of Using a Route Pattern to Send a GET Method	
	with Some Required Parameter Values	5-39
5-10	Using Browser to Show the Results of Using a Query String to Send a GET Method	
	with Some Parameter Name/Value Pairs	5-41
5-11	Complete Response Body in JSON Format	5-48
5-12	Generating Nested JSON Objects	5-52



List of Tables

1-1	Advanced Installation Prompts for Installing and Configuring ORDS	1-11
1-2	Options for Configuring Application Express or Migrating from mod_plsql	1-12
1-3	Enabling Features in ORDS	1-13
1-4	Options for Running in Standalone Mode	1-13
1-5	Parameters for Installing Oracle REST Data Services	1-17
1-6	Parameters for Enabling SQL Developer Web	1-19
1-7	Parameters for Enabling REST-Enabled SQL	1-20
1-8	Parameters for Enabling Database API	1-21
1-9	Parameters for Installing into the CDB	1-21
1-10	Parameters for Configuring Application Express	1-22
1-11	Parameters for Installing Oracle REST Data Services in Standalone Mode	1-25
1-12	Miscellaneous Parameters	1-27
5-1	Parameters for batchload	5-16
7-1	Mappings of mod_plsql Directives to ORDS Settings	7-3
10-1	List of Implicit Parameters	10-1
10-2	Pagination Implicit Parameters	10-9
12-1	Open Service Broker Service Catalog	12-6
B-1	Oracle REST Data Services Configuration Files Parameters	B-3
C-1	List of ORDS user defined service	C-2



Preface

Oracle REST Data Services Installation, Configuration, and Development Guide explains how to install and configure Oracle REST Data Services. (Oracle REST Data Services was called *Oracle Application Express Listener* before Release 2.0.6.)



Effective with Release 3.0, the title of this book is *Oracle REST Data Services Installation, Configuration, and Development Guide*. The addition of "Development" to the title reflects the fact that material from a previous separate unofficial "Developer's Guide" has been included in this book in Developing Oracle REST Data Services Applications.

Topics:

- Audience
- Documentation Accessibility
- Related Documents
- Conventions

Audience

This document is intended for system administrators or application developers who are installing and configuring Oracle REST Data Services. This guide assumes you are familiar with web technologies, especially REST (Representational State Transfer), and have a general understanding of Windows and UNIX platforms.

Documentation Accessibility

For information about Oracle's commitment to accessibility, visit the Oracle Accessibility Program website at http://www.oracle.com/pls/topic/lookup?ctx=acc&id=docacc.

Access to Oracle Support

Oracle customers that have purchased support have access to electronic support through My Oracle Support. For information, visit http://www.oracle.com/pls/topic/lookup?ctx=acc&id=trs if you are hearing impaired.



Related Documents

For more information and resources relating to Oracle REST Data Services, see the following the Oracle Technology Network (OTN) site:

http://www.oracle.com/technetwork/developer-tools/rest-data-services/

Conventions

The following text conventions are used in this document:

Convention	Meaning
boldface	Boldface type indicates graphical user interface elements associated with an action, or terms defined in text or the glossary.
italic	Italic type indicates book titles, emphasis, or placeholder variables for which you supply particular values.
monospace	Monospace type indicates commands within a paragraph, URLs, code in examples, text that is displayed on the screen, or text that you enter.



Changes in This Release for Oracle REST Data Services Installation, Configuration, and Development Guide

This section lists the changes in this document for release 20.2.

Changes in Oracle REST Data Services Release 20.4

This section lists the changes in Oracle REST Data Services for this release.

New Features

Following are the new features in this release:

- See Cross-Origin Resource Sharing Feature
- See Monitoring ORDS.
- ORDS can now generate HTTP error responses in JSON or HTML format. See About HTTP Error Responses
- Updated the section Understanding Configurable Parameters with error.responseFormat key details.
- Updated with Oracle WebLogic Server version supported. See Supported Java EE Application Servers.



1

Introduction to Oracle REST Data Services

This chapter introduces Oracle REST Data Services and also describes how to install and deploy it. REST stands for Representational State Transfer.



Oracle REST Data Services was called *Oracle Application Express Listener* before Release 2.0.6.

Topics:

- About Oracle REST Data Services
- Understanding the Installation Process
- Configuring and Installing Oracle REST Data Services
- Running in Standalone Mode
- Deploying to Oracle WebLogic Server
- Deploying to Apache Tomcat
- Upgrading Oracle REST Data Services
- Using a Bequeath Connection to Install, Upgrade, Validate, or Uninstall Oracle REST Data Services

About Oracle REST Data Services

Oracle REST Data Services is a Java EE-based alternative for Oracle HTTP Server and mod_plsql . The Java EE implementation offers increased functionality including a command line based configuration, enhanced security, file caching, and RESTful web services. Oracle REST Data Services also provides increased flexibility by supporting deployments using Oracle WebLogic Server, Apache Tomcat, and a standalone mode.

The Oracle Application Express architecture requires some form of web server to proxy requests between a web browser and the Oracle Application Express engine. Oracle REST Data Services satisfies this need but its use goes beyond that of Oracle Application Express configurations. Oracle REST Data Services simplifies the deployment process because there is no Oracle home required, as connectivity is provided using an embedded JDBC driver.

Understanding the Installation Process

This section offers an overview of Oracle REST Data Services and provides information about supported Java Platform, Enterprise Edition (Java EE) application servers and system requirements.

Topics:

- Supported Java EE Application Servers
- System Requirements

Supported Java EE Application Servers

Oracle REST Data Services supports the following Java EE application servers:

Application Server	Supported Release
Oracle WebLogic Server	12c Release 2 (from version 12.2.1.3 and later) and 14c Release and later
Apache Tomcat	Release 8.5.x through Release 9.0.x

Supported Oracle Application Express (APEX) Versions

Oracle REST Data Services supports the currently supported versions of APEX.



The Oracle Application Express (Formerly HTML DB) table in the ORACLE INFORMATION-DRIVEN SUPPORT document for supported versions of APEX.

System Requirements

Oracle REST Data Services system requirements are as follows:

- Oracle Database (Enterprise Edition, Standard Edition or Standard Edition One) release 11g Release 2 or later, or Oracle Database 11g Release 2 Express Edition.
- Oracle Java 8 or later.
- Web browser requirements:
 - Microsoft Internet Explorer 8.0 or later.
 - Mozilla Firefox 3.0 or later.
 - Google Chrome 2.0 or later.



Note:

Oracle Application Express is *not* a prerequisite for using Oracle REST Data Services.

If Oracle Application Express is installed and if RESTful services have been configured during the installation (see the step Configure RESTful Services in Oracle Application Express Installation Guide), then Oracle REST Data Services supports it, including executing the RESTful services defined in Oracle Application Express.

About Installing Oracle REST Data Services

To install Oracle REST Data Services:

- 1. Download, install, and configure Oracle REST Data Services.
- 2. Deploy Oracle REST Data Services. Deployment options include:
 - Standalone Mode.
 - Oracle WebLogic Server.
 - Apache Tomcat.

Related Topics

- Running in Standalone Mode
- Deploying to Oracle WebLogic Server

Configuring and Installing Oracle REST Data Services

Before you deploy Oracle REST Data Services, you must install and configure it using a command-line interface.

Topics:

- About Using the Command-Line Interface
- About the Database Users Used by Oracle REST Data Services
- Privileges Required for Oracle REST Data Services
- Downloading, Configuring and Installing Oracle REST Data Services
- Using SQL Developer Oracle REST Data Services Administration (Optional)
- Using OAuth2 in Non-HTTPS Environments

See Also:

To use the Oracle REST API for JSON Data Persistence, you must also install the Oracle REST API. See "Oracle REST API Installation" in *Oracle REST Data Services SODA for REST Developer's Guide*.



About Using the Command-Line Interface

Oracle REST Data Services provides several command line commands. For example, you can configure the location where Oracle REST Data Services stores configuration files, configure the database Oracle REST Data Services uses, and start Oracle REST Data Services in standalone mode.

To display a full list of available commands, go to the directory or folder containing the ords.war file and execute the following command:

java -jar ords.war help

A list of the available commands is displayed. To see instructions on how to use each of these commands, enter help followed by the command name, for example:

java -jar ords.war help configdir

About the Database Users Used by Oracle REST Data Services

Oracle REST Data Services uses the following database users:

User Name	Required	Description
APEX_PUBLIC_USER	Only if using Oracle REST Data Services with Oracle Application Express	If you use Oracle REST Data Services with Oracle Application Express, this is the database user used when invoking PL/SQL Gateway operations, for example, all Oracle Application Express operations.
		For information on unlocking the APEX_PUBLIC_USER, see Configure APEX_PUBLIC_USER Account in Oracle Application Express Installation Guide.
APEX_REST_PUBLIC_USER	Only if using RESTful Services defined in Application Express of version 5.0 or above.	The database user used when invoking Oracle Application Express RESTful Services if RESTful Services defined in Application Express workspaces are being accessed
APEX_LISTENER	Only if using RESTful Services defined in Application Express of version 5.0 or above.	The database user used to query RESTful Services definitions stored in Oracle Application Express if RESTful Services defined in Application Express workspaces are being accessed
ORDS_METADATA	Yes	Owner of the PL/SQL packages used for implementing many Oracle REST Data Services capabilities. ORDS_METADATA is where the metadata about Oracle REST Data Services-enabled schemas is stored.
		It is not accessed directly by Oracle REST Data Services; the Oracle REST Data Services application never creates a connection to the ORDS_METADATA schema. The schema password is set to a random string, connect privilege is revoked, and the password is expired.



User Name	Required	Description
ORDS_PUBLIC_USER	Yes	User for invoking RESTful Services in the Oracle REST Data Services-enabled schemas.

The APEX_<xxx> users are created during the Oracle Application Express installation process.

Privileges Required for Oracle REST Data Services

As part of the Oracle REST Data Services installation, privileges are granted to several users and roles:

- ORDS_RUNTIME_ROLE role
 - ORDS_RUNTIME_ROLE is granted EXECUTE on the following packages if these packages are not granted EXECUTE to PUBLIC:
 - * SYS.DBMS LOB
 - * SYS.DBMS_SESSION
 - * SYS.DBMS UTILITY
 - * SYS.WPIUTL
 - ORDS_RUNTIME_ROLE is granted the necessary ORDS_METADATA object privileges
 to determine the repository version and to access the connection pool
 configurations.
- ORDS_PUBLIC_USER user
 - ORDS_PUBLIC_USER is granted connect to allow connection to the database.
 - ORDS_PUBLIC_USER is granted role, ORDS_RUNTIME_ROLE to allow the user to act as an ORDS runtime user
- ORDS_ADMINISTRATOR_ROLE role
 - ORDS_ADMINISTRATOR_ROLE is granted EXECUTE on ORDS_METADATA.ORDS_ADMIN PL/SQL package.
- PUBLIC
 - PUBLIC is granted EXECUTE on ORDS_METADATA.ORDS_REPVERSION view to allow the repository version to be queried by anyone.
 - PUBLIC is granted SELECT on many ORDS_METADATA views.
 - PUBLIC is granted EXECUTE on ORDS_METADATA PL/SQL packages that are available for developer users.
- ORDS_METADATA schema
 - ORDS_METADATA schema is granted on the following packages if these packages are not granted EXECUTE on PUBLIC:
 - * SYS.DBMS_ASSERT
 - * SYS.DBMS LOB
 - * SYS.DBMS_OUTPUT



- * SYS.DBMS_SCHEDULER
- * SYS.DBMS SESSION
- * SYS.DBMS_UTILITY
- * SYS.DEFAULT_JOB_CLASS
- * SYS.HTP
- * SYS.OWA
- * SYS.WPG_DOCLOAD
- ORDS_METADATA is granted SELECT (11g) or READ (12c or later) on the following view if it is not granted SELECT or READ to PUBLIC:
 - * SYS.SESSION_PRIVS
- ORDS_METADATA schema is granted EXECUTE on the following packages:
 - * SYS.DBMS_CRYPTO
 - * SYS.DBMS_METADATA
- ORDS_METADATA schema is granted SELECT (11g) or READ (12c or later) on the following views:
 - * SYS.DBA_OBJECTS
 - * SYS.DBA ROLE PRIVS
 - * SYS.DBA TAB COLUMNS
- ORDS_METADATA schema is granted SELECT including WITH GRANT OPTION on the following views:
 - * SYS.USER_CONS_COLUMNS
 - * SYS.USER_CONSTRAINTS
 - * SYS.USER_OBJECTS
 - * SYS.USER_PROCEDURES
 - * SYS.USER_TAB_COLUMNS
 - * SYS.USER_TABLES
 - * SYS.USER_VIEWS
- ORDS_METADATA schema is granted the following system privileges:
 - * ALTER USER
 - * CREATE ANY TRIGGER
 - * CREATE JOB
 - * CREATE PUBLIC SYNONYM
 - * DROP PUBLIC SYNONYM
- ORDS_METADATA schema is granted the necessary object privileges to migrate Application Express REST data to ORDS_METADATA tables.
- ORDS_METADATA schema is granted ORDS_ADMINISTRATOR_ROLE,
 ORDS_RUNTIME_ROLE roles with administrator option.
- PUBLIC is granted SELECT on many ORDS_METADATA tables and views.



- PUBLIC is granted EXECUTE on PL/SQL packages that are available for users to invoke.
- ORDS_METADATA is granted EXECUTE on the following packages if these packages are not granted EXECUTE to PUBLIC:
 - SYS.DBMS_ASSERT
 - SYS.DBMS_LOB
 - SYS.DBMS_OUTPUT
 - SYS.DBMS SCHEDULER
 - SYS.DBMS_SESSION
 - SYS.DBMS_UTILITY
 - SYS.DEFAULT_JOB_CLASS
 - SYS.HTP
 - SYS.OWA
 - SYS.WPG_DOCLOAD
- ORDS_METADATA is granted the necessary object privileges to migrate Application Express REST data to ORDS_METADATA tables.

Downloading, Configuring and Installing Oracle REST Data Services

The procedures in this topic apply to installing Oracle REST Data Services in a traditional (non-CDB) database.



You must complete the configuration steps in this topic before deploying to an application server.

To install and configure Oracle REST Data Services:

 Download the file ords.version.number.zip from the Oracle REST Data Services download page.

Note that the *version.number* in the file name reflects the current release number.

- 2. Unzip the downloaded zip file into a directory (or folder) of your choice:
 - UNIX and Linux: unzip ords.version.number.zip
 - Windows: Double-click the file ords.version.number.zip in Windows Explorer
- 3. Choose one of the following installation options:
 - Advanced Installation Using Command-Line Prompts
 - Silent Installation Using a Parameter File
- 4. You can reinstall or uninstall Oracle REST Data Services if required.



Related Topics

- Using the Multitenant Architecture with Oracle REST Data Services
- About the Database Users Used by Oracle REST Data Services
- If You Want to Reinstall or Uninstall (Remove) Oracle REST Data Services



Oracle REST Data Services Downloads

ORDS Installer Privileges Script

This section describes about the script file that provides privileges to the user to install, upgrade, validate and uninstall ORDS.



This script is used when you do not want to use SYS AS SYSDBA to install, upgrade, validate and uninstall ORDS for Oracle PDB or Oracle 11g.

Starting with ORDS 19.2 release, the Oracle REST Data Services installation archive file contains a script, ords_installer_privileges.sql which is located in the installer folder. The script provides the assigned database user the privileges to install, upgrade, validate and uninstall ORDS in Oracle Pluggable Database or Oracle 11g.

Perform the following steps:

- Using SQLcl or SQL*Plus, connect to Oracle PDB or 11g database with SYSDBA privileges.
- 2. Execute the following script providing the database user:

```
SQL> @/path/to/installer/ords_installer_privileges.sql exampleuser
SQL> exit
```

You must use the specified database user to install, upgrade, validate and uninstall ORDS.

Advanced Installation Using Command-Line Prompts

You can perform an advanced installation in which you are prompted for the necessary parameter values.

To perform an advanced installation, enter the following command:

java -jar ords.war install advanced



Note:

If you use a TNS connection to install ORDS, then you must specify the oracle.net.tns_admin system property on the command line that contains the folder with the tnsnames.ora file.

To perform installation using TNS connection, enter the following command:

java -Doracle.net.tns_admin=/path/to/tnsFolder -jar ords.war install advanced

Use the following on-line help command to check for additional options available for the install command: java -jar ords.war help install

During installation, Oracle REST Data Services checks if configuration files already exist in the specified configuration folder:

- If configuration files do not exist in that folder, then they are created. For example: defaults.xml, apex pu.xml files.
- If configuration files from an earlier release exist in that folder, Oracle REST Data Services checks if <name>_pu.xml is present. If it is not present, then you are prompted to enter the password for the ORDS_PUBLIC_USER account. If the configuration files <name>_al.xml and <name>_rt.xml from Release 2.0.n exist, then they are preserved. (However, in Releases 2.0.n RESTful Services was optional, and therefore the files might not exist in the configuration folder.)
- If multiple configuration files exist from a previous release (examples: apex.xml, apex_al.xml, apex_rt.xml, sales.xml, sales_al.xml, sales_rt.xml, ...), and if <name>_pu.xml does not exist, then you are prompted to select the database configuration so that the Oracle REST Data Services schema can be created in that database.

The following shows an example for an advanced installation. In this example, if you accepted the default value as 1 for Enter 1 if you wish to start in standalone mode or 2 to exit [1], the remaining prompts are displayed; and if you will be using Oracle Application Express, then you must specify the APEX static resources location.

```
d:\ords> java -jar ords.war install advanced
This Oracle REST Data Services instance has not yet been configured.
Please complete the following prompts
Enter the location to store configuration data: /path/to/config
Specify the database connection type to use.
Enter number for [1] Basic [2] TNS [3] Custom URL [1]:
Enter the name of the database server [localhost]:
Enter the database listen port [1521]:
Enter 1 to specify the database service name, or 2 to specify the database SID
[1]:
Enter the database service name:orcl
Enter 1 if you want to verify/install Oracle REST Data Services schema or 2 to
skip this step [1]:
Enter the database password for ORDS_PUBLIC_USER:
Confirm password:
Requires to login with administrator privileges to verify Oracle REST Data
Services schema.
```



```
Enter the administrator username: EXAMPLEUSER
Enter the database password for EXAMPLEUSER:
Confirm password:
Connecting to database user: EXAMPLEUSER url: jdbc:oracle:thin:@//localhost:1521/
orcl
Retrieving information.
Enter the default tablespace for ORDS_METADATA [SYSAUX]:
Enter the temporary tablespace for ORDS_METADATA [TEMP]:
Enter the default tablespace for ORDS_PUBLIC_USER [USERS]:
Enter the temporary tablespace for ORDS_PUBLIC_USER [TEMP]:
Enter 1 if you want to use PL/SQL Gateway or 2 to skip this step.
If using Oracle Application Express or migrating from mod_plsql then you must
enter 1 [1]:
Enter the PL/SQL Gateway database user name [APEX_PUBLIC_USER]:
Enter the database password for APEX_PUBLIC_USER:
Confirm password:
Enter 1 to specify passwords for Application Express RESTful Services database
users (APEX_LISTENER, APEX_REST_PUBLIC_USER) or 2 to skip this step [1]:
Enter the database password for APEX_LISTENER:
Confirm password:
Enter the database password for APEX_REST_PUBLIC_USER:
Confirm password:
Enter a number to select a feature to enable:
   [1] SQL Developer Web (Enables all features)
   [2] REST Enabled SQL
  [3] Database API
   [4] REST Enabled SQL and Database API
   [5] None
Choose [1]:
Enter 1 if you wish to start in standalone mode or 2 to exit [1]:
Enter the APEX static resources location:/path/to/apex/images
Enter 1 if using HTTP or 2 if using HTTPS [1]:
Enter the HTTP port [8080]:
OR
Enter 1 if using HTTP or 2 if using HTTPS [1]:2
Enter the HTTPS port [8443]:
Enter the SSL hostname:mysslhost
Enter 1 to use the self-signed certificate or 2 if you will provide the SSL
certificate [1]:
```



Descriptions for Advanced Installation Prompts

This section describes the options you can choose while performing advanced installation of Oracle REST Data Services schema.

Table 1-1 Advanced Installation Prompts for Installing and Configuring ORDS

Options	Description
This Oracle REST Data Services instance has not yet been configured. Please complete the following prompts Enter the location to store configuration data:/path/to/config	Specify the location for the ORDS configuration files. If the location does not exist, then it will be created.
Specify the database connection type to use. Enter number for [1] Basic [2] TNS [3] Custom URL [1]:	Specify if you want a Basic connection, TNS connection or Custom URL connection
The following example is for a Basic Connection	ո:
<pre>Enter the name of the database server [localhost]:</pre>	Specify the Oracle database hostname.
Enter the database listen port [1521]:	Specify the Oracle database port.
Enter 1 to specify the database service name, or 2 to specify the database SID [1]: Enter the database service name:orcl	Specify the Oracle database service name, if you choose option 1. Otherwise, if you choose option 2 then, specify the Oracle database SID.
The following example is for a TNS Connection Enter the TNS Network Alias:orcl The following example is for a Custom URL Con Enter the Custom JDBC URL: jdbc:oracle:thin:@// localhost:1521/orcl	Specify the TNS network alias identifier.
Enter 1 if you want to verify/ install Oracle REST Data Services schema or 2 to skip this step [1]: Enter the database password for ORDS_PUBLIC_USER: Confirm password:	Specify 1 to install the Oracle REST Data Services schema and create the Oracle REST Data Services proxy user, ORDS_PUBLIC_USER. Specify the proxy user, ORDS_PUBLIC_USER and the corresponding password.



Table 1-1 (Cont.) Advanced Installation Prompts for Installing and Configuring ORDS

Options	Description
Requires to login with administrator privileges to verify Oracle REST Data Services schema. Enter the administrator username: EXAMPLEUSER Enter the database password for EXAMPLEUSER: Confirm password:	Specify the user with ORDS Installer privileges or the SYS AS SYSDBA account. Specify the password of the user.
Enter the default tablespace for ORDS_METADATA [SYSAUX]: Enter the temporary tablespace for ORDS_METADATA [TEMP]:	Specify the default tablespace and temporary tablespace for the Oracle REST Data Services schema, ORDS_METADATA.
Enter the default tablespace for ORDS_PUBLIC_USER [USERS]: Enter the temporary tablespace for ORDS_PUBLIC_USER [TEMP]	Specify the default tablespace and temporary tablespace for the Oracle REST Data Services proxy user, ORDS_PUBLIC_USER.

Table 1-2 Options for Configuring Application Express or Migrating from mod_plsql

Options	Description
Enter 1 if you want to use PL/SQL Gateway or 2 to skip this step. If using Oracle Application Express or migrating from mod_plsql then you must enter 1 [1]: Enter the PL/SQL Gateway database user name [APEX_PUBLIC_USER]: Confirm password:	You can perform one of the following: If you are using Oracle Application Express, then specify the PL/SQL gateway user as APEX_PUBLIC_USER and the corresponding database password. If you are migrating from Oracle mod_plsql, then specify the PL/SQL gateway database username and database password. If you are not using either Oracle Application Express or migrating from
Enter the database password for APEX_PUBLIC_USER:	Application Express or migrating from Oracle mod_plsql, then select 2 to skip this step.



Table 1-2 (Cont.) Options for Configuring Application Express or Migrating from mod_plsql

Options	Description
Enter 1 to specify passwords for Application Express RESTful Services	If you have specified APEX_PUBLIC_USER for the PL/SQL Gateway user, then you have the option of using Application Express RESTful Services.
database user (APEX_LISTENER, APEX REST PUBLIC USER) or 2 to	Specify 2 if you do not want to use Application Express RESTful Services and skip this step.
skip this step [1]: Enter the database password for APEX_LISTENER: Confirm password: Enter the database password for APEX_REST_PUBLIC_USER: Confirm password:	For Application Express 5.0 and above, option 1 is required. The database users are created using the script apex_rest_config.sql provided in the Application Express installation media.

Table 1-3 Enabling Features in ORDS

Options	Description
Enter a number to select a feature to enable: [1] SOL Developer Web (Enables all	Specify 1 to enable all the features: SQL Developer Web, REST Enabled SQL and Database API. Specify 2 for REST Enabled SQL or 3 for Database API. Specify 4 to enable both REST Enabled SQL and Database API. Refer to "Accessing SQL Developer Web", "REST Enabled SQL Service", and "Enabling ORDS Database API" documentation for more information.
features) [2] REST Enabled SQL [3] Database API	
<pre>[4] REST Enabled SQL and Database API [5] None Choose [1]:</pre>	

Table 1-4 Options for Running in Standalone Mode

Options	Description
Enter 1 if you wish to start in standalone mode or 2 to exit [1]:	Specify 1 to start in standalone mode using the Jetty web server that is bundled with ORDS.
Enter the APEX static resources location:/path/to/apex/images	Specify the location of the Application Express images. This prompt will appear if you have specified APEX_PUBLIC_USER for the PL/SQL Gateway user.



Table 1-4 (Cont.) Options for Running in Standalone Mode

Options	Description
Enter 1 if using HTTP or 2 if using HTTPS [1]: Enter the HTTP port [8080]:	Specify the HTTP port if you choose 1.
OR Enter 1 if using HTTP or 2 if using HTTPS [1]:2 Enter the HTTPS port [8443]: Enter the SSL hostname:mysslhost Enter 1 to use the self-signed certificate or 2 if you will provide the SSL certifi cate [1]:	Specify the HTTPS port and the Secure Socket Layer (SSL) hostname if you choose 2. You have the option of using the self-signed certificate which generates the self-signed certificate automatically.
OR Enter 1 to use the self-signed certificate or 2 if you will provide the SSL certificate [1]:2 Enter the path for the SSL Certificate:/path/to/sslcert Enter the path for the SSL Certificates private key:/path/to/sslcertprivatekey	Specify the path for the SSL certificate and the path for SSL certificate private key if you choose 2.

Related Topics

- REST-Enabled SQL Service
- About the Oracle REST Data Services Configuration Files
- Starting in Standalone Mode
- Configuring and Installing Oracle REST Data Services
- Installing Application Express and Configuring Oracle REST Data Services
- Accessing SQL Developer Web
- Enabling ORDS Database API
 This section describes how to enable the Oracle REST Data Services (ORDS)
 Database API.

ORDS Parameter File

Oracle REST Data Services can be installed in either simple or silent mode without any user interaction.



You can perform either simple or silent installation for Oracle REST Data Services using the parameters specified in the <code>params/ords_params.properties</code> file under the location where you installed Oracle REST Data Services. This is the default Oracle REST Data Services parameter file. You can edit that file to change the default values to reflect your environment and preferences.

You can perform the installation for Oracle REST Data Services using the parameters specified in the params/ords_params.properties file under the location where you installed Oracle REST Data Services. This is the default Oracle REST Data Services parameter file. The Oracle REST Data Services parameter file consists of key or value pairs in the format key=value.

Alternatively, you have the option of specifying your own Oracle REST Data Services parameter file by including the --parameterFile option. If the --parameterFile option is not specified, the default Oracle REST Data Services parameter file is used.

Parameters Used in ORDS Parameter File

This section lists the parameters used in ORDS parameter file.

Topics:

- Parameters for Database Connection
- Parameters for Installing Oracle REST Data Services
- Parameters for Installing into the CDB
- Parameters for Configuring Application Express
- Parameters for Running in Standalone Mode
- Miscellaneous Parameters

Parameters for Database Connection

This section lists the database connection parameters that must be specified in the properties file. You can specify a Basic, TNS or Custom URL connection.

Topics:

- Parameters for Basic Connection
- Parameters for TNS Connection
- Parameters for Custom URL Connection

Parameters for Basic Connection

This section lists the parameters that must be specified in the properties file for basic database connection.

For basic connection, you must specify db.hostname and db.port database connection parameters. In addition, specify either db.servicename or db.sid parameters. If you are specifying a database connection to an Oracle 12.x PDB, then provide the db.servicename parameter.

Key	Туре	Description	Example
db.connectionType	string	Specifies the connection type. The value is basic.	basic



Key	Туре	Description	Example
db.hostname	string	Specifies the host system for the Oracle database.	myhostname
db.port	numeric	Specifies the database listener port.	1521
db.servicename	string	Specifies the network service name of the database.	orcl.example.com
db.sid	string	Specifies the name of the database.	orcl

Parameters for TNS Connection

This section lists the parameters for TNS connection to install ORDS.

If you use a TNS connection to install ORDS, then you must specify the oracle.net.tns_admin system property on the command line that contains the folder of the tnsnames.ora file. The tnsnames.ora file must exist in that folder. For example:

\$ java -Doracle.net.tns_admin=/path/to/tnsFolder -jar ords.war install
 simple

Key	Туре	Description	Example
db.connectionType	string	Specifies the connection type. The value is tns.	tns
db.tnsDirectory	string	Specifies the folder of where the tnsnames.ora file is located.	/path/to/ tnsfolder
db.tnsAliasName	string	Specifies the tns alias name that must exist in the tnsnames.ora file.	orcl

Parameters for Custom URL Connection

This section lists the parameters for Custom URL connection to install ORDS.

Key	Туре	Description	Example
db.connectionType	string	Specifies the connection type. The value is customurl.	customurl
db.customURL	string	Specifies the custom url.	<pre>jdbc:oracle:thin: @// localhost:1521/ orcl</pre>

Parameters for Installing Oracle REST Data Services

This section lists the parameters required for installing Oracle REST Data Services schema.



To install Oracle REST Data Services schema, following parameters must be specified:

- Username and password of the user with ORDS Installer privileges or with SYS AS SYSDBA account.
- ORDS_PUBLIC_USER password
- Existing default and temporary tablespaces for the ORDS_METADATA schema and ORDS_PUBLIC_USER.

Note:

If all of the default and temporary tablespace parameters are omitted in the Oracle REST Data Services parameter file, then the Oracle database default and temporary tablespaces are used.

Table 1-5 Parameters for Installing Oracle REST Data Services

Key	Туре	Description	Example
rest.services.ord s.add	boolean	Specifies whether to install the Oracle REST Data Services schema. Set the value to true.	true
		Supported values:	
		truefalse (default)	
user.public.passw ord	string	Specifies the password for ORDS_PUBLIC_USE R.	password
schema.tablespace .default	string	Specifies the ORDS_METADATA default tablespace. Specify an existing default tablespace.	SYSAUX
schema.tablespace .temp	string	Specifies the ORDS_METADATA temporary tablespace. Specify an existing temporary tablespace.	TEMP
user.tablespace.d efault	string	Specifies the ORDS_PUBLIC_USE R default tablespace. Specify an existing default tablespace.	SYSAUX
user.tablespace.t	string	Specifies the ORDS_PUBLIC_USE R temporary tablespace. Specify an existing temporary tablespace.	TEMP



Table 1-5 (Cont.) Parameters for Installing Oracle REST Data Services

Key	Туре	Description	Example
bequeath.connect	boolean	Specifies whether to connect as bequeath.	true
		Supported values:	
		 true 	
		 false (default) 	

Related Topics

 Using a Bequeath Connection to Install, Upgrade, Validate, or Uninstall Oracle REST Data Services

Parameters for Enabling SQL Developer Web

This section lists the parameters for enabling SQL Developer Web.



Table 1-6 Parameters for Enabling SQL Developer Web

Key	Туре	Description	Example
feature.sdw	string	Specifies if SQL Developer Web is enabled.	true

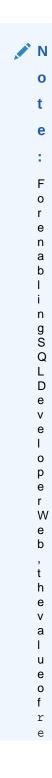




Table 1-6 (Cont.) Parameters for Enabling SQL Developer Web

Key	Туре	Description	Example
			s t E n a b l e d s q l . a c t i v e must also be true.
restEnabledSql.ac tive	string	Default value is false. Specifies if REST-Enabled SQL is enabled.	true
database.api.enabled	string	Default value is false. Specifies if the Database API is enabled. Default value is false.	true

Parameters for Enabling REST-Enabled SQL

This section describes the parameter for enabling REST-Enabled SQL.

Table 1-7 Parameters for Enabling REST-Enabled SQL

Key	Туре	Description	Example
restEnabledSql.ac tive	string	Specifies if REST- Enabled SQL is enabled.	true
		Default value is false.	

Parameters for Enabling Database API

This section describes the parameter for enabling Database API.

Table 1-8 Parameters for Enabling Database API

Key	Туре	Description	Example
database.api.enab	string	Specifies if Database API is enabled.	true
		Default value is false.	

Parameters for Installing into the CDB

This section lists the parameters required for installing Oracle REST Data Services into the CDB and all of its PDBs.

Oracle database 12.x provides you the option of installing Oracle REST Data Services in the CDB and all of its PDBs.



Provide the CDB service name for db.servicename or sid for db.sid.

Table 1-9 Parameters for Installing into the CDB

Key	Туре	Description	Example
pdb.open.asneeded	boolean	Specifies whether to open all PDBs in read write mode if their status is either closed or read only. If the value is set to true, then the following PDB parameters are ignored: pdb.open.readwrite pdb.skip.closed pdb.skip.readonly Supported values: true false (default)	true
pdb.open.readwrit e	string	Specifies the list of PDB service names to open for read write mode if their status is read only.	PDB1, PDB2, MYPDB



Table 1-9 (Cont.) Parameters for Installing into the CDB

Key	Туре	Description	Example
pdb.skip.closed	boolean	Specifies whether to skip PDBs that are closed. Supported values: true false (default)	true
pdb.skip.readonly	boolean	Specifies whether to skip PDBs with read only status. Supported values: true false (default)	true
pdb.exclude	string	Specifies the list of PDB service names to exclude for install.	PDB3, PDB4, PDB_X

Related Topics

• Setting Up ORDS in a CDB Environment

This section describes how to setup Oracle REST Data Services (ORDS) into a multitenant container database (CDB) environment.

Parameters for Configuring Application Express

This section lists the parameters for using Application Express.

Table 1-10 Parameters for Configuring Application Express

Key	Туре	Description	Example
plsql.gateway.add	boolean	Specifies whether to configure Oracle REST Data Services for Application Express. Set this value to true.	true
		Supported values: true false (default)	
db.username	string	Specifies the PL/SQL gateway username. For Application Express, you must specify APEX_PUBLIC_USE R.	APEX_PUBLIC_USER



Table 1-10 (Cont.) Parameters for Configuring Application Express

Key	Туре	Description	Example
db.password	string	Specifies the password for APEX_PUBLIC_USE R. The password must match APEX_PUBLIC_USE R database password.	password
rest.services.ape x.add	boolean	Specifies whether to configure Oracle REST Data Services for Application Express RESTful Services.	true
		Supported values: true false (default) Set this value to true if you want to use APEX RESTful Services.	
user.apex.listene r.password	string	Specifies the password for APEX_LISTENER. If rest.services.ape x.add is set to true, you must provide a password for APEX_LISTENER. The password must match APEX_LISTENER database password. Otherwise, if rest.services.ape x.add is set to false, omit this parameter.	password
user.apex.restpub lic.password	string	Specifies the password for APEX_REST_PUBLIC _USER. If rest.services.ape x.add is set to true, you must provide a password for APEX_REST_PUBLIC _USER. The password must match APEX_REST_PUBLIC _USER database password. Otherwise, if rest.services.ape x.add is set to false, omit this parameter.	password



Table 1-10 (Cont.) Parameters for Configuring Application Express

Key	Туре	Description	Example
security.external SessionTrustedOri gins	String	Comma separated list of origins that are trusted to make CORS requests for PL/SQL Gateway or APEX.	https://

Example 1-1 Parameters to configure for Application Express and APEX RESTful Services and run in standalone mode

Following example shows parameters to install Oracle REST Data Services, configure for Application Express and APEX RESTful Services and run in standalone mode using http:



Passwords in the parameter file will be encrypted during installation. The encrypted passwords are stored in the parameter file. For example, user.public.password=@0585904F6C9B442532D5212962835D00C8.

db.hostname=localhost db.password=password db.port=1521 db.servicename=orcl.example.com db.username=APEX_PUBLIC_USER plsql.gateway.add=true rest.services.apex.add=true rest.services.ords.add=true schema.tablespace.default=SYSAUX schema.tablespace.temp=TEMP standalone.http.port=8080 standalone.mode=true standalone.static.images=/path/to/images standalone.use.https=false user.apex.listener.password=password user.apex.restpublic.password=password user.public.password=password user.tablespace.default=SYSAUX user.tablespace.temp=TEMP



✓ See Also:

- For information on APEX_PUBLIC_USER, refer to section Configure APEX_PUBLIC_USER Account, in Oracle Application Express Installation Guide.
- For information on APEX_LISTENER and APEX_REST_PUBLIC_USER, refer to section, Configuring RESTful Services with Oracle REST Data Services in Oracle Application Express Installation Guide.

Parameters for Running in Standalone Mode

This section lists parameters for running Oracle REST Data Services in standalone mode.

Table 1-11 Parameters for Installing Oracle REST Data Services in Standalone Mode

Key	Туре	Description	Example
standalone.mode	boolean	Indicates whether to use the web application server (Jetty) that is included with Oracle REST Data Services.	true
		Supported values: true	
		 false (default) 	
standalone.http.p ort	numeric	Specifies the HTTP listener port.	8080
standalone.use.ht tps	boolean	Specifies whether to use https.	true
standalone.https. port	numeric	Specifies HTTPS listener port.	8443
standalone.ssl.ho st	string	Specifies the Secure Socket Layer (SSL) certificate hostname. You must specify this option if you are using https.	mysecurehost
standalone.use.ss	boolean	Specifies whether you will provide the SSL certificate. If this value is set to true, you must specify the standalone.ssl.ce rt.path and standalone.ssl.ke y.path.	true



Table 1-11 (Cont.) Parameters for Installing Oracle REST Data Services in Standalone Mode

Key	Туре	Description	Example
standalone.ssl.ce rt.path	string	Specifies the SSL certificate path. If you are providing the SSL certificate, you must specify the certificate location.	/path/to/ssl/cert
standalone.ssl.ke y.path	string	Specifies the SSL certificate key path. If you are providing the SSL certificate, you must specify the certificate key location.	/path/to/ssl/key
standalone.static .images	string	Specifies the location of Application Express images. If you are using Application Express, specify the location of Application Express images.	/path/to/apex/ images



On Microsoft Windows systems, if you specify an Application Express static images location for standalone.static.images, use the backslash character (/) before the colon, and use a forwardslash for the folder separator. For example, standalone.static.images=d\:/test/apex426/apex/images/

Example 1-2 Parameters to run in standalone mode using http

Following code snippet shows an example of the list of parameters to specify for installing Oracle REST Data Services and running in standalone mode using http:

db.hostname=localhost
db.port=1521
db.servicename=orcl.example.com
plsql.gateway.add=false
rest.services.apex.add=false
rest.services.ords.add=true
schema.tablespace.default=SYSAUX
schema.tablespace.temp=TEMP
standalone.http.port=8080
standalone.mode=true
standalone.use.https=false
user.public.password=password
user.tablespace.default=SYSAUX
user.tablespace.temp=TEMP



Example 1-3 Parameters to run in standalone mode using https and providing the ssl certificate paths

Following code snippet shows an example of the list of parameters to specify for installing and running Oracle REST Data Services in standalone mode using https and providing the ssl certificate paths:

```
db.hostname=localhost
db.port=1521
db.servicename=orcl.example.com
plsql.qateway.add=false
rest.services.apex.add=false
rest.services.ords.add=true
schema.tablespace.default=SYSAUX
schema.tablespace.temp=TEMP
standalone.https.port=8443
standalone.mode=true
standalone.ssl.cert.path=/path/to/ssl/cert
standalone.ssl.host=mysecurehost
standalone.ssl.key.path=/path/to/ssl/key
standalone.use.https=true
standalone.use.ssl.cert=true
user.public.password=password
user.tablespace.default=SYSAUX
user.tablespace.temp=TEMP
```

Related Topics

Running in Standalone Mode

Miscellaneous Parameters

This section lists some miscellaneous parameters.

Table 1-12 Miscellaneous Parameters

Key	Туре	Description	Example
migrate.apex.rest	boolean	Specifies whether to migrate APEX RESTful Services definitions to Oracle REST Data Services schema.	true
		Supported values: true false (default)	

Simple Installation Using a Parameter File

Oracle REST Data Services can be installed in simple mode without any user interaction.

You can perform a simple installation of Oracle REST Data Services using an ORDS parameters file. A simple installation prompts you for the information if the required parameter does not exist in the ORDS parameter file.



Following is an example code snippet for installing Oracle REST Data Services in simple mode:

```
java -jar ords.war install simple
java -jar ords.war install --parameterFile /path/to/
my_params.properties simple

java -jar ords.war install
java -jar ords.war install --parameterFile /path/to/my_params.properties
java -jar ords.war
```



Use the following on-line help command to check for additional options available for the install command: java -jar ords.war help install

Silent Installation Using a Parameter File

Oracle REST Data Services can be installed in silent mode without any user interaction.

You can perform a silent installation of Oracle REST Data Services using an ORDS parameters file. A silent installation must have the required parameters defined in the parameter file; otherwise, an error occurs.

Following is an example code snippet for installing Oracle REST Data Services in silent mode:

```
java -jar ords.war install --silent
java-jar ords.war install --silent --parameterFile /path/to/
my params.properties
```



Use the following on-line help command to check for additional options available for the install command: java -jar ords.war help install

Parameters Required for Silent Installation

This section describes the parameters required for installing Oracle REST Data Services in silent mode.

If you want to install Oracle REST Data Services in silent mode, then the required parameters must be defined in the ORDS parameter file.



Parameter Group	Required Parameters	Description
Database Connection	Refer to "Parameters for Database Connection" section for the list of parameters.	Specify Basic, TNS or Custom URL connection.
Installing ORDS	rest.services.ords.add Supported values: true false	If rest.services.ords.add= true, then refer to "Parameters Used in ORDS Parameter File." section for additional parameters.
Configuring for Application Express or PL/SQL Gateway	<pre>plsql.gateway.add Supported values: true false</pre>	If plsql.gateway.add=true, then refer to "Parameters for Configuring Application Express" section for additional required parameters.
Running in Standalone Mode	standalone.mode Supported values: true false	If standalone.mode=true, then refer to "Parameters for Running Oracle REST Data Services in Standalone Mode" for additional required parameters.

Related Topics

- Parameters for Database Connection
 - This section lists the database connection parameters that must be specified in the properties file. You can specify a Basic, TNS or Custom URL connection.
- Parameters for Installing Oracle REST Data Services
 This section lists the parameters required for installing Oracle REST Data Services schema.
- Parameters Used in ORDS Parameter File
 This section lists the parameters used in ORDS parameter file.
- Parameters for Configuring Application Express
 This section lists the parameters for using Application Express.
- Running in Standalone Mode

Changing Default Configuration from the Command Line

This section describes how you can update the ORDS default configuration file.

The following set property command is used to update the ORDS default configuration file:

\$ java -jar ords.war set-property cproperty key> <value>

ORDS must be restarted for the changes to take effect.

Example 1-4

Examples of Enabling a Feature.



The following example updates the properties in the existing defaults.xml file to enable SQL Developer Web.

```
$ java -jar ords.war set-property feature.sdw true
$ java -jar ords.war set-property restEnabledSql.active true
$ java -jar ords.war set-property database.api.enabled true
```

Example 1-5

The following example updates the properties in the existing defaults.xml file to enable REST-Enable SQL.

```
$ java -jar ords.war set-property restEnabledSql.active true
```

Example 1-6

The following example updates the properties in the existing defaults.xml file to enable Database API.

```
$ java -jar ords.war set-property database.api.enabled true
```

Validating the Oracle REST Data Services Installation

If you want to check that the Oracle REST Data Services installation is valid, go to the directory or folder containing the ords.war file and enter the validate command in the following format:

```
java -jar ords.war validate [--database <dbname>]
```

Note:

When you install Oracle REST Data Services, it attempts to find the Oracle Application Express (APEX) schema and creates a view. This view joins the relevant tables in the APEX schema to the tables in the Oracle REST Data Services schema. If you install Oracle REST Data Services before APEX, then Oracle REST Data Services cannot find the APEX schema and it creates a stub view in place of the missing APEX tables.

Oracle highly recommends that you install Oracle REST Data Services after APEX to ensure that the APEX objects, which Oracle REST Data Services needs to query, are present. If you install Oracle REST Data Services before APEX, then use the validate command to force Oracle REST Data Services to reconstruct the queries against the APEX schema.

If --database is specified, *<dbname>* is the pool name that is stored in the Oracle REST Data Services configuration files.

You are prompted for any necessary information that cannot be obtained from the configuration of pool name, such as host, port, SID or service name, and the name and password of the user with ORDS Installer privileges, or SYS AS SYSDBA user.



Note:

If the validate command is run against a CDB, then it will validate the CDB and all of its PDBs.

Note:

If you use a TNS connection to validate ORDS, then you must specify the oracle.net.tns_admin system property on the command line that contains the folder with tnsnames.ora file.

Example:

\$ java -Doracle.net.tns_admin=/path/to/tnsFolder -jar ords.war
validate

If You Want to Reinstall or Uninstall (Remove) Oracle REST Data Services

If you want to reinstall Oracle REST Data Services, you must first uninstall the existing Oracle REST Data Services; and before you uninstall, ensure that Oracle REST Data Services is stopped.

Uninstalling Oracle REST Data Services removes the ORDS_METADATA schema, the ORDS_PUBLIC_USER user, and Oracle REST Data Services-related database objects (including public synonyms) if they exist in the database. To uninstall (remove, or deinstall) Oracle REST Data Services, go to the directory or folder containing the ords.war file and enter the uninstall command as follows:

java -jar ords.war uninstall

The uninstall command prompts you for some necessary information (host, port, SID or service name, username, password).

See Also:

To uninstall Oracle REST Data Services from a CDB, see Using the Multitenant Architecture with Oracle REST Data Services.





If you use a TNS connection to uninstall ORDS, then you must specify the oracle.net.tns_admin system property on the command line that contains the folder with tnsnames.ora file.

Example:

\$ java -Doracle.net.tns_admin=/path/to/tnsFolder -jar ords.war
uninstall

Using SQL Developer Oracle REST Data Services Administration (Optional)

This section describes how to use Oracle SQL Developer to administer Oracle REST Data Services.



"Oracle REST Data Services Administration" in *Oracle SQL Developer* User's Guide

Topics:

- About SQL Developer Oracle REST Data Services Administration
- Configuring an Administrator User

About SQL Developer Oracle REST Data Services Administration

Oracle SQL Developer enables you to administer Oracle REST Data Services using a graphical user interface. To take full advantage of these administration capabilities, you must use SQL Developer Release 4.1 or later. Using SQL Developer for Oracle REST Data Services administration is optional.

Using this graphical user interface, you can update the database connections, JDBC settings, URL mappings, RESTful connections, security (allowed procedures, blocked procedures, validation function and virus scanning), Caching, Pre/Post Processing Procedures, Environment, and Excel Settings. Oracle SQL Developer also provides statistical reporting, error reporting, and logging.



"Oracle REST Data Services Administration" in *Oracle SQL Developer* User's Guide



Configuring an Administrator User

If you want to be able to administer Oracle REST Data Services using SQL Developer, then you must configure an administrator user as follows:

Execute the following command:

```
java -jar ords.war user adminlistener "Listener Administrator"
```

- Enter a password for the adminlistener user.
- Confirm the password for the adminlistener user.
- If you are using Oracle REST Data Services without HTTPS, follow the steps listed under the section, **Using OAuth2 in Non-HTTPS Environments**.

When using SQL Developer to retrieve and/or upload an Oracle REST Data Services configuration, when prompted, enter the credentials provided in the preceding list.

Using OAuth2 in Non-HTTPS Environments

RESTful Services can be protected with the OAuth2 protocol to control access to nonpublic data. To prevent data snooping, OAuth2 requires all requests involved in the OAuth2 authentication process to be transported using HTTPS. The default behavior of Oracle REST Data Services is to verify that all OAuth2 related requests have been received using HTTPS. It will refuse to service any such requests received over HTTP, returning an HTTP status code of 403 Forbidden.

This default behavior can be disabled in environments where HTTPS is not available as follows:

- 1. Locate the folder where the Oracle REST Data Services configuration is stored.
- 2. Edit the file named defaults.xml.
- 3. Add the following setting to the end of this file just before the properties> tag.
 <entry key="security.verifySSL">false</entry>
- 4. Save the file.
- 5. Restart Oracle REST Data Services if it is running.

Note that it is only appropriate to use this setting in development or test environments. It is never appropriate to use this setting in production environments because it will result in user credentials being passed in clear text.



Oracle REST Data Services must be restarted after making configuration changes. See your application server documentation for information on how to restart applications.



Running in Standalone Mode

Although Oracle REST Data Services supports the Java EE application servers, you also have the option of running in standalone mode. This section describes how to run Oracle REST Data Services in standalone mode.

Standalone mode is suitable for development use and is supported in production deployments. Standalone mode, however, has minimal management capabilities when compared to most Java EE application servers and may not have adequate management capabilities for production use in some environments.



If you use a TNS connection to run ORDS in standalone mode, then you must specify the <code>oracle.net.tns_admin</code> system property on the command line that contains the folder with <code>tnsnames.ora</code> file.

Example: \$ java -Doracle.net.tns_admin=/path/to/tnsFolder -jar ords.war standalone

Run the following help command to check the additional options available for the standalone command:

java -jar ords.war help standalone

Topics:

- · Starting in Standalone Mode
- Stopping the Server in Standalone Mode
- Configuring a Doc Root for Non-Application Express Static Resources

Related Topics

Supported Java EE Application Servers

Starting in Standalone Mode

To launch Oracle REST Data Services in standalone mode:

1. To start Standalone mode, execute the following command:

```
java -jar ords.war standalone
```

If you have not yet completed the standalone configuration, you are prompted to do so.





Tip:

To see help on standalone mode options, execute the following command:

java -jar ords.war help standalone



If you want to use RESTful services that require secure access, you should use HTTPS.

- When prompted, specify the location of the folder containing the Oracle Application Express static resources used by Oracle REST Data Services, or press Enter if you do not want to specify this location.
- 3. When prompted select if you want Oracle REST Data Services to generate a self-signed certificate automatically or if you want to provide your own certificate. If you want to use your own certificate, provide the path for the Certificate and DER encoded related private key when prompted.

If the private key has not already been converted to DER, see section, **Converting a Private Key to DER (Linux and Unix)** before you enter the values here.

You are only prompted for these values the first time you launch standalone mode.



Ensure that no other servers are listening on the port you choose. The default port 8080 is commonly used by HTTP or application servers, including the embedded PL/SQL gateway; the default secure port 8443 is commonly used by HTTPS.

Related Topics

- Using OAuth2 in Non-HTTPS Environments
- Converting a Private Key to DER (Linux and Unix)

Converting a Private Key to DER (Linux and Unix)

Usually, you would have created a private key and a Certificate Signing Request before obtaining your signed certificate. The private key needs to be converted into DER in order for Oracle REST Data Services to read it properly.

For example, assume that the original private key was created using the OpenSSL tool with a command similar to either of the following:

openssl req -new -newkey rsa:2048 -nodes -keyout yourdomain.key -out yourdomain.csr



or

```
openssl genrsa -out private.em 2048
```

In this case, you must run a command similar to the following to convert it and remove the encryption: openssI pkcs8 -topk8 -inform PEM -outform DER -in yourdomain.key -out yourdomain.der -nocrypt

```
openssl pkcs8 -topk8 -inform PEM -outform DER -in yourdomain.key -out yourdomain.der -nocrypt
```

After doing this, you can include the path to <code>yourdomain.der</code> when prompted by Oracle REST Data Services, or you can modify the following entries in <code>conf/ords/standalone.properties</code>:

```
ssl.cert=<path to yourdomain.crt>
ssl.cert.key=<path to yourdomain.der>
ssl.host=yourdomain
```

Also, ensure that jetty.secure.port is set.

Stopping the Server in Standalone Mode

To stop the Oracle REST Data Services server in standalone mode, at a command prompt press **Ctrl+C**.

Configuring a Doc Root for Non-Application Express Static Resources

You can configure a doc root for standalone mode to deploy static resources that are outside the /i folder that is reserved for Application Express static resources.

To do so, specify the --doc-root parameter with the standalone mode command, as in the following example:

```
java -jar ords.war standalone --doc-root /var/www/html
```

The preceding example makes any resource located within <code>/var/www/html</code> available under <code>http://server:port/</code>. For example, if the file <code>/var/www/html/hello.txt</code> exists, it will be accessible at <code>http://server:port/hello.txt</code>.

The value specified for --doc-root is stored in \${config.dir}/ords/standalone/standalone.properties in the standalone.doc.root property. If a custom doc root is not specified using --doc-root, then the default doc-root value of \${config.dir}/ords/standalone/doc_root is used. Any file placed within this folder will be available at the root context.

This approach has the following features and considerations:

- HTML resources can be addressed without their file extension. For example, if a file named hello.html exists in the doc root, it can be accessed at the URI http://server:port/hello.
- Attempts to address a HTML resource with its file extension are redirected to the location without an extension. For example, if the URI http://server:port/



hello.html is accessed, then the client is redirected to http://server:port/hello.

The usual practice is to serve HTML resources without their file extensions, so this feature facilitates that practice, while the redirect handles the case where the resource is addressed with its file extension.

- Index pages for folders are supported. If a folder contains a file named index.html or index.htm, then that file is used as the index page for the folder.
 For example, if /var/www/html contains /abc/xyz/index.html, then accessing http://server:port/abc/xyz/ displays the contents of index.html.
- Addressing a folder without a trailing slash causes a redirect to the URI with
 a trailing slash. For example, if a client accesses http://server:port/abc/xyz,
 then the server issues a redirect to http://server:port/abc/xyz/.
- Resources are generated with weak etags based on the modification stamp of the file and with a Cache Control header that causes the resources to be cached for 1 hour.

Deploying to Oracle WebLogic Server

This section describes how to deploy Oracle REST Data Services on Oracle WebLogic Server. It assumes that you have completed the installation process and are familiar with Oracle WebLogic Server. If you are unfamiliar with domains, managed servers, deployment, security, users and roles, refer to your Oracle WebLogic Server documentation.

Topics:

- About Oracle WebLogic Server
- Downloading, Installing, and Configuring Oracle REST Data Services
- Configuring Oracle Application Express Images
- Launching the Administration Server Console
- Installing the Oracle WebLogic Server Deployment
- Configuring WebLogic to Handle HTTP Basic Challenges Correctly
- Verifying the State and Health of ords and i

About Oracle WebLogic Server

You can download Oracle WebLogic Server from Oracle Technology Network.

To learn more about installing Oracle WebLogic Server, see *Oracle Fusion Middleware* Getting Started With Installation for Oracle WebLogic Server and Oracle Fusion Middleware Installation Guide for Oracle WebLogic Server.



weblogic downloads



Downloading, Installing, and Configuring Oracle REST Data Services

You must complete this step before deploying Oracle REST Data Services on WebLogic.

Related Topics

Configuring and Installing Oracle REST Data Services

Configuring Oracle Application Express Images

If you are using Oracle Application Express, you must create a web archive to reference the Oracle Application Express, image files. However, if you are **not** using Oracle Application Express, you may skip the rest of this section about configuring Oracle Application Express images.

Before you begin, you must create a web archive (WAR) file to reference the Oracle Application Express image files. Use the static command to create a web archive file named i.war:

java -jar ords.war static <apex directory>\images

Where:

<apex directory> is the directory location of Oracle Application Express.

This command runs the static command contained in the ords.war file. It packages the Application Express static images into an archive file named i.war.

The created images WAR does not contain the static resources; instead, it references the location where the static resources are stored. Therefore the static resources must be available at the specified path on the server where the WAR is deployed.



Tip:

Use java -jar ords.war help static to see the full range of options for the static command.

Use the i.war file to deploy to WebLogic in the following steps:

- Launching the Administration Server Console
- 2. Installing the Oracle WebLogic Server Deployment
- 3. Configuring WebLogic to Handle HTTP Basic Challenges Correctly

Launching the Administration Server Console

To launch the Administration Server console:

- 1. Start an Administration Server.
- Launch the WebLogic Administration Console by typing the following URL in your web browser:

http://<host>:<port>/console



Where:

- <host> is the DNS name or IP address of the Administration Server.
- <port> is the port on which the Administration Server is listening for requests (port 7001 by default).
- 3. Enter your WebLogic Administrator username and password.
- 4. If your domain is in *Production* mode, click the **Lock & Edit** button on the left-pane below the submenu Change Center. If your domain is in *Development* mode, this button does not appear.

Installing the Oracle WebLogic Server Deployment



Tip:

The Oracle REST Data Services files, ords.war and i.war, must be available before you start this task.

To install the deployment:

 Go to the WebLogic Server Home Page. Below Domain Configuration, select Deployments.

The Summary of Deployments is displayed.

- Click Install.
- 3. Specify the location of the ords.war file and click **Next**.

The ords.war file is located in the folder where you unzipped the Oracle REST Data Services ZIP file.



Tip:

WebLogic Server determines the context root from the file name of a WAR archive. If you need to keep backward compatibility, so that URLs are of the form http://server/apex/... rather than http://server/ords/..., then you must rename ords.war to apex.war before the deployment.

The Install Application assistant is displayed.

- 4. Select Install this deployment as an application and click Next.
- Select the servers and/or clusters to which you want to deploy the application or module and click Next.



Tip

If you have not created additional Managed Servers or clusters, you do not see this assistant page.



- 6. In the Optional Settings, specify the following:
 - a. Name Enter:

ords

b. Security - Select the following:

Custom Roles: Use roles that are defined in the Administration Console; use policies that are defined in the deployment descriptor

c. Source accessibility - Select:

Use the defaults defined by the deployment's targets

7. Click Next.

A summary page is displayed.

- 8. Under Additional configuration, select one of the following:
 - Yes, take me to the deployment's configuration Displays the Configuration page.
 - No I will review the configuration later Returns you to the Summary of Deployments page.
- 9. Review the summary of configuration settings that you have specified.
- 10. Click Finish.
- 11. Repeat the previous steps to deploy the i.war file.

In the optional settings, specify the following:

a. Name - Enter:

i

b. Security - Select:

Custom Roles: Use roles that are defined in the Administration Console; use policies that are defined in the deployment descriptor

c. Source Accessibility - Select:

Use the defaults defined by the deployment's targets

12. If your domain is in Production Mode, then on the Change Center click **Activate** Changes.

Related Topics

- Configuring and Installing Oracle REST Data Services
- Configuring Oracle Application Express Images

Configuring WebLogic to Handle HTTP Basic Challenges Correctly

By default WebLogic Server attempts to intercept all HTTP Basic Authentication challenges. This default behavior needs to be disabled for Oracle REST Data Services to function correctly. This is achieved by updating the <code>enforce-valid-basic-auth-credentials</code> flag. The WebLogic Server Administration Console does not display the <code>enforce-valid-basic-auth-credentials</code> setting. You can use WebLogic Scripting Tool (WLST) commands to check, and edit the value in a running server.



The following WLST commands display the domain settings:

```
connect('weblogic','weblogic','t3://localhost:7001')
cd('SecurityConfiguration')
cd('mydomain')
ls()
```

If the domain settings displayed, contains the following entry:

```
-r-- EnforceValidBasicAuthCredentials true
```

Then you must set this entry to false.

To set the entry to false, use the WLST commands as follows:

```
connect('weblogic', 'weblogic', 't3://localhost:7001')
edit()
startEdit()
cd('SecurityConfiguration')
cd('mydomain')
set('EnforceValidBasicAuthCredentials','false')
save()
activate()
disconnect()
exit()
```

Note:

WebLogic Server must be restarted for the new settings to take effect.

In the preceding example:

- weblogic is the WebLogic user having administrative privileges
- weblogic is the password
- mydomain is the domain
- The AdminServer is running on the localhost and on port 7001

Related Topics

WebLogic Server Command Reference

Verifying the State and Health of ords and i

In the Summary of Deployments, select the **Control** tab and verify that both the ords and i State are Active and the Health status is OK.

If ords and/or i are not Active, then enable them. In the Deployments table, select the check box next to ords and/or i. Click **Start** and select **Servicing all requests** to make them active.



Deploying to Apache Tomcat

This section describes how to deploy Oracle REST Data Services on Apache Tomcat.

Topics:

- About Apache Tomcat
- Downloading, Installing, and Configuring Oracle REST Data Services
- Configuring Oracle Application Express Images
- · Installing the Apache Tomcat Deployment

About Apache Tomcat



Tip:

This section assumes that you have completed the installation process and are familiar with Apache Tomcat. If you are unfamiliar with domains, servers, applications, security, users and roles, see your Apache Tomcat documentation.

You can download Apache Tomcat from:



apache tomcat 80

Downloading, Installing, and Configuring Oracle REST Data Services

You must complete this step before deploying Oracle REST Data Services on Apache Tomcat.

Related Topics

Configuring and Installing Oracle REST Data Services

Configuring Oracle Application Express Images

If you are using Oracle Application Express, you must create a web archive to reference the Oracle Application Express, image files. However, if you are **not** using Oracle Application Express, you may skip the rest of this section about configuring Oracle Application Express images.

To configure Oracle Application Express Images on Apache Tomcat:

• Copy the contents of the <apex directory>/images folder to <Tomcat directory>/webapps/i/.

Where:

- <apex directory> is the directory location of the Oracle Application Express distribution.
- <Tomcat directory> is the folder where Apache Tomcat is installed.

Installing the Apache Tomcat Deployment



Tip

The Oracle REST Data Services file ords.war must be available before you start this task.

To install the Apache Tomcat deployment:

1. Move the ords.war file into the webapps folder where Apache Tomcat is installed.



Tip:

Apache Tomcat determines the context root from the file name of a WAR archive. If you need to keep backward compatibility, so that URLs are of the form http://server/apex/..., rather than http://server/ords/..., then you must rename ords.war to apex.war before moving it into to the webapps folder

Access Oracle Application Express by typing the following URL in your web browser:

http://<hostname>:<port>/ords/

Where:

- <hostname> is the name of the server where Apache Tomcat is running.
- <port> is the port number configured for Apache Tomcat application server.

Related Topics

- Configuring and Installing Oracle REST Data Services
- Configuring Oracle Application Express Images

Monitoring ORDS

Standard Java runtime environment diagnostic and monitoring tools are used to gain an insight on the health of an ORDS instance running in Apache Tomcat, WebLogic Server, or a standalone mode. These tools track the memory and CPU usage, stuck threads, and other resources. ORDS provides additional insight through the ORDS instance API. The metrics available through the instance API makes it possible to check the status (valid or invalid) of the database pools and to gauge how the pools are being used. This helps in determining the actual load on the system and inform configuration changes in the future.



Topics:

- Enabling the ORDS Instance API
- Authorization for Using the ORDS Instance API
- API Document
- Using the Instance API

Enabling the ORDS Instance API

This section explains how to enable the ORDS instance API.

To enable the ORDS instance API:

- 1. Set the instance.api.enabled property to *true*.java -jar ords.war set-property instance.api.enabled true
- 2. Restart ORDS.

Authorization for Using the ORDS Instance API

The System Administrator role is required to use the ORDS instance API. For production environments, it is recommended that a user with this role is configured through the mid-tier.

API Document

An OpenAPI description of the ORDS instance API services is available at http://server>/ords/_/instance-api/stable/metadata-catalog/openapi.json.

Using the Instance API

The ORDS instance API service neither provides access to the database nor does it require the client to specify a database user for authentication. However, the ORDS instance returns information on the database pools. The instance API can be used as a basic health check service. To get a summary of the number of valid and invalid database pools, send a GET request to /ords/_/instance-api/stable/status.curl --user sysadmin:oracle http://<server>/ords/_/instance-api/stable/status. This service returns a count of valid and invalid pools. It also returns links to additional information with more details on the database pools cache.

ORDS can be deployed as a single instance or in a cluster. In a cluster, you must address each instance directly to get the specific information about that specific instance as the database pool statistics for one instance may differ from the other instance. However, if the load balancer routes to each instance in a round robin basis (as recommended), then every instance will have similar pool statistics.

Upgrading Oracle REST Data Services

If you want to upgrade to a new release of Oracle REST Data Services, you must do the following:

1. Stop the Oracle REST Data Services instance.



- If you are running Oracle REST Data Services on your application server (such as Oracle WebLogic Server, or Apache Tomcat), stop Oracle REST Data Services.
- If you are running Oracle REST Data Services in standalone mode, refer to section, **Stopping the Server in Standalone Mode**.
- Go to the folder where you unzipped the new Oracle REST Data Services release distribution.
- 3. Enter the following on the command line:

```
java -jar ords.war install advanced

or

java -jar ords.war
```

- 4. When prompted for the configuration folder, use the configuration folder where the Oracle REST Data Services configuration files are stored. (The configuration location will be stored in the ords.war file.)
 - If you specified an existing Oracle REST Data Services configuration folder that contains the configuration files, Oracle REST Data Services will attempt to connect to each database defined in the configuration folder and check the installed version.
 - If you specified an Oracle REST Data Services configuration folder that does
 not exist, you will be prompted for the database connection information, the
 ORDS_PUBLIC_USER credentials, and additional configuration information.
 Oracle REST Data Services will attempt to connect to this database and check
 the installed version.

When Oracle REST Data Services checks the installed version, it does the following, depending on whether an earlier 3.0.*n* version is already installed in the database.

- If the installed version is an earlier 3.0.*n* version of Oracle REST Data Services, you are prompted for the username and password (user with ORDS Installer privileges or SYS AS SYSDBA) to enable Oracle REST Data Services to apply the in-place upgrade. The in-place upgrade will modify the existing installation to add the updated schema objects and packages. The existing metadata stored in the Oracle REST Data Services schema will remain intact.
- If Oracle REST Data Services is not already installed in the database (or if you are upgrading from Release 2.0.n), you are prompted for the username and password (user with ORDS Installer privileges or SYS AS SYSDBA) to enable Oracle REST Data Services to perform the installation, and you will also be prompted for the default and temporary tablespaces for the ORDS_METADATA schema and ORDS_PUBLIC_USER.

When the upgrade or installation completes, you can re-deploy the ords.war file to your application server or start Oracle REST Data Services in standalone mode.

Related Topics

- Troubleshooting Oracle REST Data Services
- Stopping the Server in Standalone Mode



Using a Bequeath Connection to Install, Upgrade, Validate, or Uninstall Oracle REST Data Services

You can use the bequeath connection to install, upgrade, validate, or uninstall Oracle REST Data Services. The installer will not prompt you for the SYS username and password for the operation

In the parameter file, add the property: bequeath.connect=true

Using a bequeath connection for installing, validating, or uninstalling Oracle REST Data Services is supported on Linux and Windows systems for Oracle Database Release 12, but only on Linux systems for Oracle Database Release 11.

The command used must be run by an operating system user that is a member of the DBA group. Example of installing Oracle REST Data Services:

```
java -jar ords.war
```

Bequeath Connection Using Linux

On a Linux system, you must set the following environment variables to use the bequeath connection:

- ORACLE_HOME
- ORACLE_SID
- LD LIBRARY PATH (to point to ORACLE_HOME/lib)

For Oracle Database Release 11 (but not for Release 12), you must specify the option -DuseOracleHome=true. Examples of installing Oracle REST Data Services on a Linux system:

- For Oracle Database Release 11: java -DuseOracleHome=true -jar ords.war
- For Oracle Database Release 12: java -jar ords.war

Authorizing Oracle REST Data Services to Access Oracle Data Guard Protected Users

To access the database schema objects that are protected by an Oracle Data Vault Realm, it is necessary to grant a proxy user authorization to the Oracle REST Data Services Public User.

The following example authorizes the Oracle REST Data Services Public User, ORDS_PUBLIC_USER to proxy the database HR user:

```
begin
   DBMS_MACADM.AUTHORIZE_PROXY_USER('ORDS_PUBLIC_USER','HR');
end;
/
```



2

Configuring Oracle REST Data Services (Advanced)

This section explains how to configure Oracle REST Data Services for connecting to multiple databases for routing requests, and it refers to other documentation sources for other configuration information.



Oracle REST Data Services must be restarted after making configuration changes. See your application server documentation for information on how to restart applications.

Topics:

- Configuring Multiple Databases
- Support for Oracle RAC Fast Connection Failover
- Configuring Security, Caching, Pre- and Post Processing, Environment, and Excel Settings
- Configuring REST-Enabled SQL Service Settings
- Configuring the Maximum Number of Rows Returned from a Query
- Configuring the Custom Error Pages
- Developing RESTful Services for Use with Oracle REST Data Services

Configuring Multiple Databases

Oracle REST Data Services supports the ability to connect to more than one database. This section describes different strategies for routing requests to the appropriate database.

Topics:

- About the Request URL
- Configuring Additional Databases
- Routing Based on the Request Path Prefix
- Routing Based on the Request URL Prefix

About the Request URL

Oracle REST Data Services supports a number of different strategies for routing requests to the appropriate database. All of these strategies rely on examining the

request URL and choosing the database based on some kind of match against the URL. It is useful to recap the pertinent portions of a request URL. Consider the following URL:

https://www.example.com/ords/sales/f?p=1:1

This URL consists of the following sections:

- Protocol: https
- Host Name: www.example.com
- Context Root: /ords

The context root is the location at which Oracle REST Data Services is deployed on the application server.

Request Path: /sales/f?p=1.1

This is the portion of the request URL relative to the context root.

For different applications, it may be important to route requests based on certain prefixes in the request path or certain prefixes in the full request URL.

There are two steps to configuring multiple databases:

- Configuring the database connection information
- 2. Configuring which requests are routed to which database

Configuring Additional Databases

When you first configure Oracle REST Data Services, you configure a default database connection named: apex. You can create additional database connections using the setup command.



Tip:

To see full help for the setup command type:

java -jar ords.war help setup

To create a database connection type the following:

java -jar ords.war setup --database <database name>

Where:

<database name> is the name you want to give the database connection.

You are prompted to enter the information required to configure the database. After you have configured the additional databases, define the rules for how requests are routed to the appropriate database.

Related Topics

- Configuring and Installing Oracle REST Data Services
- · Routing Based on the Request Path Prefix



Routing Based on the Request URL Prefix

Routing Based on the Request Path Prefix

You create request routing rules using the map-url command.



Tip:

To see full help for the map-url command type:

```
java -jar ords.war help map-url
```

If you want to route requests based just on matching a prefix in the request path portion of the URL, use the map-url command as follows:

java -jar ords.war map-url --type base-path --workspace-id <workspace name>
<path prefix> <database name>

Where:

- <workspace name> is the name of the Oracle Application Express workspace
 where RESTful services for this connection are defined. This may be omitted if
 RESTful Services are not being used.
- <path prefix> is the prefix that must occur at the start of the request path.
- <database name> is the name of the database connection configured in the previous step.

Related Topics

Configuring Additional Databases

Example of Routing Based on the Request Path Prefix

Assuming Oracle REST Data Services is deployed on a system named example.com at the context path /ords, then create the following rule:

```
java -jar ords.war map-url --type base-path --workspace-id sales_rest /sales
sales_db
```

This rule means that any requests matching https://example.com/ords/sales/... are routed to the sales_db database connection. The sales_rest workspace defined within the sales_db database is searched for RESTful Services definitions.

The previous rule matches all of the following requests:

```
https://example.com/ords/sales/f?p=1:1
https://example.com/ords/sales/leads/
https://www.example.com/ords/sales/forecasting.report?month=jan (If
www.example.com resolves to the same system as example.com.)
```

The previous rule does not match of any of the following requests:

```
http://example.com/ords/sales/f?p=1:1 (The protocol is wrong.)
https://example.com:8080/ords/sales/f?p=1:1 (The port is wrong: 443 is default
for https, but don't specify if using default.)
```



```
https://example.com/ords/f?p=1:1 (Missing the /sales prefix.)
https://example.com/pls/sales/leads/ (The context path is wrong.)
```

Routing Based on the Request URL Prefix

If you want to route requests based on a match of the request URL prefix, use the map-url command as follows:

java -jar ords.war map-url --type base-url --workspace-id <workspace name> <url
prefix> <database name>

Where:

- <workspace name> is the name of the Oracle Application Express workspace
 where RESTful services for this connection are defined. This may be omitted if
 RESTful Services are not being used.
- <ur>
 <url prefix> is the prefix with which the request URL must start.
- <database name > is the name of the database connection.

Example of Routing Based on the Request URL Prefix

Assuming Oracle REST Data Services is deployed on a system named example.com at the context path /ords, then create the following rule:

```
java -jar ords.war map-url --type base-url --workspace-id sales_rest https://
example.com/ords/sales sales_db
```

This rule means that any requests matching https://example.com/ords/sales/... are routed to the sales_db database connection. The sales_rest workspace defined within the sales_db database is searched for RESTful Services definitions.

The previous rule matches all of the following requests:

```
https://example.com/ords/sales/f?p=1:1
https://example.com/ords/sales/leads/
https://example.com/ords/sales/forecasting.report?month=jan
```

The previous rule does not match of any of the following requests:

```
http://example.com/ords/sales/f?p=1:1 (The protocol is wrong.)
https://example.com:8080/ords/sales/f?p=1:1 (The port is wrong: 443 is default
for https, but don't specify if using default.)
https://example.com/ords/f?p=1:1 (Missing the /sales segment of the base URL.)
https://example.com/pls/sales/leads/ (The context path is wrong.)
https://www.example.com/ords/sales/forecasting.report?month=jan (The host name
is wrong.)
```

Support for Oracle RAC Fast Connection Failover

Oracle REST Data Services support the Fast Connection Failover (FCF) feature of Oracle Real Application Clusters (Oracle RAC).

Oracle REST Data Services runs with the Universal Connection Pool (UCP) in all the Application Server environments that it supports, such as WebLogic, Tomcat. UCP in turn supports Fast Connection Failover . To enable FCF, Oracle Notification Service (ONS) must to be enabled. To enable ONS, add entries to the list of properties in the



Oracle REST Data Services defaults.xml configuration file as shown in the following code snippet:

```
<entry key="jdbc.enableONS">true</entry>
<entry
key= "jdbc.ONSConfig">nodes=racnode1:4200,racnode2:4200\nwalletfile=/
oracle11/onswalletfile</entry>
```

ONS is the messaging facility used to send the Fast Application Notification (FAN) events. When ONS is enabled, Oracle REST Data Services automatically enables FCF. To Enable specific FCF capabilities such as fail over or other advanced FCF capabilities such as load balancing, you need to add entries in the configuration file for the custom connection as shown in the following code snippet:

After updating the defaults.xml configuration file, Oracle REST Data Services need to be restarted for the changes to take effect.

UCP supports Fast Connection Failover. FCF listens and responds to FAN events to deal with the following two scenarios:

- Unplanned outages: When RAC detects an instance failure, it generates a FAN
 Down event which FCF picks up. FCF then terminates all connections to the failed
 instance and directs all future requests to the surviving RAC instances.
- Planned outages: For instance, when a Database Administrator (DBA) wants to
 gracefully shut down a RAC instance for performing some maintenance activity.
 The instance shutdown generates a FAN Planned Down event which FCF picks
 up. FCF then directs all new requests to other RAC instances and drains or allows
 currently active transactions to complete.



Long running transactions may need to be terminated forcefully.

Configuring Security, Caching, Pre- and Post Processing, Environment, and Excel Settings

To configure security, caching, pre- and post- processing, environment, and Excel settings, see Using SQL Developer Oracle REST Data Services Administration (Optional).



Configuring REST-Enabled SQL Service Settings

This section explains how to configure the REST- Enabled SQL service.



Enabling the REST- Enabled SQL service enables authentication against the Oracle REST Data Service enabled database schemas. This makes the database schemas accessible over HTTPS, using the database password. Oracle highly recommends that you provide strong secure database passwords

REST- Enabled SQL service is a feature of Oracle REST Data Service. By default, the REST Enabled SQL service is turned off. To enable the REST- Enabled SQL service and the REST- Enabled SQL Export service, perform the following steps:

- Locate the folder where the Oracle REST Data Services configuration file is stored.
- 2. Open the defaults.xml file and add: <entry key="restEnabledSql.active">true</entry>.
- 3. Save the file.
- Restart Oracle REST Data Services.

Configuring the Maximum Number of Rows Returned from a Query

To configure maximum number of rows returned from a query, perform the following steps:

- Locate the folder where the Oracle REST Data Services configuration file is stored.
- 2. Open the defaults.xml file and update the value of the misc.pagination.maxRows parameter:<entry key="misc.pagination.maxRows">1500</entry>



The default value for misc.pagination.maxRows is 500.

- 3. Save the file.
- Restart Oracle REST Data Services.



Configuring the Custom Error Pages

This section explains how to configure a custom error page instead of the error page generated by Oracle REST Data Services.

To configure a custom error page, perform the following steps:

- Locate the folder where the Oracle REST Data Services configuration file is stored.
- 2. Open the defaults.xml file and update the value of the error.externalPath parameter:

<entry key="error.externalPath">/path/to/error/pages/folder/</entry>
Where:

- /path/to/error/pages/folder is the path to a folder containing files that define the error pages. The files are stored in {status}.html format.
 - Where, {status} is the HTTP status code for which you want to create a custom error page.
- 3. Save the file.
- Restart Oracle REST Data Services.

Example 2-1 Configuring custom error page for "HTTP 404" status code

To configure a custom error page for the "HTTP 404 – Not Found" status, perform the following steps:

- 1. Create a file named 404.html.
- 2. Save it under /usr/local/share/ords/error-pages/ folder.
- Configure the error.externalPath parameter to point to /usr/local/share/ ords/errro-pages/ folder.
- Save the file.
- Restart Oracle REST Data Services.

Developing RESTful Services for Use with Oracle REST Data Services

For more information on how to develop RESTful Services for use with Oracle REST Data Services, see Developing Oracle REST Data Services Applications.

Managing ORDS Administrator Privilege

Access to the <code>ORDS_ADMIN PL/SQL</code> package is provisioned through the <code>ORDS_ADMINISTRATOR_ROLE</code>. This role can be provisioned through the <code>ORDS_ADMIN</code> package to create additional ORDS administrators.



Provisioning ORDS_ADMINISTRATOR_ROLE to a User

This section describes how to provision <code>ORDS_ADMINISTRATOR_ROLE</code> role to a user.

You can provision <code>ORDS_ADMINISTRATOR_ROLE</code> role to a user by using either the database <code>GRANT</code> command or through the <code>ORDS_ADMIN.PROVISION_ADMIN_ROLE</code> PL/SQL method (as an ORDS Administrator).

Example 2-2 Using Grant command

```
GRANT ORDS_ADMINISTRATOR_ROLE TO HR_ADMIN;
```

Example 2-3 Using ORDS_ADMIN package method

```
BEGIN
  ORDS_ADMIN.PROVISION_ADMIN_ROLE(
    p_user => 'HR_ADMIN');
END;
/
```

Unprovisioning ORDS_ADMINISTRATOR_ROLE from a User

This section describes how to unprovision <code>ORDS_ADMINISTRATOR_ROLE</code> from a user.

As an ORDS administrator, you can unprovision <code>ORDS_ADMINISTRATOR_ROLE</code> from a user by either using the database <code>REVOKE</code> command or through the <code>ORDS_ADMIN.UNPROVISION_ROLES</code> PL/SQL method.

Example 2-4 Using REVOKE command

```
REVOKE ORDS_ADMINSTRATOR_ROLE FROM HR_ADMIN;
```

Example 2-5 Using ORDS_ADMIN package method

```
BEGIN
  ORDS_ADMIN.UNPROVISION_ROLES(
    p_user => 'HR_ADMIN',
    p_administrator_role => TRUE);
END;
/
```

Managing ORDS Runtime Privilege

The ORDS_RUNTIME_ROLE database role allows a user to act as a runtime user. A runtime user can manage and configure the runtime connection resources required by an ORDS service instance. The ORDS_PUBLIC_USER is one such database user. When additional runtime users are provisioned, it is possible to configure discrete ORDS service instances with different destination addresses and connection pools but hosted on the same Oracle database container.

It is recommended not to re-use a runtime user for any other purpose as it accumulates the grants necessary to proxy to other users. A runtime user only requires the CREATE SESSION privilege in addition to the ORDS RUNTIME ROLE role.

Provisioning ORDS_RUNTIME_ROLE to a User

This section describes how to provision <code>ORDS_RUNTIME_ROLE</code> role to a user.

As an ORDS administrator, you can provision <code>ORDS_RUNTIME_ROLE</code> role to a user by using either the database <code>GRANT</code> command or through the <code>ORDS_ADMIN.PROVISION_ADMIN_ROLE</code> PL/SQL method.

Example 2-6 Using Grant command

```
GRANT ORDS_RUNTIME_ROLE TO ORDS_PUBLIC_USER_2;
```

Example 2-7 Using ORDS_ADMIN package method

```
BEGIN
  ORDS_ADMIN.PROVISION_RUNTIME_ROLE(
    p_user => 'ORDS_PUBLIC_USER_2');
END;
/
```

Unprovisioning ORDS_RUNTIME_ROLE from a User

This section describes how to unprovision the <code>ORDS_RUNTIME_ROLE</code> role from a user

As an administrator, you can unprovision the <code>ORDS_RUNTIME_ROLE</code> from a user, by either using the database <code>REVOKE</code> command or through the <code>ORDS_ADMIN.UNPROVISION_ROLES</code> PL/SQL method.

Example 2-8 Using REVOKE command

```
REVOKE ORDS_RUNTIME_ROLE FROM ORDS_RUNTIME_USER_2;
```

Example 2-9 Using ORDS_ADMIN package method

```
BEGIN
  ORDS_ADMIN.UNPROVISION_ROLES(
    p_user => 'ORDS_RUNTIME_USER_2',
    p_runtime_role => TRUE);
END;
/
```



3

Installing and Configuring Customer Managed ORDS on Autonomous Database

This section explains how to install and configure Customer Managed Oracle REST Data Services (ORDS) on Autonomous Database.

Topics:

- About Customer Managed Oracle REST Data Services on Autonomous Database
- Downloading Wallet and Verifying Connection to Autonomous Database
- Creating Customer Managed Oracle REST Data Services User Role
- Downloading and Configuring Oracle REST Data Services
- Preparing and Starting ORDS

About Customer Managed Oracle REST Data Services on Autonomous Database

When you provision an Autonomous Database instance, by default Oracle REST Data Services (ORDS) is preconfigured and available for the instance. With the default ORDS, Oracle performs any required configuration, patching, and maintenance. Additionally, you can also configure Autonomous Database to use ORDS running in a customer managed environment.

When you use the default ORDS on Autonomous Database, you cannot modify any of the ORDS configuration options. For example, with the default configuration, the JDBC connection pools have a maximum of 100 connections and the connections for ORDS are preconfigured to use the LOW database service. Use a customer managed environment if you want manual control of the configuration and management of Oracle REST Data Services. For example, use this option when your applications require larger connection pools or if you need more control over the ORDS configuration options.

When ORDS runs in a customer managed environment, you are responsible for configuration, patching, and maintenance of ORDS in the customer managed environment. After you configure Autonomous Database to use your customer managed ORDS in addition to the existing autonomously managed ORDS, you can route ORDS HTTPS traffic through your environment. The default Autonomous Database web server and ORDS are still running and ORDS traffic goes to the ORDS running in the customer managed environment. This provides an additional and alternative HTTPS solution for Autonomous Database.

Installing and configuring a customer managed environment for ORDS allows you to run ORDS with configuration options that are not possible using the default Oracle managed ORDS available with Autonomous Database.

Installing and configuring a customer managed environment for ORDS is only supported with Autonomous Database on Shared Exadata Infrastructure.

Note:

- Oracle REST Data Services 19.4.6 or higher is required to use a customer managed environment for ORDS with Autonomous Database.
- Installing and configuring a customer managed environment for ORDS is only supported with Autonomous Database on Shared Exadata Infrastructure.

Downloading Wallet and Verifying Connection to Autonomous Database

You need to configure ORDS to connect to the Autonomous Database. With Oracle REST Data Services (ORDS) running in a customer managed environment, you need to obtain the Autonomous Database wallet on the system that runs the customer managed ORDS. Perform the following steps to download the wallet and verify the connection to the Autonomous Database:

- Download the wallet for the Autonomous Database instance. Alternatively you can
 use the OCI CLI to generate the wallet. See generate-wallet for information on
 using the CLI.
- 2. Convert the wallet.zip from the previous step to text. The base64 command encodes binary strings into text representations using the base64 encoding format. For example, run the following command:

```
base64 -w 0 wallet NAME.zip > wallet NAME.zip.b64
```

This step prepares the wallet as a text file as required for use in the ORDS configuration (instructions for this follow).

- 3. Verify that you can connect from the customer managed environment where you are installing and configuring ORDS to your Autonomous Database. For example, using SQLc1 and the wallet you download in Step 1, verify the connection as follows:
 - a. Connect with SQLcl.

See Also:

- Connect with Oracle SQLcl Cloud Connection for Autonomous Data Warehouse environment.
- Connect with Oracle SQLcl Cloud Connection for Autonomous Transaction Processing environment.



b. View the database services and connect to your Autonomous Database from the customer managed environment.

Creating Customer Managed Oracle REST Data Services User Role

To use Autonomous Database with Oracle REST Data Services (ORDS) running in a customer managed environment on your Autonomous Database, you must create a user, grant privileges to the user, and run the procedure ORDS ADMIN.PROVISION RUNTIME ROLE.

Perform the following steps to create a user for the ORDS JDBC Connection Pool and prepare the Autonomous Database instance for using Oracle REST Data Services in a customer managed environment:

- 1. Connect to your Autonomous Database as the ADMIN user.
- Create a new ORDS user and grant the required privileges to the new user as follows:

```
CREATE USER "ORDS_PUBLIC_USER2" IDENTIFIED BY "password"; GRANT "CONNECT" TO "ORDS_PUBLIC_USER2";
```

The new user name <code>ORDS_PUBLIC_USER2</code> is the recommended user name. This name is not required and you can choose a different user name. If you choose a different user name, then all the corresponding user names in these steps need to use the name you choose, rather than <code>ORDS_PUBLIC_USER2</code>.

3. Create a database user with the ORDS Developer role, so that it can act as an ORDS Runtime user. Additional changes to the ORDS configuration are required to use a user other than ORDS_PUBLIC_USER. As the ADMIN user, run the following procedure:



```
END;
```

Following are the parameters:

- p_user: The name of the user to be configured.
- p_proxy_enabled_schemas: When set to true, proxy grants are added for any REST enabled schemas.

Downloading and Configuring Oracle REST Data Services

To use Autonomous Database with Oracle REST Data Services (ORDS) running in a customer managed environment you need to install ORDS.



Oracle REST Data Services 19.4.6 or higher is required for a customer managed environment with Autonomous Database.

Depending on where you install Oracle REST Data Services for your customer managed environment, do the following:

- If your customer managed environment for Oracle REST Data Services runs in Oracle Cloud Infrastructure, then use an Oracle YUM repository and perform a YUM install of ORDS.
- If your customer managed environment for Oracle REST Data Services runs in some other environment, then download ORDS from the Oracle REST Data Services Download page. See Introduction to Oracle REST Data Services for more information.
- In the location where ORDS is installed, create an ORDS configuration folder (this
 creates a folder and sets up the ORDS configuration environment and settings).
 For example:

```
java -jar ords.war configdir ./ORDSConfig_2
```

On Oracle Cloud Infrastructure with Linux with a YUM repository the ORDS configuration folder is: /opt/oracle/ords/config.

2. Edit the ORDS configuration file created in the preceding step ./ords/conf/ $apex_pu.xml$ to add or update the following:



[CDATA[contents_of_wallet_NAME.zip.b64]]></entry>
/properties>

Notes:

- The extra "!" in front of the password causes the password to be encrypted the next time the ORDS service starts.
- The db.wallet.zip entry (contents_of_wallet_NAME.zip.b64) includes the contents of the base64 encoded wallet archive that you prepared previously. Ensure that this text is enclosed in a CDATA block (this is a long string of characters). See Downloading Wallet and Verifying Connection to Autonomous Database for details on how to create the wallet_NAME.zip.b64 file.
- The db.username, specified as ORDS_PUBLIC_USER2 is the database username you previously defined. See Creating Customer Managed Oracle REST Data Services User Role for more information.
- 3. Edit ./ords/defaults.xml as required for your ORDS installation. See Understanding Configurable Parameters for more information.
- **4.** Ensure the plsql gateway is enabled for APEX support:

```
<entry key="plsql.gateway.enabled">true</entry>
```

If you want use ORDS with APEX, then you need to enable the PL/SQL gateway in ORDS.

Preparing and Starting ORDS

To use customer managed Oracle REST Data Services (ORDS) on Autonomous Database, on the system where ORDS runs, you need to perform additional configuration steps and then start ORDS.

For ORDS running with APEX, perform all the steps starting from **Step 1**. For ORDS running without APEX, perform the steps starting from **Step 3**.

1. In the location where ORDS is installed, install the APEX images.

```
unzip apex_19version.zip
```



To use your customer managed ORDS environment for APEX, you must download the APEX images of the APEX release that is currently deployed in your Oracle Autonomous Database. When Oracle announces the next APEX upgrade, you must pre-deploy the images from the upgraded APEX release or defer the APEX upgrade to avoid any service interruption. You can download the APEX images from the Oracle APEX downloads page.



See Also:

- APEX Apply Defer Updates
- Oracle APEX Downloads
- 2. Edit the standalone properties to add or edit the static images property:

standalone.static.path=/path/to/apex/images

3. Create a wallet_cache folder, so that ORDS stores the Autonomous Database wallet on this folder and uses it while connecting to JDBC. For example:

mkdir wallet_cache

- 4. Start ORDS.
 - If your customer managed environment for Oracle REST Data Services runs in Oracle Cloud Infrastructure, then start the ORDS service as follows:

/opt/oracle/ords start

• If your customer managed environment for Oracle REST Data Services runs in the directory where ORDS is installed, then start the ORDS service as follows:

java -Duser.timezone=UTC -Ddb.wallet.cache=wallet_cache -jar ords.war standalone --apex-images images --port 8088



4

Using the Multitenant Architecture with Oracle REST Data Services

This section outlines installing, configuring, upgrading and uninstalling Oracle REST Data Services in a multitenant container database.

- Setting Up ORDS in a CDB Environment
- Setting Up ORDS in an Application Container

Setting Up ORDS in a CDB Environment

This section describes how to setup Oracle REST Data Services (ORDS) into a multitenant container database (CDB) environment.

Oracle Database 12c Release 1 (12.1) introduced the multitenant architecture. This database architecture has a multitenant container database (CDB) that includes a root container, CDB\$ROOT, a seed database, PDB\$SEED, and multiple pluggable databases (PDBs). A PDB appears to users and applications as if it were a non-CDB. Each PDB is equivalent to a separate database instance in Oracle Database Release 11g.

The root container, CDB\$ROOT, holds common objects that are accessible to every PDB utilizing metadata links or object links. The seed database, PDB\$SEED, is used when you create a new PDB to seed the new pluggable database. The key benefit of the Oracle Database 12c multitenant architecture is that the database resources, such as CPU and memory, can be shared across all of the PDBs. This architecture also enables many databases to be treated as one for tasks such as upgrades or patches, and backups.

The installation process when you have multiple releases is described in the following section:

Installation Enabling Multiple Releases



If you want to install directly into a PDB (not connected to Root during installation), see Advanced Installation Using Command-Line Prompts for more information.

Preinstallation Tasks for Oracle REST Data Services CDB Installation

- Ensure that the PDBs are open (not mounted/closed) in read/write mode (except for PDB\$SEED, which remains in read-only mode). For more information, see Oracle Multitenant Administrator's Guide
- Ensure that the default and temporary tablespaces to be used by the ORDS_METADATA schema and the ORDS_PUBLIC_USER user exist and that you know

the tablespace names. The installation procedure creates those users, but it does not create the tablespaces.



ORDS_METADATA and ORDS_PUBLIC_USER are installed in the seed container, and the default and temporary tablespaces exist in PDB\$SEED. If these tablespaces do not already exist, then you must create the tablespaces in PDB\$SEED. For more information, see Oracle Multitenant Administrator's Guide

Installation Enabling Multiple Releases

This section describes the installation process when you have multiple releases of Oracle REST Data Services and patch sets in the PDBs in a multitenant environment.

When Oracle REST Data Services is installed into a CDB, the proxy user, Oracle REST Data Services public user (ORDS_PUBLIC_USER) is installed in the root container and is a common user. The ORDS_METADATA schema is a local user that contains the metadata for Oracle REST Data Services. Both the ORDS_METADATA schema and the ORDS_PUBLIC_USER are installed in the seed container (PDB\$SEED) and all of the pluggable databases.

Since the ORDS_METADATA is installed as a local user, this provides you the flexibility of installing multiple Oracle REST Data Services releases in the pluggable databases.

Command Line Installation

You must provide the SYS AS SYSDBA credentials in the Root (CDB\$ROOT) container to perform the installation.

Advanced Installation

This section describes the advanced installation prompts for installing Oracle REST Data Services into a CDB to enable multiple Oracle REST Data Services releases.

To install Oracle REST Data Services into a CDB to enable multiple Oracle REST Data Services releases, perform the following steps:

- Navigate to the folder where you unzipped the Oracle REST Data Services installation kit.
- 2. Enter the following command:

```
java -jar ords.war install advanced
```

3. When prompted, enter the database connection information for your CDB.

```
Enter the name of the database server[localhost]:
Enter the database listen port [1521]:
Enter 1 to specify the database service name, or 2 to specify the database SID [1]:
Enter the database service name:(for example, cdb.example.com)
```



4. Verify the Oracle REST Data Services installation.

```
Enter 1 if you want to verify/install Oracle REST Data Services schema or 2 to skip this step [1]:
```

Accept or enter 1 (the default) to install Oracle REST Data Services into the CDB and all of its PDBs.

```
Enter the database password for ORDS PUBLIC USER:
Confirm password:
Requires to login with administrator privileges to verify Oracle
REST Data Services schema.
Enter the administrator username: SYS
Enter the database password for SYS AS SYSDBA:
Confirm password:
Retrieving information....
Your database connection is to a CDB. ORDS common user
ORDS PUBLIC USER will be
created in the CDB. ORDS schema will be installed in the PDBs.
Root CDB$ROOT - create ORDS common user
PDB PDB$SEED - install ORDS 18.2.0.
ONLY, open for
READ/WRITE)
PDB PDBName1 - install ORDS 18.2.0.<JulianDay.Time>
PDB PDBName2 - install ORDS 18.2.0.<JulianDay.Time>
Enter 1 if you want to install ORDS or 2 to skip this step [1]:
```

- 6. Press enter to continue with the installation.
- 7. When prompted, enter additional information as needed. See Advanced Installation Using Command-Line Prompts for more information.



To use the pluggable mapping feature, see Making All PDBs Addressable by Oracle REST Data Services (Pluggable Mapping) for more information.

Silent Installation

Silent installation reads the properties from the Oracle REST Data Services parameter file.

To perform a silent installation, enter the following command:

```
java -jar ords.war install simple
java -jar ords.war
```



Related Topics

Advanced Installation Using Command-Line Prompts

Upgrading Oracle REST Data Services in a CDB Environment

When you use a new release of Oracle REST Data Services, upgrading its schema in the CDB and its pluggable databases (PDBs) will occur automatically when you perform a simple or advanced installation.

For example:

```
java -jar ords.war
```

If Oracle REST Data Services is already installed or upgraded, a message displays the Oracle REST Data Services schema version, and you will not be prompted for information.

Migrating Oracle REST Data Services in the CDB to Enable Multiple Releases

This section describes how to migrate Oracle REST Data Services in the CDB to enable multiple releases.

Starting with release 18.2.0 and later, if you have an Oracle REST Data Services schema and ORDS_METADATA that is installed in the CDB\$ROOT container, then during upgrade it will migrate the common ORDS_METADATA schema to your PDBs as a local schema. Oracle database 12.1.0.2 and later releases support this change.

Making All PDBs Addressable by Oracle REST Data Services

This section describes how to make all application PDBs in a CDB addressable by ORDS. This step is required for starting ORDS from the CDB.

For more information refer to Making All PDBs Addressable by Oracle REST Data Services (Pluggable Mapping)

Uninstalling Oracle REST Data Services in a CDB Environment

To uninstall Oracle REST Data Services from a CDB, use the uninstall command.

For example:

```
java -jar ords.war uninstall
```

Oracle REST Data Services will be removed from the CDB and its pluggable databases (PDBs).

Related Topics

If You Want to Reinstall or Uninstall (Remove) Oracle REST Data Services

Setting Up ORDS in an Application Container

This section describes how to setup Oracle REST Data Services in an application container.



Starting with ORDS release 20.2.1, Oracle REST Data Services can be installed or upgraded into an application container using the ORDS SQL scripts provided in the ords.version.number.zip file.

An application container consists of an application root where the application is defined and one or more PDBs that share the metadata about the application from the application root. You can have multiple application containers within a CDB and each container can have different versions of Oracle REST Data Services. Installing or upgrading Oracle REST Data Services in an application container is done against the application root container. When an application PDB wants to use the upgraded version, it must synchronize with the application root. Oracle REST Data Services continues to run in the application PDB with the existing version until the application PDB synchronizes with the application root.

Topics:

- · Prerequisites for Creating ORDS in an Application Container
- Installing ORDS in the Application Root Container
- · Creating an Application Seed
- Creating an Application PDB from the Application Seed
- ORDS Configuration Files Setup
- Running ORDS
- Validating ORDS in the Application Root Container
- Upgrading ORDS in the Application Container
- Uninstalling ORDS from the Application Container
- · Verifying ORDS in the Application Container

Prerequisites for Creating ORDS in an Application Container

This section describes the prerequisites for installing ORDS in an application container.

Following prerequisites must be met before you install ORDS in an application container:

- Download ORDS version 20.2.1 or later from Oracle REST Data Services Downloads.
- Extract the ORDS SQL scripts.
- To obtain the ORDS SQL scripts, execute the following commands:

```
unzip ords.version.number.zip ords.war
unzip ords.war 'WEB-INF/lib/ords-installer-*.jar'
unzip 'WEB-INF/lib/ords-installer-*.jar' 'db/*'
mv db scripts
```

The ORDS SQL scripts are located in the scripts folder. The scripts folder contains the subdirectories for the install, upgrade, validate, and uninstall SQL scripts. You can run these SQL scripts using SQLcl, SQL*Plus, or SQL Developer.



Creating an Application Root Container

This section describes how to create an application root container.

To create an application root container:

- 1. Ensure that the current container is in CDB\$ROOT.
- 2. Use the AS APPLICATION CONTAINER clause of the CREATE PLUGGABLE DATABASE statement to create an application container.
- 3. Open the application container.

Example:

CREATE PLUGGABLE DATABASE ords_app_root1 AS APPLICATION CONTAINER ADMIN USER admin IDENTIFIED BY <admin_password>

FILE_NAME_CONVERT=('pdbseed', 'ords_app_root1');

ALTER PLUGGABLE DATABASE ords_app_root1 OPEN;

Note:

ords_app_root1 and the admin user in the preceding example can be any valid Oracle identifier.

If Oracle managed files is enabled in the CDB or the PDB_FILE_NAME_CONVERT initialization parameter is set, then omit the FILE NAME CONVERT clause.

The ORDS users, namely <code>ORDS_PUBLIC_USER</code> and <code>ORDS_METADATA</code>, must not exist in the seed (for example, <code>pdbseed</code>) or cloned pdb.



Creating an Application Container

Installing ORDS in the Application Root Container

This section describes how to install ORDS in the application root container.

To install ORDS in the application root container, perform the following steps:

- 1. Connect to the application root container.
- 2. Run /path/to/scripts/install/core/ords_app_con_install.sql command using the following parameters:
 - Log folder (must include the forward slash at the end)
 - Default tablespace for ORDS schema
 - · Temporary tablespace for ORDS schema
 - Default tablespace for ORDS proxy user



- Temporary tablespace for ORDS proxy user
- ORDS proxy user password
- Scripts path (requires the fully qualified path to the ORDS scripts)



The tablespaces must already exist in the database.

ALTER SESSION SET CONTAINER = ords app root1;

@/path/to/scripts/install/core/ords_app_con_install.sql /path/to/logs/ SYSAUX TEMP SYSAUX TEMP P033w0r6! /path/to/scripts

Where:

The ords_app_con_install.sql creates an application named ORDS and assigns the application version to the ORDS product version. The product version format is Year.Quarter.Patch.rJulianDay24HRMM (for example, 20.2.1.r2121800).

The preceding script installs ORDS and creates the following:

- The ORDS schema, ORDS_METADATA
- The ORDS proxy user, ORDS PUBLIC USER and
- The related database objects in the application container



Verifying ORDS in the Application Container

Creating an Application Seed

This section describes how to create an application seed.

An application seed is used to provision application PDBs with the application root's applications pre-installed.

To create an application seed:

- 1. Ensure that the current container is in the CDB\$ROOT.
- 2. Alter session and set container to the application root.
- 3. Use the AS SEED clause of the CREATE PLUGGABLE DATABASE statement to create an application seed.
- 4. Sync the ORDS application with the application seed.
- 5. Compile invalid objects.
- Open the application seed in a read only mode.



Note:

ords_app_root1 and the admin user in the following example can be any valid Oracle identifier.

If Oracle managed files is enabled in the CDB or the PDB_FILE_NAME_CONVERT initialization parameter is set, then omit the FILE_NAME_CONVERT clause.

```
ALTER SESSION SET CONTAINER = ords_app_root1;

CREATE PLUGGABLE DATABASE AS SEED ADMIN USER admin IDENTIFIED BY
<admin_password>
FILE_NAME_CONVERT=('pdbseed', 'ords_app_root1_seed');

ALTER PLUGGABLE DATABASE ords_app_root1$seed open;

ALTER SESSION SET CONTAINER = ords_app_root1$seed;

ALTER PLUGGABLE DATABASE application ORDS sync;

begin
   sys.dbms_utility.compile_schema('ORDS_METADATA', FALSE);

end;

/

ALTER PLUGGABLE DATABASE ords_app_root1$seed close immediate;

ALTER PLUGGABLE DATABASE ords_app_root1$seed open read only;
```

See Also:

Creating an Application Container

Creating an Application PDB from the Application Seed

This section describes how to create an application PDB that is seeded from the application seed

An application PDB is created by issuing the CREATE PLUGGABLE DATABASE statement from the application root.

To create an application PDB from the application seed:

- 1. Ensure that the current container is in CDB\$ROOT.
- 2. Alter session and set the container to the application root.
- 3. Use the CREATE PLUGGABLE DATABASE command to create a PDB from the application seed.



Note:

ords_app_pdb1 and the admin user in the following example can be any valid Oracle identifier.

If Oracle managed files is enabled in the CDB or the PDB_FILE_NAME_CONVERT initialization parameter is set, then omit the FILE_NAME_CONVERT clause.

See Also:

Creating an Application Container

ORDS Configuration Files Setup

This section describes how to setup the ORDS configuration files:

Topics:

- Specifying the ORDS Configuration Folder
- Creating the ORDS Configuration Files for the Application Root Container
- Making all Application PDBs in an Application Root Container Addressable by ORDS

Specifying the ORDS Configuration Folder

This section describes how to specify the ORDS configuration folder.

The configuration folder contains the ORDS configuration files. If the configuration folder is undefined, then you are prompted for the configuration folder when you execute the setup command.

To specify the location for your ORDS configuration files, use the following command:

```
java -jar ords.war configdir /path/to/config
```



Creating the ORDS Configuration Files for the Application Root Container

This section describes how to create the ORDS configuration files for the application root container.

To create the ORDS configuration files for the application root container, execute the following setup command to create the configuration files:

```
java -jar ords.war setup --configOnly
```

Where, the --configonly option must be specified to create the configuration files. When prompted for the service name, specify the application root servicename.

Example 4-1 Configuring ORDS for Application Express

```
java -jar ords.war setup --configOnly
    Specify the database connection type to use.
    Enter number for [1] Basic [2] TNS [3] Custom URL [1]:
    Enter the name of the database server [localhost]:
    Enter the database listen port [1521]:
    Enter 1 to specify the database service name, or 2 to specify the
database SID [1]:
    Enter the database service name: ords_app_root1
    Enter the database password for ORDS_PUBLIC_USER:
    Confirm password:
    Enter 1 if you want to use PL/SQL Gateway or 2 to skip this step.
    If using Oracle Application Express or migrating from mod_plsql
then you must enter 1 [1]:
    Enter the PL/SQL Gateway database user name [APEX_PUBLIC_USER]:
    Enter the database password for APEX_PUBLIC_USER:
    Confirm password:
    Enter 1 to specify passwords for Application Express RESTful
Services database users (APEX_LISTENER, APEX_REST_PUBLIC_USER) or 2 to
skip this step [1]:
    Enter the database password for APEX_LISTENER:
    Confirm password:
    Enter the database password for APEX_REST_PUBLIC_USER:
    Confirm password:
    Enter a number to select a feature to enable:
      [1] SQL Developer Web (Enables all features)
      [2] REST Enabled SOL
      [3] Database API
      [4] REST Enabled SQL and Database API
      [5] None
    Choose [1]:
```

Example 4-2 Configuring ORDS only

```
java -jar ords.war setup --configOnly
    Specify the database connection type to use.
    Enter number for [1] Basic [2] TNS [3] Custom URL [1]:
```



```
Enter the name of the database server [localhost]:
   Enter the database listen port [1521]:
   Enter 1 to specify the database service name, or 2 to specify the
database SID [1]:
   Enter the database service name: ords_app_root1
   Enter the database password for ORDS_PUBLIC_USER:
   Confirm password:
   Enter 1 if you want to use PL/SQL Gateway or 2 to skip this step.
   If using Oracle Application Express or migrating from mod_plsql
then you must enter 1 [1]:2
   Enter a number to select a feature to enable:
     [1] SQL Developer Web (Enables all features)
     [2] REST Enabled SQL
     [3] Database API
     [4] REST Enabled SQL and Database API
     [5] None
   Choose [1]:
```

Making all Application PDBs in an Application Root Container Addressable by ORDS

This section describes how to make all application PDBs in an application root container addressable by ORDS. This step is required for starting ORDS from the application root container.

For more information refer to Making All PDBs Addressable by Oracle REST Data Services (Pluggable Mapping).

Running ORDS

This section lists the different methods you can use to run ORDS after installing ORDS in the application container.

Once you install ORDS in the application container and create the ORDS configuration files, run ORDS using one of the following methods:

- Standalone Mode
- Deploy on Oracle WebLogic Server
- Deploy Oracle REST Data Services on Apache Tomcat

See Also:

- Starting in Standalone Mode
- Deploying to Oracle WebLogic Server
- Deploying to Apache Tomcat



Validating ORDS in the Application Root Container

This section describes how to validate ORDS in the application root container.

You can validate an application in an application container. These operations are performed in the application root. The application container propagates the application changes to the application PDBs when the application PDBs synchronize with the application in the application root. The ords_app_con_validate.sql script repairs the Oracle REST Data Services schema and verifies if the ORDS schema is valid.

To repair ORDS in the application root:

- 1. In SQLcl or SQL*Plus, connect to the application root.
- 2. Run /path/to/scripts/validate/core/ords_app_con_validate.sql with the following parameters:
 - Log folder (must include the forward slash at the end)
 - Scripts path (requires the fully qualified path to the ORDS scripts)

```
ALTER SESSION SET CONTAINER = ords_app_root1;
```

@/path/to/scripts/validate/core/ords_app_con_validate.sql /path/to/ logs/ /path/to/scripts

The $ords_app_con_validate.sql$ sets the application version to the ORDS product version with suffix " v YYMMDD24HRMISS".

For example:

Year.Quarter.Patch.rJulianDay24MI v YYMMDD24HRMISS

20.2.0.r1801800_v_200705160015

To synchronize the ORDS application in an application PDB with the latest changes in the application root:

- 1. In SQLcl or SQL*Plus, ensure that the current container is the application PDB
- 2. Run the ALTER PLUGGABLE DATABASE APPLICATION statement specifying the ORDS application with the SYNC clause.

For example:

```
ALTER SESSION SET CONTAINER = ords_app_pdb1;

ALTER PLUGGABLE DATABASE APPLICATION ORDS SYNC;
```



Note:

When you install ORDS, it attempts to find the Oracle Application Express (APEX) schema and creates a view. This view joins the relevant tables in the APEX schema to the tables in the Oracle REST Data Services schema. If you install Oracle REST Data Services before APEX, then Oracle REST Data Services cannot find the APEX schema and it creates a stub view in place of the missing APEX tables.

Oracle highly recommends that you install Oracle REST Data Services after APEX to ensure that the APEX objects that Oracle REST Data Services needs to query are present.

If you install Oracle REST Data Services before APEX, then use the ords_app_con_validate.sql script to force Oracle REST Data Services to reconstruct the queries against the APEX schema.

Upgrading ORDS in the Application Container

This section describes how to upgrade ORDS in the application container.

You can upgrade an application in an application container. These operations are performed in the application root. The application container propagates the application changes to the application PDBs when the application PDBs synchronize with the application in the application root.

Prerequisites:

- ORDS must already be installed in the application container.
- Upgrading ORDS from an earlier release to a new release (for example, ORDS release 20.2.x.x to 20.3.x.x).

To upgrade ORDS in the application root:

- In SQLcl or SQL*Plus, connect to the application root.
- 2. Run /path/to/scripts/upgrade/ords_app_con_upgrade.sql with the following parameters:
 - Log folder (must include the forward slash at the end)
 - Scripts path (requires the fully qualified path to the ORDS scripts)

Note:

The ords_app_con_upgrade.sql script upgrades ORDS in the application root container to the release that you are using. For example, if the ORDS application version is 20.2.1.r2121800, and the ORDS upgrade script is 20.3.0.r2601900, then the script upgrades ORDS to release 20.3.0.r2601900 in the application root container.

To synchronize the ORDS application in an application PDB with the upgrade changes in the application root:



- 1. In SQLcl or SQL*Plus, ensure that the current container is the application PDB.
- 2. Run the ALTER PLUGGABLE DATABASE APPLICATION statement specifying the ORDS application with the SYNC clause.

ALTER SESSION SET CONTAINER = ords_app_pdb1;

ALTER PLUGGABLE DATABASE APPLICATION ORDS SYNC;



Verifying ORDS in the Application Container

Uninstalling ORDS from the Application Container

This section describes how to uninstall ORDS from the application container.

You can uninstall an application from an application container. These operations are performed in the application root. The application container propagates the application changes to the application PDBs when the application PDBs synchronize with the application in the application root.

To uninstall ORDS from the application root:

- In SQLcl or SQL*Plus, connect to the application root.
- 2. Run /path/to/scripts/uninstall/core/ords_app_con_uninstall.sql with the following parameters:
 - Log folder (must include the forward slash at the end)
 - Scripts path (requires the fully qualified path to the ORDS scripts)

ALTER SESSION SET CONTAINER = ords_app_root1;

@/path/to/scripts/uninstall/core/ords_app_con_uninstall.sql /path/to/
logs/ /path/to/scripts

To synchronize the application PDB to uninstall the ORDS application:

- 1. In SQLcl or SQL*Plus, ensure that the current container is the application PDB.
- 2. Run the ALTER PLUGGABLE DATABASE APPLICATION statement specifying the ORDS application with the SYNC clause.

For example:

```
ALTER SESSION SET CONTAINER = ords_app_pdb1;

ALTER PLUGGABLE DATABASE APPLICATION ORDS SYNC;
```



Verifying ORDS in the Application Container



Verifying ORDS in the Application Container

This section describes how to verify ORDS in the application container.

To verify the ORDS for install, upgrade, validate, and uninstall in the application container:

- Manually inspect the following log files for any errors:
 - Install ordsinstall_<timestamp>.log
 - Upgrade ordsupgrade_<timestamp>.log
 - Validate ordsvalidate_<timestamp>.log
 - Uninstall ordsuninstall_<timestamp>.log
- Query dba_applications to verify if the ORDS application exists and its application version is the same as the ORDS product version.

SQL> select app_name, app_version, app_status from dba_applications
where app_name = 'ORDS';

• Query dba_app_errors to check for any errors:

SQL> select app_name, app_statement, errornum, errormsg from dba_app_errors where app_name = 'ORDS';

no rows selected

If you are uninstalling ORDS from the application container, the ${\tt APP_STATUS}$ contains the value ${\tt UNINSTALLED}$.

Making All PDBs Addressable by Oracle REST Data Services (Pluggable Mapping)

Pluggable mapping refers to the ability to make all PDBs in a CDB root or in an application root container addressable by Oracle REST Data Services. To use this feature, follow the instructions described in this topic.

If the Oracle REST Data Services configuration file includes the db.serviceNameSuffix parameter, this indicates that the Oracle REST Data Services pool points to a CDB root or an application root, and that the PDBs connected to that CDB root or an application root should be made addressable by Oracle REST Data Services.

The value of the db.serviceNameSuffix parameter must match the value of the DB_DOMAIN database initialization parameter, and it must start with a period (.). To set the value of the db.serviceNameSuffix parameter:

- In SQLcl or SQL*Plus, connect to the root as a user with SYSDBA privileges.
- Check the value of the DB_DOMAIN database initialization parameter.



SQL> show parameter DB_DOMAIN

3. Exit SQLcl or SQL*Plus.

SOL> exit

4. If the DB_DOMAIN value is not empty, then on the command line, enter the command to create the key and value for the db.serviceNameSuffix parameter and its DB_DOMAIN. This will be used to add this entry to the Oracle REST Data Services configuration file.

echo db.serviceNameSuffix=.value-of-DB_DOMAIN > snsuffix.properties

For example, if DB_DOMAIN is set to example.com, enter the following:

echo db.serviceNameSuffix=.example.com > snsuffix.properties

5. If the db.serviceNameSuffix parameter value is not defined, enter a command in the following format to add an entry to the configuration file:

java -jar ords.war set-properties --conf pool-name snsuffix.properties

Where *pool-name* is one of the following:

- poolName for a PL/SQL Gateway configuration
- poolName_pu for an Oracle REST Data Services RESTful Services configuration
- poolName rt for an Application Express RESTful Services configuration

Example 1: You want to make PDBs in a CDB root or an application root addressable globally. Specify defaults by entering the following command:

java -jar ords.war set-properties --conf defaults snsuffix.properties

Note:

The approach shown in Example 1 (setting the property for all pools through the defaults.xml file) is best for most use cases.

Example 2: You want to make PDBs in a CDB root or an application root addressable for your PL/SQL Gateway, and your pool name is apex. Enter the following command:

java -jar ords.war set-properties --conf apex snsuffix.properties

For example, if the database pointed to by apex has a DB_DOMAIN value of example.com and contains the two PDBs pdb1.example.com and pdb2.example.com, the first PDB will be mapped to URLs whose path starts with / ords/pdb1/, and the second PDB will be mapped to URLs whose path starts with /ords/pdb2/.

Example 3: You want to make PDBs in a CDB root or an application root addressable for your Oracle REST Data Services RESTful Services, and your pool name is <code>apex_pu</code>. Enter the following command:

java -jar ords.war set-properties --conf apex_pu snsuffix.properties



Example 4: You want to make PDBs in a CDB root or an application root addressable for your Application Express RESTful Services and your pool name is apex_rt. Enter the following command:

java -jar ords.war set-properties --conf apex_rt snsuffix.properties

Related Topics

About the Oracle REST Data Services Configuration Files



5

Developing Oracle REST Data Services Applications

This section explains how to develop applications that use Oracle REST Data Services. It includes guidance and examples.



If you want to get started quickly, you can try the tutorial in Oracle REST Data Services Quick Start Guide. However, you should then return to this chapter to understand the main concepts and techniques.

Note:

Ensure that you have installed and configured both Oracle Application Express 4.2 or later, and Oracle REST Data Services 3.0 or later, before attempting to follow any of the tutorials and examples.

To use the Oracle REST API for JSON Data Persistence, you must first install the Oracle REST API. See "Oracle REST API Installation" in *Oracle REST Data Services SODA for REST Developer's Guide*.

It is assumed that you are familiar with Oracle Application Express. If you are new to Oracle Application Express, see the Oracle Application Express documentation.

Topics:

- Introduction to Relevant Software
- Getting Started with RESTful Services
- Automatic Enabling of Schema Objects for REST Access (AutoREST)
- Filtering in Queries
- Configuring Secure Access to RESTful Services
- About Oracle REST Data Services User Roles
- Authenticating Against WebLogic Server User Repositories
- Integrating with Existing Group/Role Models
- Using the Oracle REST Data Services PL/SQL API

You may also want to review Creating an Image Gallery , a supplementary extended example that uses Oracle Application Express to build an application.

Introduction to Relevant Software

This section explains some key relevant software for developing applications that use Oracle REST Data Services.

Topics:

- About Oracle Application Express
- About RESTful Web Services

Related Topics

About Oracle REST Data Services

About Oracle Application Express

Oracle Application Express is a declarative, rapid web application development tool for the Oracle database. It is a fully supported, no cost option available with all editions of the Oracle database. Using only a web browser, you can develop and deploy professional applications that are both fast and secure.

About RESTful Web Services

Representational State Transfer (REST) is a style of software architecture for distributed hypermedia systems such as the World Wide Web. An API is described as RESTful when it conforms to the tenets of REST. Although a full discussion of REST is outside the scope of this document, a RESTful API has the following characteristics:

- Data is modelled as a set of resources. Resources are identified by URIs.
- A small, uniform set of operations are used to manipulate resources (for example, PUT, POST, GET, DELETE).
- A resource can have multiple representations (for example, a blog might have an HTML representation and an RSS representation).
- Services are stateless and since it is likely that the client will want to access related resources, these should be identified in the representation returned, typically by providing hypertext links.

Release 4.2 of Oracle Application Express leverages the capabilities of Oracle REST Data Services to provide developers with an easy to use graphical user interface for defining and testing RESTful Web Services.

Getting Started with RESTful Services

This section introduces RESTful Services, and provides guidelines and examples for developing applications that use RESTful Services.

Topics:

- RESTful Services Terminology
- About Request Path Syntax Requirements
- "Getting Started" Documents Included in Installation



- About cURL and Testing RESTful Services
- Automatic Enabling of Schema Objects for REST Access (AutoREST)
- Manually Creating RESTful Services Using SQL and PL/SQL
- About Working with Dates Using Oracle REST Data Services

Related Topics

Developing Oracle REST Data Services Applications

RESTful Services Terminology

This section introduces some common terms that are used throughout this document:

- RESTful service: An HTTP web service that conforms to the tenets of the RESTful architectural style.
- Resource module: An organizational unit that is used to group related resource templates.
- Resource template: An individual RESTful service that is able to service requests for some set of URIs (Universal Resource Identifiers). The set of URIs is defined by the URI Pattern of the Resource Template
- **URI pattern**: A pattern for the resource template. Can be either a route pattern or a URI template, although you are encouraged to use route patterns.
- Route pattern: A pattern that focuses on decomposing the path portion of a URI into its component parts. For example, a pattern of /:object/:id? will match /emp/101 (matches a request for the item in the emp resource with id of 101) and will also match /emp/ (matches a request for the emp resource, because the :id parameter is annotated with the ? modifier, which indicates that the id parameter is optional).
 - For a detailed explanation of route patterns, see <code>docs\javadoc\plugin-api\route-patterns.html</code>, under <code>csqldeveloper-install>\ords</code> and under the location (if any) where you manually installed Oracle REST Data Services.
- **URI template**: A simple grammar that defines the specific patterns of URIs that a given resource template can handle. For example, the pattern <code>employees/{id}</code> will match any URI whose path begins with <code>employees/</code>, such as <code>employees/2560</code>.
- Resource handler: Provides the logic required to service a specific HTTP method for a specific resource template. For example, the logic of the GET HTTP method for the preceding resource template might be:

```
select empno, ename, dept from emp where empno = :id
```

• **HTTP operation**: HTTP (HyperText Transport Protocol) defines standard methods that can be performed on resources: GET (retrieve the resource contents), POST (store a new resource), PUT (update an existing resource), and DELETE (remove a resource).

Related Topics

About RESTful Web Services



About Request Path Syntax Requirements

To prevent path-based attacks, Oracle REST Data Services performs a number of validation checks on the syntax of the path element of each request URL.

Each path must conform to the following rules:

- Is not empty or whitespace-only
- Does not contain any of the following characters: ?, #, ;, %
- Does not contain the null character (\u0000)
- Does not contain characters in the range: \u0001-\u0031
- Does not end with white space or a period (.)
- Does not contain double forward slash (//) or double back slash(\\)
- Does not contain two or more periods in sequence (..., ..., and so on)
- Total length is {@value #MAX_PATH_LENGTH} characters or less
- Does not match any of the following names (case insensitive), with or without file extensions: CON, PRN, AUX, CLOCK\$, NUL, COM0, COM1, COM2, COM3, COM4, COM5, COM6, COM7, COM8, COM9, LPT0, LPT1, LPT2, LPT3, LPT4, LPT5, LPT6, LPT7, LPT8, LPT9

If you intend to auto-REST enable objects, then avoid object names that do not comply with these requirements. For example, do not create a table named #EMPS. If you do want to auto-REST enable objects that have non-compliant names, then you must use an alias that complies with the requirements.

These requirements are applied to the URL decoded form of the URL, to prevent attempted circumvention of percent encodings.

"Getting Started" Documents Included in Installation

When you install Oracle REST Data Services, an examples folder is created with subfolders and files that you may find helpful. The installation folder hierarchy includes this:

```
ords
conf
docs
examples
soda
getting-started
```

In this hierarchy:

- examples\soda: Contains sample JSON documents used in some examples included in Oracle REST Data Services SODA for REST Developer's Guide.
- examples\getting-started: Double-click index.html for a short document about how to get started developing RESTful Services using Oracle REST Data Services. This document focuses on using SQL Developer to get started. (SQL Developer is the primary tool for managing Oracle REST Data Services. For example, the ability to auto-enable REST support for schemas and tables is available only in SQL Developer.)



About cURL and Testing RESTful Services

Other sections show the testing of RESTful Services using a web browser. However, another useful way to test RESTful Services is using the command line tool named cURL.

This powerful tool is available for most platforms, and enables you to see and control what data is being sent to and received from a RESTful service.

```
curl -i https://server:port/ords/workspace/hr/employees/7369
```

This example produces a response like the following:

```
HTTP/1.1 200 OK
Server: Oracle-REST-Data-Services/2.0.6.78.05.25
ETag: "..."
Content-Type: application/json
Transfer-Encoding: chunked
Date: Thu, 28 Mar 2014 16:49:34 GMT

{
   "empno":7369,
   "ename":"SMITH",
   "job":"CLERK",
   "mgr":7902,
   "hiredate":"1980-12-17T08:00:00Z",
   "sal":800,
   "deptno":20
}
```

The -i option tells cURL to display the HTTP headers returned by the server.

Related Topics

Exploring the Sample RESTful Services in Application Express (Tutorial)



cURL

The example in this section uses cURL with the services mentioned in Exploring the Sample RESTful Services in Application Express (Tutorial)

Automatic Enabling of Schema Objects for REST Access (AutoREST)

If Oracle REST Data Services has been installed on the system associated with a database connection, you can use the AutoREST feature to conveniently enable or disable Oracle REST Data Services access for specified tables and views in the schema associated with that database connection. Enabling REST access to a table, view or PL/SQL function, procedure or package allows it to be accessed through RESTful services.

AutoREST is a quick and easy way to expose database tables as REST resources. You sacrifice some flexibility and customizability to gain ease of effort. AutoRest lets you quickly expose data but (metaphorically) keeps you on a set of guide rails. For

example, you cannot customize the output formats or the input formats, or do extra validation.

On the other hand, manually created resource modules require you to specify the SQL and PL/SQL to support the REST resources. Using resource modules requires more effort, but offers more flexibility; for example, you can customize what fields are included, do joins across multiple tables, and validate the incoming data using PL/SQL.

So, as an application developer you must make a choice: use the "guide rails" of AutoREST, or create a resource module to do exactly what you need. If you choose AutoREST, you can just enable a table (or set of tables) within a schema.

Note that enabling a schema is not equivalent to enabling all tables and views in the schema. It just means making Oracle REST Data Services aware that the schema exists and that it may have zero or more resources to expose to HTTP. Those resources may be AutoREST resources or resource module resources.

You can automatically enable Oracle REST Data Services queries to access individual database schema objects (tables, views, and PL/SQL) by using a convenient wizard in Oracle SQL Developer. (Note that this feature is only available for Oracle REST Data Services- enabled schemas, not for Oracle Application Express workspaces.)

To enable Oracle REST Data Services access to one or more specified tables or views, you must do the following in SQL Developer:

1. Enable the schema (the one associated with the connection) for REST access.

Schema level: To enable Oracle REST Data Services access to selected objects (that you specify in the next step) in the schema associated with a connection, right-click its name in the Connections navigator and select **REST Services**, then **Enable REST Services**.

(To drop support for Oracle REST Data Services access to objects in the schema associated with a connection, right-click its name in the Connections navigator and select **REST Services**, then **Drop REST Services**.)

2. Individually enable REST access for the desired objects.

Table or view level: To enable Oracle REST Data Services access to a specified table or view, right-click its name in the Connections navigator and select **Enable REST Services**.

For detailed usage information, click the **Help** button in the wizard or dialog box in SQL Developer.

Examples: Accessing Objects Using RESTful Services

This section provides examples of using Oracle REST Data Services queries and other operations against tables and views after you have REST-enabled them.

You can automatically expose table and view objects as RESTful services using SQL Developer. This topic provides examples of accessing these RESTful services.





Tip:

Although these examples illustrate the URL patterns used to access these resources, clients should avoid hard coding knowledge of the structure of these URLs; instead clients should follow the hyperlinks in the resources to navigate between resources. The structure of the URL patterns may evolve and change in future releases.

This topic provides examples of accessing objects using RESTful Services.

- Get Schema Metadata
- Get Object Metadata
- Get Object Data
- Get Table Data Using Paging
- **Get Table Data Using Query**
- Get Table Row Using Primary Key
- **Insert Table Row**
- **Update/Insert Table Row**
- **Delete Using Filter**
- Post by Batch Load

Get Schema Metadata

This example retrieves a list of resources available through the specified schema alias. It shows RESTful services that are created by automatically enabling a table or view, along with RESTful Services that are created by resource modules.

This example retrieves a list of resources available through the specified schema alias.

```
Pattern: GET http://<HOST>:<PORT>/ords/<SchemaAlias>/metadata-catalog/
```

Example: GET http://localhost:8080/ords/ordstest/metadata-catalog/

Result:

```
"items": [
 "name": "EMP",
 "links": [
  "rel": "describes",
  "href": "http://localhost:8080/ords/ordstest/emp/"
  "rel": "canonical",
  "href": "http://localhost:8080/ords/ordstest/metadata-catalog/emp/",
  "mediaType": "application/json"
1
```



```
"name": "oracle.examples.hello",
   "links": [
    "rel": "describes",
    "href": "http://localhost:8080/ords/ordstest/examples/hello/"
    "rel": "canonical",
    "href": "http://localhost:8080/ords/ordstest/metadata-catalog/examples/
hello/",
    "mediaType": "application/json"
  }
   ]
 }
  1,
  "hasMore": false,
  "limit": 25,
  "offset": 0,
  "count": 2,
  "links": [
   "rel": "self",
   "href": "http://localhost:8080/ords/ordstest/metadata-catalog/"
 },
   "rel": "first",
   "href": "http://localhost:8080/ords/ordstest/metadata-catalog/"
 }
}
```

The list of resources includes:

- Resources representing tables or views that have been REST enabled.
- Resources defined by resource modules. Note that only resources having a
 concrete path (that is, not containing any parameters) will be shown. For example,
 a resource with a path of /module/some/path/ will be shown, but a resource with a
 path of /module/some/:parameter/ will not be shown.

Each available resource has two hyperlinks:

- The link with relation describes points to the actual resource.
- The link with relation canonical describes the resource.

Get Object Metadata

This example retrieves the metadata (which describes the object) of an individual object. The location of the metadata is indicated by the canonical link relation.

```
Pattern: GET http://<HOST>:<PORT>/ords/<SchemaAlias>/metadata-catalog/
<ObjectAlias>/
```

Example: GET http://localhost:8080/ords/ordstest/metadata-catalog/emp/

Result:

```
{
    "name": "EMP",
    "primarykey": [
          "empno"
```



```
],
"members": [
    {
        "name": "empno",
        "type": "NUMBER"
        "name": "ename",
        "type": "VARCHAR2"
        "name": "job",
        "type": "VARCHAR2"
        "name": "mgr",
        "type": "NUMBER"
        "name": "hiredate",
        "type": "DATE"
        "name": "sal",
        "type": "NUMBER"
        "name": "comm",
        "type": "NUMBER"
        "name": "deptno",
        "type": "NUMBER"
],
"links": [
        "rel": "collection",
        "href": "http://localhost:8080/ords/ordstest/metadata-catalog/",
        "mediaType": "application/json"
        "rel": "canonical",
        "href": "http://localhost:8080/ords/ordstest/metadata-catalog/emp/"
        "rel": "describes",
        "href": "http://localhost:8080/ords/ordstest/emp/"
]
```

Get Object Data

This example retrieves the data in the object. Each row in the object corresponds to a JSON object embedded within the JSON array

Pattern: GET http://<HOST>:<PORT>/ords/<SchemaAlias>/<ObjectAlias>/

Example: GET http://localhost:8080/ords/ordstest/emp/

Result:

```
"items": [
  "empno": 7499,
  "ename": "ALLEN",
  "job": "SALESMAN",
  "mgr": 7698,
  "hiredate": "1981-02-20T00:00:00Z",
  "sal": 1600,
  "comm": 300,
  "deptno": 30,
   "links": [
    "rel": "self",
    "href": "http://localhost:8080/ords/ordstest/emp/7499"
  ]
 },
  "empno": 7934,
  "ename": "MILLER",
  "job": "CLERK",
  "mgr": 7782,
  "hiredate": "1982-01-23T00:00:00Z",
  "sal": 1300,
  "comm": null,
  "deptno": 10,
  "links": [
    "rel": "self",
    "href": "http://localhost:8080/ords/ordstest/emp/7934"
  ]
],
"hasMore": false,
"limit": 25,
"offset": 0,
"count": 13,
"links": [
  "rel": "self",
  "href": "http://localhost:8080/ords/ordstest/emp/"
  "rel": "edit",
  "href": "http://localhost:8080/ords/ordstest/emp/"
  "rel": "describedby",
  "href": "http://localhost:8080/ords/ordstest/metadata-catalog/emp/"
  "rel": "first",
  "href": "http://localhost:8080/ords/ordstest/emp/"
]
}
```



Get Table Data Using Paging

This example specifies the offset and limit parameters to control paging of result data.

Pattern: GET http://<HOST>:<PORT>/ords/<SchemaAlias>/<ObjectAlias>/?
offset=<Offset>&limit=<Limit>

Example: GET http://localhost:8080/ords/ordstest/emp/?offset=10&limit=5

Result:

```
"items": [
 "empno": 7900,
 "ename": "JAMES",
 "job": "CLERK",
 "mgr": 7698,
 "hiredate": "1981-12-03T00:00:00Z",
 "sal": 950,
  "comm": null,
  "deptno": 30,
  "links": [
   "rel": "self",
    "href": "http://localhost:8080/ords/ordstest/emp/7900"
 ]
 "empno": 7934,
 "ename": "MILLER",
 "job": "CLERK",
 "mgr": 7782,
 "hiredate": "1982-01-23T00:00:00Z",
 "sal": 1300,
 "comm": null,
  "deptno": 10,
  "links": [
    "rel": "self",
    "href": "http://localhost:8080/ords/ordstest/emp/7934"
 ]
"hasMore": false,
"limit": 5,
"offset": 10,
"count": 3,
"links": [
 "rel": "self",
 "href": "http://localhost:8080/ords/ordstest/emp/"
 "rel": "edit",
 "href": "http://localhost:8080/ords/ordstest/emp/"
```



```
},
{
   "rel": "describedby",
   "href": "http://localhost:8080/ords/ordstest/metadata-catalog/emp/"
},
{
   "rel": "first",
   "href": "http://localhost:8080/ords/ordstest/emp/?limit=5"
},
{
   "rel": "prev",
   "href": "http://localhost:8080/ords/ordstest/emp/?offset=5&limit=5"
}

]
```

Get Table Data Using Query

This example specifies a filter clause to restrict objects returned.

```
Pattern: GET http://<HOST>:<PORT>/ords/<SchemaAlias>/<ObjectAlias>/?
q=<FilterClause>
```

```
Example: GET http://localhost:8080/ords/ordstest/emp/?q={"deptno": {"\$lte":20}}
```

Result:

```
"items": [
 "empno": 7566,
 "ename": "JONES",
 "job": "MANAGER",
 "mgr": 7839,
 "hiredate": "1981-04-01T23:00:00Z",
 "sal": 2975,
 "comm": null,
  "deptno": 20,
  "links": [
   "rel": "self",
   "href": "http://localhost:8080/ords/ordstest/emp/7566"
 ]
},
 "empno": 7934,
 "ename": "MILLER",
 "job": "CLERK",
 "mgr": 7782,
 "hiredate": "1982-01-23T00:00:00Z",
  "sal": 1300,
  "comm": null,
  "deptno": 10,
  "links": [
   "rel": "self",
   "href": "http://localhost:8080/ords/ordstest/emp/7934"
```



```
]
 }
 ],
 "hasMore": false,
 "limit": 25,
 "offset": 0,
 "count": 7,
 "links": [
   "rel": "self",
   "href": "http://localhost:8080/ords/ordstest/emp/?
q=%7B%22deptno%22:%7B%22%24lte%22:20%7D%7D"
   "rel": "edit",
  "href": "http://localhost:8080/ords/ordstest/emp/?
q=%7B%22deptno%22:%7B%22%24lte%22:20%7D%7D"
   "rel": "describedby",
  "href": "http://localhost:8080/ords/ordstest/metadata-catalog/emp/"
   "rel": "first",
  "href": "http://localhost:8080/ords/ordstest/emp/?
q=%7B%22deptno%22:%7B%22%24lte%22:20%7D%7D"
 ]
```

Get Table Row Using Primary Key

This example retrieves an object by specifying its identifying key values.

```
Pattern: GET http://<HOST>:<PORT>/ords/<SchemaAlias>/<ObjectAlias>/
<KeyValues>
```

Where <KeyValues> is a comma-separated list of key values (in key order).

Example: GET http://localhost:8080/ords/ordstest/emp/7839

Result:

```
"empno": 7839,
"ename": "KING",
"job": "PRESIDENT",
"mgr": null,
"hiredate": "1981-11-17T00:00:00Z",
"sal": 5000,
"comm": null,
"deptno": 10,
"links": [
    {
        "rel": "self",
        "href": "http://localhost:8080/ords/ordstest/emp/7839"
    },
    {
        "rel": "edit",
        "href": "http://localhost:8080/ords/ordstest/emp/7839"
    },
}
```



```
{
  "rel": "describedby",
  "href": "http://localhost:8080/ords/ordstest/metadata-catalog/emp/item"
},
  {
  "rel": "collection",
  "href": "http://localhost:8080/ords/ordstest/emp/"
}
}
```

Insert Table Row

This example inserts data into the object. The body data supplied with the request is a JSON object containing the data to be inserted.

If the object has a primary key, then there must be an insert trigger on the object that populates the primary key fields. If the table does not have a primary key, then the ROWID of the row will be used as the item's identifier.

If the object lacks a trigger to assign primary key values, then the PUT operation described in next section, **Update/Insert Table Row** should be used instead.

Pattern: POST http://<HOST>:<PORT>/ords/<SchemaAlias>/<ObjectAlias>/

Example:

```
curl -i -H "Content-Type: application/json" -X POST -d "{ \"empno\" :7,
\"ename\": \"JBOND\", \"job\":\"SPY\", \"deptno\" :11 }" "http://localhost:8080/
ords/ordstest/emp/
Content-Type: application/json
{ "empno" :7, "ename": "JBOND", "job": "SPY", "deptno" :11 }
Result:
 "empno": 7,
 "ename": "JBOND",
 "job": "SPY",
 "mgr": null,
 "hiredate": null,
 "sal": null,
 "comm": null,
 "deptno": 11,
 "links": [
   "rel": "self",
   "href": "http://localhost:8080/ords/ordstest/emp/7"
   "rel": "edit",
   "href": "http://localhost:8080/ords/ordstest/emp/7"
   "rel": "describedby",
   "href": "http://localhost:8080/ords/ordstest/metadata-catalog/emp/item"
   "rel": "collection",
   "href": "http://localhost:8080/ords/ordstest/emp/"
```



```
}
]
}
```

Update/Insert Table Row

This example inserts or updates (sometimes called an "upsert") data in the object. The body data supplied with the request is a JSON object containing the data to be inserted or updated.

Pattern: PUT http://<HOST>:<PORT>/ords/<SchemaAlias>/<ObjectAlias>/
<KeyValues>

Example:

```
curl -i -H "Content-Type: application/json" -X PUT -d "{ \"empno\" :7,
\"ename\": \"JBOND\", \"job\":\"SPY\", \"deptno\" :11 }" "http://localhost:8080/
ords/ordstest/emp/7
Content-Type: application/json
{ "empno" :7, "ename": "JBOND", "job": "SPY", "deptno" :11 }
Result:
 "empno": 7,
 "ename": "JBOND",
 "job": "SPY",
 "mgr": null,
 "hiredate": null,
 "sal": null,
 "comm": null,
 "deptno": 11,
 "links": [
   "rel": "self",
   "href": "http://localhost:8080/ords/ordstest/emp/7"
   "rel": "edit",
   "href": "http://localhost:8080/ords/ordstest/emp/7"
   "rel": "describedby",
   "href": "http://localhost:8080/ords/ordstest/metadata-catalog/emp/item"
   "rel": "collection",
   "href": "http://localhost:8080/ords/ordstest/emp/"
 1
```

Delete Using Filter

This example deletes object data specified by a filter clause.

Pattern: DELETE http://<HOST>:<PORT>/ords/<SchemaAlias>/<ObjectAlias>/?
q=<FilterClause>



```
Example: curl -i -X DELETE "http://localhost:8080/ords/ordstest/emp/?
q={"deptno":11}"

Result:
{
    "itemsDeleted": 1
}
```

Post by Batch Load

This example inserts object data using the batch load feature. The body data supplied with the request is a CSV file. The behavior of the batch operation can be controlled using the optional query parameters, which are described in Table 5-1.

Pattern: POST http://<HOST>:<PORT>/ords/<SchemaAlias>/<ObjectAlias>/
batchload?<Parameters>

Parameters:

Table 5-1 Parameters for batchload

Parameter	Description
batchesPerCommit	Sets the frequency for commits. Optional commit points can be set after a batch is sent to the database. The default is every 10 batches. 0 indicates commit deferred to the end of the load. Type: Integer.
batchRows	Sets the number of rows in each batch to send to the database. The default is 50 rows per batch. Type: Integer.
dateFormat	Sets the format mask for the date data type. This format is used when converting input data to columns of type date. Type: String.
delimiter	Sets the field delimiter for the fields in the file. The default is the comma (,).
enclosures	embeddedRightDouble
errors	Sets the user option used to limit the number of errors. If the number of errors exceeds the value specified for errorsMax (the service option) or by errors (the user option), then the load is terminated.
	To permit no errors at all, specify 0. To indicate that all errors be allowed (up to errorsMax value), specify UNLIMITED (-1).
errorsMax	A service option used to limit the number of errors allowed by users. It intended as an option for the service provider and not to be exposed as a user option. If the number of errors exceeds the value specified for errorsMax (the service option) or by errors (the user option), then the load is terminated.
	To permit no errors at all, specify 0. To indicate that all errors be allowed, specify UNLIMITED (-1).
lineEnd	Sets the line end (terminator). If the file contains standard line end characters (\r. \r\n or \n), then lineEnd does not need to be specified.
lineMax	Sets a maximum line length for identifying lines/rows in the data stream. A lineMax value will prevent reading an entire stream as a single line when the incorrect lineEnd character is being used. The default is unlimited.
locale	Sets the locale.
responseEncoding	Sets the encoding for the response stream.



Table 5-1 (Cont.) Parameters for batchload

Parameter	Description
responseFormat	Sets the format for response stream. This format determines how messages and bad data will be formatted. Valid values: RAW, SQL.
timestampFormat	Sets the format mask for the time stamp data type. This format is used when converting input data to columns of type time stamp.
timestampTZFormat	Sets the format mask for the time stamp time zone data type. This format is used when converting input data to columns of type time stamp time zone.
truncate	Indicates if and/or how table data rows should be deleted before the load. False (the default) does not delete table data before the load; True causes table data to be deleted with the DELETE SQL statement; Truncate causes table data to be deleted with the TRUNCATE SQL statement.

Example:

```
POST http://localhost:8080/ords/ordstest/emp/batchload?batchRows=25 Content-Type: text/csv

empno,ename,job,mgr,hiredate,sal,comm,deptno
0,M,SPY MAST,,2005-05-01 11:00:01,4000,,11
7,J.BOND,SPY,0,2005-05-01 11:00:01,2000,,11
9,R.Cooper,SOFTWARE,0,2005-05-01 11:00:01,10000,,11
26,Max,DENTIST,0,2005-05-01 11:00:01,5000,,11
```

Result:

```
#INFO Number of rows processed: 4
#INFO Number of rows in error: 0
#INFO Elapsed time: 00:00:03.939 - (3,939 ms) 0 - SUCCESS: Load processed
without errors
```

Filtering in Queries

This section describes and provides examples of filtering in queries against REST-enabled tables and views.

Filtering is the process of limiting a collection resource by using a per-request dynamic filter definition across multiple page resources, where each page contains a subset of items found in the complete collection. Filtering enables efficient traversal of large collections.

To filter in a query, include the parameter q=FilterObject, where FilterObject is a JSON object that represents the custom selection and sorting to be applied to the resource. For example, assume the following resource:

https://example.com/ords/scott/emp/

The following guery includes a filter that restricts the ENAME column to "JOHN":

https://example.com/ords/scott/emp/?q={"ENAME":"JOHN"}



FilterObject Grammar

The FilterObject must be a JSON object that complies with the following syntax:

```
FilterObject { orderby , asof, wmembers }
```

The orderby, asof, and wmembers attributes are optional, and their definitions are as follows:

```
orderby
  "$orderby": {orderByMembers}
orderByMembers
    orderByProperty
    orderByProperty , orderByMembers
orderByProperty
    columnName : sortingValue
sortingValue
  "ASC"
  "DESC"
  "-1"
   -1
asof
  "$asof": date
  "$asof": "datechars"
  "$asof": scn
  "$asof": +int
wmembers
    wpair
    wpair , wmembers
wpair
    columnProperty
    complexOperatorProperty
columnProperty
    columnName : string
    columnName : number
    columnName : date
    columnName : simpleOperatorObject
columnName : complexOperatorObject
    columnName : [complexValues]
columnName
  "\p{Alpha}[[\p{Alpha}]]([[\p{Alnum}]#$_])*$"
complexOperatorProperty
    complexKey : [complexValues]
    complexKey : simpleOperatorObject
complexKey
  "$and"
  "$or"
```



```
complexValue , complexValues
complexValue
    simpleOperatorObject
    complexOperatorObject
    columnObject
columnObject
    {columnProperty}
simpleOperatorObject
    {simpleOperatorProperty}
complexOperatorObject
    {complexOperatorProperty}
simpleOperatorProperty
   "$eq" : string | number | date
   "$ne" : string | number | date
   "$lt" : number | date
   "$lte" : number | date
   "$gt" : number | date
   "$gte" : number | date
   "$instr" : string
   "$ninstr" : string
   "$like" : string
   "$null" : null
   "$notnull" : null
   "$between" : betweenValue
betweenValue
    [null , betweenNotNull]
    [betweenNotNull , null]
    [betweenRegular , betweenRegular]
betweenNotNull
    number
    date
betweenRegular
    string
    number
    date
Data type definitions include the following:
string
       JSONString
number
       JSONNumber
date
       { "$date": "datechars" }
scn
       {"$scn": +int}
Where:
datechars is an RFC3339 date format in UTC (Z)
```

complexValues

```
JSONString
          " chars "
chars
         char
         char chars
char
         \verb"any-Unicode-character" except-"-or-\control-character"
          //
           \/
          \b
          \n
          \r
          \t
          \u four-hex-digits
JSONNumber
    int
    int frac
    int exp
    int frac exp
    digit
    digit1-9 digits
    - digit
    - digit1-9 digits
frac
    . digits
    e digits
digits
    digit
    digit digits
    e+
    e-
    Ε
    E+
```

The FilterObject must be encoded according to Section 2.1 of RFC3986.

Examples: FilterObject Specifications

The following are examples of operators in FilterObject specifications.

```
ORDER BY property ($orderby)

Order by with literals

{
    "$orderby": {"SALARY": "ASC", "ENAME": "DESC"}
}

Order by with numbers

{
```

```
"$orderby": {"SALARY": -1,"ENAME": 1}
ASOF property ($asof)
With SCN (Implicit)
 "$asof": 1273919
With SCN (Explicit)
  "$asof": {"$scn": "1273919"}
With Date (Implicit)
  "$asof": "2014-06-30T00:00:00Z"
With Date (Explicit)
  "$asof": {"$date": "2014-06-30T00:00:00Z"}
EQUALS operator ($eq)
(Implicit and explicit equality supported._
Implicit (Support String and Dates too)
 "SALARY": 1000
Explicit
 "SALARY": { "$eq": 1000}
Strings
 "ENAME": {"$eq":"SMITH"}
Dates
  "HIREDATE": {"$date": "1981-11-17T08:00:00Z"}
NOT EQUALS operator ($ne)
```



```
Number
 "SALARY": { "$ne": 1000}
String
 "ENAME": {"$ne":"SMITH"}
Dates
 "HIREDATE": { "$ne": { "$date": "1981-11-17T08:00:00Z" } }
LESS THAN operator ($1t)
(Supports dates and numbers only)
Numbers
  "SALARY": {"$lt": 10000}
Dates
  "SALARY": {"$lt": {"$date":"1999-12-17T08:00:00Z"}}
LESS THAN OR EQUALS operator ($1te)
(Supports dates and numbers only)
Numbers
  "SALARY": { "$lte": 10000}
Dates
  "HIREDATE": {"$lte": {"$date":"1999-12-17T08:00:00Z"}}
}
GREATER THAN operator ($gt)
(Supports dates and numbers only)
Numbers
 "SALARY": {"$gt": 10000}
Dates
```



```
{
  "SALARY": { "$gt": { "$date": "1999-12-17T08:00:00Z" } }
GREATER THAN OR EQUALS operator ($gte)
(Supports dates and numbers only)
Numbers
  "SALARY": { "$qte": 10000}
Dates
  "HIREDATE": {"$qte": {"$date":"1999-12-17T08:00:00Z"}}
In string operator ($instr)
(Supports strings only)
  "ENAME": { "$instr": "MC" }
Not in string operator ($ninstr)
(Supports strings only)
  "ENAME": { "$ninstr": "MC" }
#### LIKE operator ($like)
(Supports strings. Eescape character not supported to try to match expressions
with _ or % characters.)
  "ENAME": { "$like": "AX%" }
#### BETWEEN operator ($between)
(Supports string, dates, and numbers)
Numbers
  "SALARY": { "$between": [1000,2000]}
Dates
 "SALARY": { "$between": [{ "$date": "1989-12-17T08:00:00Z"},
{ "$date": "1999-12-17T08:00:00Z" } ] }
```



```
Strings
  "ENAME": { "$between": [ "A", "C" ] }
Null Ranges ($lte equivalent)
(Supported by numbers and dates only)
  "SALARY": { "$between": [null,2000]}
Null Ranges ($gte equivalent)
(Supported by numbers and dates only)
  "SALARY": { "$between": [1000,null]}
#### NULL operator ($null)
  "ENAME": {"$null": null}
#### NOT NULL operator ($notnull)
  "ENAME": { "$notnull": null}
#### AND operator ($and)
(Supports all operators, including $and and $or)
Column context delegation
(Operators inside $and will use the closest context defined in the JSON tree.)
  "SALARY": { | $and | : [ { | $gt | : 1000 } , { | $1t | : 4000 } ] }
Column context override
(Example: salary greater than 1000 and name like S%)
  "SALARY": { "$and": [{ "$gt": 1000}, { "ENAME": { "$like": "S% "}} ] }
Implicit and in columns
  "SALARY": [{"$gt": 1000},{"$lt":4000}]
High order AND
```

```
(All first columns and or high order operators -- $and and $ors -- defined at
the first level of the JSON will be joined and an implicit AND)
(Example: Salary greater than 1000 and name starts with S or T)
  "SALARY": {"$gt": 1000},
  "ENAME": {"$or": [{"$like":"S%"}, {"$like":"T%"}]}
Invalid expression (operators $1t and $gt lack column context)
   "$and": [{"$lt": 5000},{"$qt": 1000}]
Valid alternatives for the previous invalid expression
   "$and": [{"SALARY": {"$lt": 5000}}, {"SALARY": {"$gt": 1000}}]
}
   "SALARY": [{"$lt": 5000},{"$gt": 1000}]
}
   "SALARY": { "$and": [{ "$lt": 5000}, { "$gt": 1000}]}
}
OR operator ($or)
(Supports all operators including $and and $or)
Column context delegation
(Operators inside $or will use the closest context defined in the JSON tree)
  "ENAME": { "$or": [{ "$eq": "SMITH"}, { "$eq": "KING" }]}
Column context override
(Example: name starts with S or salary greater than 1000)
  "SALARY": { "$or": [{ "$qt": 1000}, { "ENAME": { "$like": "S%"}} ] }
```

Auto PL/SQL

This section explains how PL/SQL is made available through HTTP(S) for Remote Procedure call (RPC).

The auto PL/SQL feature uses a standard to provide consistent encoding and data transfer in a stateless web service environment. Using this feature, you can enable Oracle Database stored PL/SQL functions and procedures at package level through Oracle REST Data Services, similar to how you enable the views and tables.

Auto Enabling PL/SQL Subprograms

Oracle REST Data Services supports auto enabling of the following PL/SQL objects, based on their catalog object identifier:

- PL/SQL Procedure
- PL/SQL Function
- PL/SQL Package

The functions, and procedures within the PL/SQL package cannot be individually enabled as they are named objects within a PL/SQL package object. Therefore, the granularity level enables the objects at the package level. This granularity level enables to expose all of its public functions and procedures.

If you want to *only* enable a subset of functions and procedures, then you must create a separate delegate package and enable it to expose only that subset of functions and procedures.



Overloaded package functions and procedures are not supported.

Method and Content Type Supported for Auto Enabling PL/SQL Objects

This section discusses the method and content-type supported by this feature.

The auto enabling of the PL/SQL Objects feature supports POST as the HTTP method. In POST method, input parameters are encoded in the payload and output parameters are decoded from the response.



The standard data CRUD to HTTP method mappings are not applicable as this feature provides an RPC-style interaction.

The content-type supported is application/json.

Auto-Enabling the PL/SQL Objects

This section explains how to auto-enable the PL/SQL objects through Oracle REST Data Services.

You can enable the PL/SQL objects in one of the following ways:

- Auto-Enabling Using the PL/SQL API
- Auto-Enabling the PL/SQL Objects Using SQL Developer

Auto-Enabling Using the PL/SQL API

You can enable a PL/SQL object using the Oracle REST Data Services PL/SQL API.



To enable the PL/SQL package, use the Oracle REST Data Services PL/SQL API as shown in following sample code snippet:

```
BEGIN
  ords.enable_object(
    p_enabled => TRUE,
    p_schema => 'MY_SCHEMA',
    p_object => 'MY_PKG',
    p_object_type => 'PACKAGE',
    p_object_alias => 'my_pkg',
    p_auto_rest_auth => FALSE);
    commit;
END;
/
```

Example 5-1 Enabling the PL/SQL Function

To enable the PL/SQL function, use the Oracle REST Data Services PL/SQL API as shown in following sample code snippet:

```
BEGIN
  ords.enable_object(
    p_enabled => TRUE,
    p_schema => 'MY_SCHEMA',
    p_object => 'MY_FUNC',
    p_object_type => 'FUNCTION',
    p_object_alias => 'my_func',
    p_auto_rest_auth => FALSE);
    commit;
END;
/
```

Example 5-2 Enabling the PL/SQL Procedure

To enable the PL/SQL procedure, use the Oracle REST Data Services PL/SQL API as shown in following sample code snippet:

```
BEGIN
  ords.enable_object(
    p_enabled => TRUE,
    p_schema => 'MY_SCHEMA',
    p_object => 'MY_PROC',
    p_object_type => 'PROCEDURE',
    p_object_alias => 'my_proc',
    p_auto_rest_auth => FALSE);
  commit;
END;
/
```



Auto-Enabling the PL/SQL Objects Using SQL Developer

This section describes how to enable the PL/SQL objects using SQL Developer 4.2 and above.

To enable the PL/SQL objects (for example, package) using SQL Developer, perform the following steps:



You can now enable, packages, functions and procedures. However, the granularity of enabling is either at the whole package level, standalone function level, or at the standalone procedure level.

1. In SQL Developer, right-click on a package as shown in the following figure:



Figure 5-1 Selecting the Enable REST Service Option

2. Select **Enable RESTful Services** to display the following wizard page:

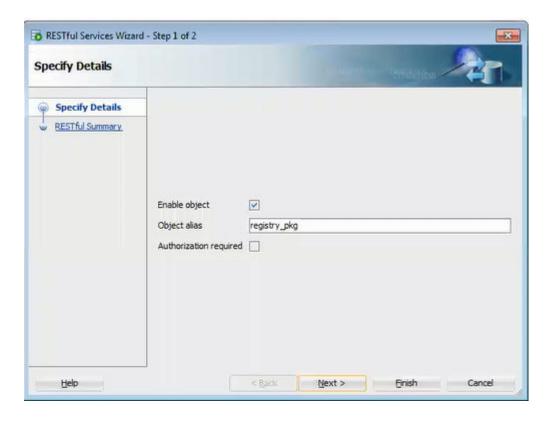


Figure 5-2 Auto Enabling the PL/SQL Package Object

- Enable object: Enable this option (that is, enable REST access for the package).
- Object alias: Accept registry_pkg for the object alias.
- Authorization required: For simplicity, disable this option.
- On the RESTful Summary page of the wizard, click Finish.

Generating the PL/SQL Endpoints

HTTP endpoints are generated dynamically per request for the enabled database objects. Oracle REST Data Services uses the connected database catalog to generate the endpoints using a query.

The following rules apply for all the database objects for generating the HTTP endpoints:

- All names are converted to lowercase
- An endpoint is generated if it is not already allocated

Stored Procedure and Function Endpoints

The function or procedure name is generated into the URL in the same way as tables and views in the same namesspace.



Example 5-3 Generating an Endpoint for the Stored Procedure

```
CREATE OR REPLACE PROCEDURE MY_SCHEMA.MY_PROC IS BEGIN NULL; END;
```

Following endpoint is generated:

```
http://localhost:8080/ords/my schema/my proc/
```

Example 5-4 Package Procedure and Function Endpoints

The package, function, and procedure endpoints are generated with package name as a parent. Endpoints for functions and procedures that are not overloaded or where the lowercase name is not already in use are generated.

If you have a package, MY_PKG as defined in the following code snippet:

```
CREATE OR REPLACE PACKAGE MY_SCHEMA.MY_PKG AS PROCEDURE MY_PROC;

FUNCTION MY_FUNC RETURN VARCHAR2;

PROCEDURE MY_PROC2;

PROCEDURE "my_proc2";

PROCEDURE MY_PROC3(P1 IN VARCHAR);

PROCEDURE MY_PROC3(P2 IN NUMBER);

END MY PKG;
```

Then the following endpoints are generated:

```
http://localhost:8080/ords/my_schema/my_pkg/MY_PROChttp://localhost:8080/ords/my_schema/my_pkg/MY_FUNChttp://localhost:8080/ords/my_schema/my_pkg/MY_FUNChttp://localhost:8080/ords/my_schema/my_pkg/MY_FUNChttp://localhost
```



Endpoints for the procedure my_proc2 is not generated because its name is not unique when the name is converted to lowercase, and endpoints for the procedure my_proc3 is not generated because it is overloaded.

Resource Input Payload

The input payload is a JSON document with values adhering to the REST standard.

The payload should contain a name/value pair for each IN or IN OUT parameter as shown in the following code snippet:

```
{
    "p1": "abc",
    "p2": 123,
    "p3": null
}
```



Note:

Where there are no IN or IN OUT parameters, an empty JSON body is required as shown in the following code snippet:

{}

Oracle REST Data Services uses the database catalog metadata to unmarshal the JSON payload into Oracle database types, which is ready to be passed to the database through JDBC.

Resource Payload Response

When the PL/SQL object is executed successfully, it returns a JSON body.

The JSON body returned, contains all OUT and IN OUT output parameter values. Oracle REST Data Services uses the database catalog metadata to marshal the execution of the result back into JSON as shown in the following code snippet:

```
{
    "p3" : "abc123",
    "p4" : 1
}
```

Where there are no OUT or IN OUT parameters, an empty JSON body is returned as shown in the following code snippet:

{

Function Return Value

The return value of functions do not have an associated name.

As the return value of functions do not have an associated name, the name "~ret" is used as shown in the following code snippet:

```
{
    "~ret" : "abc123"
}
```

Manually Creating RESTful Services Using SQL and PL/SQL

This section describes how to manually create RESTful Services using SQL and PL/SQL and shows how to use a JSON document to pass parameters to a stored procedure in the body of a REST request.

This section includes the following topics:

- About Oracle REST Data Services Mechanisms for Passing Parameters
- Using SQL/JSON Database Functions

About Oracle REST Data Services Mechanisms for Passing Parameters

This section describes the main mechanisms that Oracle REST Data Services supports for passing parameters using REST HTTP to handlers that are written by the developer:

Using JSON to Pass Parameters

You can use JSON in the body of REST requests, such as the POST or PUT method, where each parameter is a JSON name/value pair.

Using Route Patterns to Pass Parameters

You can use route patterns for required parameters in the URI to specify parameters for REST requests such as the GET method, which does not have a body, and in other special cases.

Using Query Strings for Optional Parameters

You can use query strings for optional parameters in the URI to specify parameters for REST requests, such as the GET method, which does not have a body, and in other special cases.

Prerequisite Setup Tasks To Be Completed Before Performing Tasks for Passing Parameters

This prerequisite setup information assumes you have completed steps 1 and 2 in **Getting Started with RESTful Services** section, where you have REST-enabled the ordstest schema and emp database table (Step 1) and created and tested the RESTful service from a SQL query (Step 2). You must complete these two steps before performing the tasks about passing parameters described in the subsections that follow.

Related Topics

Getting Started with RESTful Services

Using JSON to Pass Parameters

This section shows how to use a JSON document to pass parameters to a stored procedure in the body of a REST request, such as POST or PUT method, where each parameter is a name/value pair. This operation performs an update on a record, which in turn returns the change to the record as an OUT parameter.

Perform the following steps:



1. Note:

The following stored procedure performs an update on an existing record in the emp table to promote an employee by changing any or all of the following: job, salary, commission, department number, and manager. The stored procedure returns the salary change as an OUT parameter.

```
create or replace procedure promote ( l_empno IN number,
l job IN varchar2,
           1 mgr IN number, 1 sal IN number, 1 comm IN
number, l_deptno IN number,
           1 salarychange OUT number)
        is
            oldsalary
                      number;
        begin
            select nvl(e.sal, 0)into oldsalary FROM emp e
                    where e.empno = l_empno;
            update emp e set
                e.job = nvl(l_job, e.job),
                e.mgr = nvl(l_mgr, e.mgr),
                e.sal = nvl(l sal, e.sal),
                e.comm = nvl(l_comm, e.comm),
                e.deptno = nvl(l deptno, e.deptno)
                        where e.empno = l_empno;
            l_salarychange := nvl(l_sal, oldsalary) -
oldsalary;
        end;
```

As a privileged ordstest user, connect to the ordstest schema and create the promote stored procedure.

- 2. Perform the following steps to setup a handler for a PUT request on the emp resource to pass parameters in the body of the PUT method in a JSON document to the promote stored procedure.
 - **a.** Using Oracle SQL Developer, in the REST Development section, right click on the emp template and select **Add Handler** for the PUT method.
 - b. In the **Create Resource Handler** dialog, click the green plus symbol to add the MIME type application/json and then click **Apply** to send it a JSON document in the body of the PUT method.
 - c. Using the SQL Worksheet, add the following anonymous PL/SQL block: begin promote

```
(:l_empno, :l_job, :l_mgr, :l_sal, :l_comm, :l_deptno, :l_salarycha nge); end; as shown in the following figure.
```



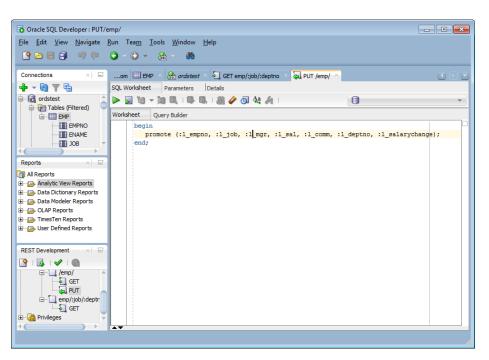
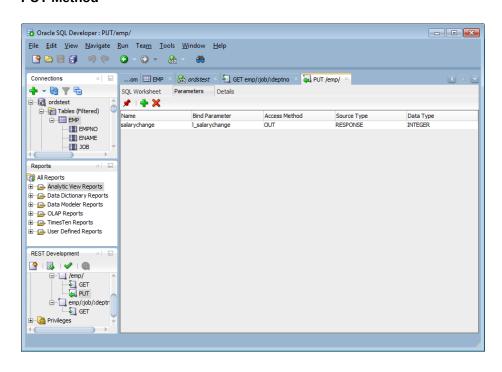


Figure 5-3 Adding an Anonymous PL/SQL Block to the Handler for the PUT Method

d. Click the Parameters tab to set the Bind Parameter as 1_salarychange, the Access Method as an OUT parameter, the Source Type as RESPONSE, and Data Type as INTEGER as shown in the following figure. This is the promote procedure's output which is an integer value equal to the change in salary in a JSON name/value format.

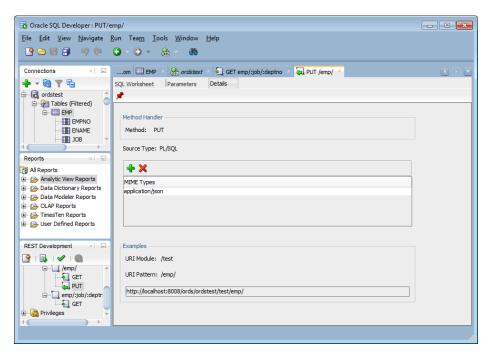
Figure 5-4 Setting the Bind Parameter I_salarychange to Pass for the PUT Method





e. Click the **Details** tab to get the URL to call as shown in the **Examples** section of the following figure. Copy this URL to your clipboard.





- f. Right click on the test module to upload the module. Do not forget this step.
- 3. To test the RESTful service, execute the following cURL command in the
 command prompt:curl -i -H "Content-Type: application/json" -X PUT d "{ \"l_empno\" : 7499, \"l_sal\" : 9999, \"l_job\" : \"Director\",
 \"l_comm\" : 300}



You can also use any REST client available to test the RESTful service.

The cURL command returns the following response:

```
HTTP/1.1 200 OK
Content-Type: application/json Transfer-Encoding: chunked
{"salarychange":8399}
```

4. In SQL Developer SQL Worksheet, perform the following SELECT statement on the emp table: SELECT * from emp to see that the PUT method was executed, then select the **Data** tab to display the records for the EMP table.



- - X oracle SQL Developer: Table ORDSTEST.EMP@ordstest <u>File Edit View Navigate Run Team Tools Window Help</u> Connections × 🖃 ...om 🖽 EMP × 🔝 ordstest × 🔄 GET emp/:job/:deptno × 🚑 PUT /emp/ × Columns Data Model | Constraints | Grants | Statistics | Triggers | Flashback | Dependencies | Details | P 🏓 🝓 💢 🕒 👢 | Sort.. | Filter: i ordstest ▼ Actions… 🖨 🔚 Tables (Filtered) 30 2 3 4 5 7566 JONES MANAGER 7839 02-APR-81 2975 (null) 20 30 30 10 20 30 20 30 13 7902 FORD ANALYST 7566 03-DEC-81 3000 (null) REST Development × 3 7902 FORD ANALISI 7560 6 11 14 7934 MILLER CLERK 7782 23-JAN-82 1300 (null) 20 ---- /emp/ --€∏ GET PUT emp/:job/:deptn - € GET ± ₽rivileges

Figure 5-6 Displaying the Results from a SQL Query to Confirm the Execution of the PUT Method

Note:

- All parameters are optional. If you leave out a name/value pair for a parameter in your JSON document, the parameter is set to NULL.
- The name/value pairs can be arranged in any order in the JSON document. JSON allows much flexibility in this regard in the JSON document.
- Only one level of JSON is supported. You can not have nested JSON objects or arrays.

Using Route Patterns to Pass Parameters

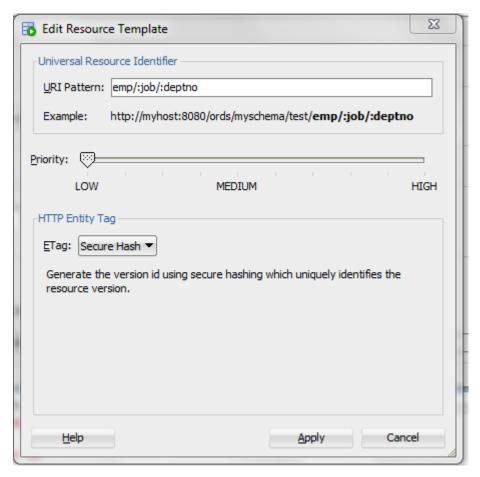
This section describes how to use route patterns in the URI to specify parameters for REST requests, such as with the GET method, which does not have a body.

First create a GET method handler for a query on the emp table that has many bind variables. These steps use a route pattern to specify the parameter values that are required.

Perform the following steps to use a route pattern to send a GET method with some required parameter values:

1. In SQL Developer, right click on the test module and select **Add Template** to create a new template that calls <code>emp</code>; however, in this case the template definition includes a route pattern for the parameters or bind variables that is included in the URI rather than in the body of the method. To define the required parameters, use a route pattern by specifying a <code>/: before the job and deptno parameters</code>. For example, for the URI pattern, enter: <code>emp/:job/:deptno</code> as shown in the following figure.

Figure 5-7 Creating a Template Definition to Include a Route Pattern for Some Parameters or Bind Variables



- Click Next to go to REST Data Services Step 2 of 3, and click Next to go to REST Data Services — Step 3 of 3, then click Finish to complete the template.
- 3. Right click on the emp/:job/:deptno template and select Add Handler for the GET method.
- 4. Right click on the GET method to open the handler.
- 5. Add the following query to the SQL Worksheet: select * from emp e where e.job = :job and e.deptno = :deptno and e.mgr = NVL (:mgr, e.mgr) and e.sal = NVL (:sal, e.sal); as also shown in the following figure.



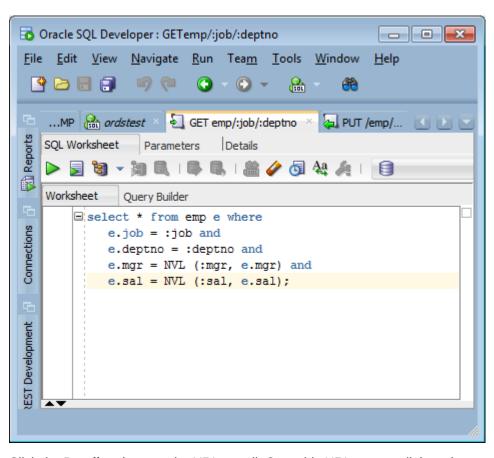


Figure 5-8 Adding a SQL Query to the Handler

- **6.** Click the **Details** tab to get the URL to call. Copy this URL to your clipboard.
- 7. Right click on the test module to upload the module. Do not forget this step.
- 8. Test the REST endpoint. In a web browser enter the URL:http://localhost:8080/ords/ordstest/test/emp/SALESMAN/30 as shown in the following figure.

Figure 5-9 Using Browser to Show the Results of Using a Route Pattern to Send a GET Method with Some Required Parameter Values



The query returns 3 records for the salesmen named Ward, Martin, and Turner.

See Also:

To learn more about Route Patterns see this document in the Oracle REST Data Services distribution at docs/javadoc/plugin-api/route-patterns.html and this document Oracle REST Data Services Route Patterns

Using Query Strings for Optional Parameters

This section describes how to use query strings in the URI to specify parameters for REST requests like the GET method, which does not have a body. You can use query strings for any of the other optional bind variables in the query as you choose.

The syntax for using query strings is: <code>?parm1=value1&parm2=value2 ...</code> <code>&parmN=valueN.</code>

For example, to further filter the query: http://localhost:8080/ords/ords/ordstest/test/emp/SALESMAN/30, to use a query string to send a GET method with some parameter name/value pairs, select employees whose mgr (manager) is 7698 and whose sal (salary) is 1500 by appending the query string ?mgr=7698&sal=1500 to the URL as follows: http://localhost:8080/ords/ordstest/test/emp/SALESMAN/30?mgr=7698&sal=1500.

To test the endpoint, in a web browser enter the following URL: http://localhost:8080/ords/ordstest/test/emp/SALESMAN/30?mgr=7698&sal=1500 as shown in the following figure:



Figure 5-10 Using Browser to Show the Results of Using a Query String to Send a GET Method with Some Parameter Name/Value Pairs

```
(a) Iocalhost:8080/ords/ordstest/test/emp/SALESMAN/30?mgr=7698&sal=1500
                                                                                                    G
Oracle Most Visited
 ▼ items: [
    ▼ {
          empno: 7844,
          ename: "TURNER",
          job: "SALESMAN",
          mgr: 7698,
          hiredate: "1981-09-07T18:30:00Z",
          sal: 1500,
          comm: 0,
          deptno: 30
  hasMore: false,
  limit: 25,
  offset: 0,
  count: 1,
 ▼ links: [
    ▼ {
          rel: "self",
         href: http://localhost:8080/ords/ordstest/test/emp/SALESMAN/30?mgr=7698&sal=1500
          rel: "describedby",
         href: http://localhost:8080/ords/ordstest/metadata-catalog/test/emp/SALESMAN/item
          rel: "first",
         href: http://localhost:8080/ords/ordstest/test/emp/SALESMAN/30?mgr=7698&sal=1500
```

The query returns one record for the salesman named Turner in department 30 who has a salary of 1500 and whose manager is 7698.

Note the following points:

- It is a good idea to URL encode your parameter values. This may not always be required; however, it is the safe thing to do. This prevents the Internet from transforming something, for example, such as a special character in to some other character that may cause a failure. Your REST client may provide this capability or you can search the Internet for the phrase url encoder to find tools that can do this for you.
- Never put a backslash at the end of your parameter list in the URI; otherwise, you may get a 404 Not Found error.

See Also:

To gain more experience using JSON to pass parameter values, see Lab 4 of the ORDS Oracle By Example (OBE) and Database Application Development Virtual Image.



Using SQL/JSON Database Functions

This section describes how to use the SQL/JSON database functions available in Oracle Database 12c Release 2 (12.2) to map the nested JSON objects to and from the hierarchical relational tables.

This section includes the following topics:

- Inserting Nested JSON Objects into Relational Tables
- Generating Nested JSON Objects from Hierachical Relational Data

Inserting Nested JSON Objects into Relational Tables

This section explains how to insert JSON objects with nested arrays into multiple, hierarchical relational tables.

The two key technologies used to implement this functionality are as follows:

- The :body bind variable that Oracle REST Data Services provides to deliver JSON and other content in the body of POST and other REST calls into PL/SQL REST handlers
- JSON_TABLE and other SQL/JSON operators provided in Oracle Database 12c Release 2 (12.2)

Some of the advantages of using these technologies for inserting data into relational tables are as follows:

- Requirements for implementing this functionality are very minimal. For example, installation of JSON parser software is not required
- You can use simple, declarative code that is easy to write and understand when the JSON to relational mapping is simple
- Powerful and sophisticated capabilities to handle more complex mappings. This includes:
 - Mechanisms for mapping NULLS and boolean values
 - Sophisticated mechanisms for handling JSON. JSON evolves over time.
 Hence, the mapping code must be able to handle both the older and newer versions of the JSON documents.

For example, simple scalar values may evolve to become JSON objects containing multiple scalars or nested arrays of scalar values or objects. SQL/JSON operators that return the scalar value can continue to work even when the simple scalar is embedded within these more elaborate structures. A special mechanism, called the **Ordinality Column**, can be used to determine the structure from where the value was derived.



See Also:

The following pages for more information on JSON_TABLE and other SQL/JSON operators and on Ordinality Column mechanism:

- json_db
- ordinality_column

Usage of the :body Bind Variable

This section provides some useful tips for using the :body bind variable.

Some of the useful tips for using the :body bind variable are as follows:

- The :body bind variable can be accessed, or de-referenced, only
 once. Subsequent accesses return a NULL value. So, you must first assign
 the :body bind variable to the local L_PO variable before using it in the two
 JSON Table operations.
- The :body bind variable is a BLOB datatype and you can assign it only to a BLOB variable.

Note:

Since $_{\text{L}P0}$ is a BLOB variable, you must use the FORMAT JSON phrase after the expression in the JSON_TABLE function. section for more information.

The :body bind variable can be used with other types of data such as image data.

See Also:

- Creating an Image Gallery for a working example of using :body bind variable with image data.
- Database SQL Language Reference

Example of JSON Purchase Order with Nested LineItems

This section shows an example that takes the JSON Purchase Order with Nested LineItems and inserts it into a row of the PurchaseOrder table and rows of the LineItem table.

Example 5-5 Nested JSON Purchase Order with Nested LineItems



```
"state" : "CA",
                       "zipCode" : 99236,
                       "country" : "United States of America"},
  "LineItems"
                   : [ {"ItemNumber" : 1,
                         "Part"
                                     : {"Description" : "One Magic
Christmas",
                                        "UnitPrice" : 19.95,
                                        "UPCCode" : 1313109289},
                         "Quantity"
                                     : 9.0},
                       {"ItemNumber" : 2,
                        "Part"
                                    : {"Description" : "Lethal Weapon",
                                       "UnitPrice" : 19.95,
                                       "UPCCode"
                                                   : 8539162892},
                        "Quantity"
                                   : 5.0}]}'
```

Table Definitions for PurchaseOrder and LineItems Tables

This section provides definitions for the PurchaseOrder and LineItem tables.

The definitions for the **PurchaseOrder** and the **LineItems** tables are as follows:

```
CREATE TABLE PurchaseOrder (
    PONo NUMBER (5),
    Requestor VARCHAR2 (50),
    CostCenter VARCHAR2 (5),
    AddressStreet VARCHAR2 (50),
    AddressCity VARCHAR2 (50),
    AddressState VARCHAR2 (2),
    AddressZip VARCHAR2 (10),
    AddressCountry VARCHAR2 (50),
    PRIMARY KEY (PONo));
CREATE TABLE LineItem (
    PONo NUMBER (5),
    ItemNumber NUMBER (10),
    PartDescription VARCHAR2 (50),
    PartUnitPrice NUMBER (10),
    PartUPCCODE NUMBER (10),
    Quantity NUMBER (10),
    PRIMARY KEY (PONo, ItemNumber));
```

PL/SQL Handler Code for a POST Request

This section gives an example PL/SQL handler code for a POST request. The handler code is used to insert a purchase order into a row of the PurchaseOrder table and rows of the LineItem table.

Example 5-6 PL/SQL Handler Code Used for a POST Request

```
Declare
  L_PO     BLOB;

Begin
  L PO := :body;
```



```
INSERT INTO PurchaseOrder
     SELECT * FROM json_table(L_PO FORMAT JSON, '$'
        COLUMNS (
          PONo
                         Number PATH '$.PONumber',
          Requestor
                         VARCHAR2 PATH '$.Requestor',
          CostCenter
                         VARCHAR2 PATH '$.CostCenter',
          AddressStreet VARCHAR2 PATH '$.Address.street',
          AddressCity VARCHAR2 PATH '$.Address.city',
          AddressState
                         VARCHAR2 PATH '$.Address.state',
          AddressZip
                         VARCHAR2 PATH '$.Address.zipCode',
          AddressCountry VARCHAR2 PATH '$.Address.country'));
INSERT INTO LineItem
SELECT * FROM json_table(L_PO FORMAT JSON, '$'
        COLUMNS (
          PONo Number PATH '$.PONumber',
          NESTED
                            PATH '$.LineItems[*]'
            COLUMNS (
              ItemNumber
                               Number PATH '$.ItemNumber',
              PartDescription VARCHAR2 PATH '$.Part.Description',
              PartUnitPrice
                               Number PATH '$.Part.UnitPrice',
              PartUPCCode
                               Number PATH '$.Part.UPCCode',
              Quantity
                               Number PATH '$.Quantity'));
commit;
end;
```

Creating the REST API Service to Invoke the Handler

This section explains how to create the REST API service to invoke the handler, using the Oracle REST Data Services.

To setup the REST API service, a URI is defined to identify the resource the REST calls will be operating on. The URI is also used by Oracle REST Data Services to route the REST HTTP calls to specific handlers. The general format for the URI is as follows:

```
<server>:<port>/ords/<schema>/<module>/<template>/<parameters>
```

Here, <server>:<port> is where the Oracle REST Data Service is installed. For testing purposes, you can use **demo** and **test** in place of **module** and **template** respectively in the URI. Modules are used to group together related templates that define the resources the REST API will be operating upon.

To create the REST API service, use one of the following methods:

 Use the Oracle REST Data Services PL/SQL API to define the REST service and a handler for the POST insert. Then connect to the jsontable schema on the database server that contains the PurchaseOrder and LineItem tables.

Note:

JSON_TABLE and other SQL/JSON operators use single quote so these must be escaped. For example, every single quote (') must be replaced with double quotes (").

 Use the Oracle REST Data Services, REST Development pane in SQL Developer to define the REST service.

Defining the REST Service and Handler using PL/SQL API

This section shows how to define the REST Service and Handler for the POST insert using the Oracle REST Data Services PL/SQL API.

You can alternatively use the Oracle REST Data Services REST development pane in SQL Developer to create the modules, templates and handlers.

```
BEGIN
 ORDS.ENABLE_SCHEMA(
     p_enabled
                       => TRUE,
     p_schema
     p_url_mapping_pattern => 'ordstest',
     p_auto_rest_auth
                       => FALSE);
 ORDS.DEFINE_MODULE(
     p_module_name => 'demo',
     p_base_path => '/demo/',
     p_items_per_page => 25,
     p_status => 'PUBLISHED',
     p_comments
                  => NULL);
 ORDS.DEFINE_TEMPLATE(
     p_module_name => 'demo',
     p_etag_query => NULL,
p_comments => NULL);
 ORDS.DEFINE_HANDLER(
     p_module_name => 'demo',
     p_pattern => 'test',
     p_method => 'POST',
     p_source_type => 'plsql/block',
     p_items_per_page => 0,
     p_mimes_allowed => '',
     p_comments => NULL,
p_source => '
declare
   L_PO BLOB := :body;
begin
INSERT INTO PurchaseOrder
     SELECT * FROM json_table(L_PO FORMAT JSON, ''$''
       COLUMNS (
```

```
PONo
                               Number
                                                PATH ''$.PONumber'',
          Requestor
                              VARCHAR2 PATH ''$.Requestor'',
          CostCenter
                             VARCHAR2
                                        PATH ''$.CostCenter''
          AddressStreet
                            VARCHAR2 PATH ''$.Address.street'',
          AddressCity
                             VARCHAR2 PATH ''$.Address.city'',
          AddressState
                             VARCHAR2 PATH ''$.Address.state'',
                              VARCHAR2 PATH ''$.Address.zipCode'',
          AddressZip
          AddressCountry
                           VARCHAR2 PATH ''$.Address.country''));
INSERT INTO LineItem
SELECT * FROM json_table(L_PO FORMAT JSON, ''$''
        COLUMNS (
          PONo Number PATH ''$.PONumber'',
          NESTED
                                     PATH ''$.LineItems[*]''
            COLUMNS (
              ItemNumber
                              Number
                                          PATH ''$.ItemNumber'',
              PartDescription VARCHAR2
                                          PATH ''$.Part.Description'',
              PartUnitPrice Number
                                          PATH ''$.Part.UnitPrice'',
              PartUPCCode Number PATH ''$.Part.UPCCode'',
                                             PATH ''$.Quantity'')));
              Quantity
                                   Number
commit;
end; '
     );
 COMMIT;
END;
```

Related Topics

- Using the Oracle REST Data Services PL/SQL API
- About Oracle REST Data Services Mechanisms for Passing Parameters
- Oracle REST Data Services PL/SQL Package Reference

Generating Nested JSON Objects from Hierachical Relational Data

This section explains how to query the relational tables in hierarchical (parent/child) relationships and return the data in a nested JSON format using the Oracle REST Data Services.

The two key technologies used to implement this functionality are as follows:

- The new SQL/JSON functions available with Oracle Database 12c Release 2
 (12.2). You can use json_objects for generating JSON objects from the relational tables, and json_arrayagg, for generating nested JSON arrays from nested (child) relational tables.
- The Oracle REST Data Services media source type used for enabling the REST service handler to execute a SQL query that in turn returns the following types of data:
 - The HTTP Content-Type of the data, which in this case is application/json
 - The JSON data returned by the json object

Some of the advantages of using this approach are as follows:



- Requirements for implementing this functionality is very minimal. For example, installation of JSON parser software is not required.
- Simple, declarative coding which is easy to write and understand which makes the JSON objects to relational tables mapping simple.
- Powerful and sophisticated capabilities to handle more complex mappings. This includes mechanisms for mapping NULLS and boolean values.

For example, a NULL in the Oracle Database can be converted to either the absence of the JSON element or to a JSON NULL value. The Oracle Database does not store Boolean types but the SQL/JSON functions allow string or numeric values in the database to be mapped to Boolean TRUE or FALSE values.

Bypassing JSON Generation for Relational Data

This section describes and provides solutions for handling responses that are already in a JSON format.

ORDS auto-formats your SQL or PL/SQL results and response to a JSON format before returning to your application. However, in some cases, the complete response body or part of it is already in a JSON format. Following are two such use cases:

Use Case 1: When the response is already in a JSON format

Following figure shows an example where the complete response is already in a JSON format:

Columns Data Model | Constraints | Grants | Statistics | Triggers | Flashback | Dependencies | Details | Partitions | Indexes | SQL 📌 🚱 🗸 🔉 🕒 I Sort.. | Filter: ♦ ID ♦ DATE_LOADED **Edit Value** 111-SEP-17 01.24.32.000000000 PM AMERICA/NEW_YORK Line Terminator: Platform Default Change. "statementId": 1, "statementType": "query", "statementPos": { statementText": "select * from hr.departments", "response": [], "result": 0, "resultSet": { Columns | Data | Model | Constraints | Grants | Statistics | Triggers | Flashback | Dependencies | Details metadata": [📌 🚻 ▼ Actions.. "columnName": "DEPARTMENT ID" "jsonColumnName": "departmen "columnTypeName": "NUMBER", ·CREATE·TABLE·"HR"."JSON_PLAY"·«¶ "precision": 4, ··(» "ID"·NUMBER(*,0),·«¶ "DATE LOADED" . TIMESTAMP . (6) » "JSON_DOC" · CLOB, · «¶ Help OK Cancel ·CONSTRAINT·"ENSURE_ISJSON"·CHECK·(json_doc·IS·JSON) EN ···)·SEGMENT·CREATION·IMMEDIATE·«¶ ··PCTFREE·10·PCTUSED·40·INITRANS·1·MAXTRANS·255·«¶ NOCOMPRESS · LOGGING«¶ ·STORAGE(INITIAL·65536·NEXT·1048576·MINEXTENTS·1·MAXEXTENTS·2147483645«¶ ·BUFFER_POOL·DEFAULT·FLASH_CACHE·DEFAULT·CELL_FLASH_CACHE·DEFAULT)«¶ ·TABLESPACE · "USERS" · «¶ LOB·("JSON_DOC")·STORE·AS·SECUREFILE·(«¶ ·TABLESPACE·**"USERS"**·ENABLE·STORAGE·IN·ROW·CHUNK·<mark>8192</mark>«¶ ·NOCACHE·LOGGING··NOCOMPRESS··KEEP_DUPLICATES·«¶

Figure 5-11 Complete Response Body in JSON Format

You must adjust your GET query text to include "application/json" before including the JSON itself as shown in the following example GET query:

The Media resource in this case is application/json and the browser handles it similar to a BLOB or a PDF.

Use Case 2: One or more columns of the response is already in a JSON format.

If one or more columns are in a JSON format, then such columns in the source query need to be aliased to indicate that the attribute must not be converted to a JSON format.

For example:

The alias text is used to name the nested JSON document attribute.

```
See Also:

ORDS: Returning Raw {JSON}
```

Example to Generate Nested JSON Objects from the Hierachical Relational Tables

This section describes how to query or GET the data we inserted into the PurchaseOrder and LineItem relational tables in the form of nested JSON purchase order.

Example 5-7 GET Handler Code using Oracle REST Data Services Query on Relational Tables for Generating a Nested JSON object

```
SELECT 'application/json', json_object('PONumber' VALUE po.PONo,
       'Requestor' VALUE po.Requestor,
       'CostCenter' VALUE po.CostCenter,
       'Address' VALUE
           json_object('street' VALUE po.AddressStreet,
                 'city' VALUE po.AddressCity,
                 'state' VALUE po.AddressState,
                 'zipCode' VALUE po.AddressZip,
                 'country' VALUE po.AddressCountry),
        'LineItems' VALUE (select json_arrayagg(
            json_object('ItemNumber' VALUE li.ItemNumber,
                   'Part' VALUE
                     json_object('Description' VALUE li.PartDescription,
                                  'UnitPrice' VALUE li.PartUnitPrice,
                                  'UPCCode' VALUE li.PartUPCCODE),
                   'Quantity' VALUE li.Quantity))
```



```
FROM LineItem li WHERE po.PONo = li.PONo))
FROM PurchaseOrder po
WHERE po.PONo = :id
```

PL/SQL API Calls for Defining Template and GET Handler

This section provides an example of Oracle REST Data Services PL/SQL API call for creating a new template in the module created.

Example 5-8 PL/SQL API Call for Creating a New test/:id Template and GET Handler in the demo Module

```
Begin
ords.define_template(
 p_module_name => 'demo',
p_pattern => 'test/:id');
ords.define handler(
 p module name => 'demo',
 p_pattern => 'test/:id',
 p_method => 'GET',
 p_source_type => ords.source_type_media,
 p source => '
   SELECT ''application/json'', json_object(''PONumber'' VALUE po.PONo,
          ''Requestor'' VALUE po.Requestor,
          ''CostCenter'' VALUE po.CostCenter,
          ''Address'' VALUE
              json_object(''street'' VALUE po.AddressStreet,
                           ''city'' VALUE po.AddressCity,
                           ''state'' VALUE po.AddressState,
                           ''zipCode'' VALUE po.AddressZip,
                           ''country'' VALUE po.AddressCountry),
          ''LineItems'' VALUE (select json_arrayagg(
              json_object(''ItemNumber'' VALUE li.ItemNumber,
                     ''Part'' VALUE
                       json_object(''Description'' VALUE
li.PartDescription,
                                    ''UnitPrice'' VALUE li.PartUnitPrice,
                                    ''UPCCode'' VALUE li.PartUPCCODE),
                       ''Quantity'' VALUE li.Quantity))
                      FROM LineItem li WHERE po.PONo = li.PONo))
               FROM PurchaseOrder po
                 WHERE po.PONo = :id '
   );
Commit;
End;
```

Testing the RESTful Services

This section shows how to test the **POST** and **GET** RESTful Services to access the Oracle database and get the results in a JSON format.

This section includes the following topics:

- Insertion of JSON Object into the Database
- Generating JSON Object from the Database

Insertion of JSON Object into the Database

This section shows how to test insertion of JSON purchase order into the database.

URI Pattern: http://<HOST>:<PORT>/ords/<SchemaAlias>/<module>/<template>

Example:

Method: POST

URI Pattern: http://localhost:8080/ords/ordstest/demo/test/

To test the RESTful service, create a file such as pol. json with the following data for PONumber 1608:

```
{"PONumber"
                  : 1608,
 "Requestor"
                 : "Alexis Bull",
 "CostCenter"
                 : "A50",
 "Address"
                  : {"street" : "200 Sporting Green",
                                 "city" : "South San Francisco",
                                 "state" : "CA",
                                 "zipCode" : 99236,
                                 "country" : "United States of
America"},
      "LineItems" : [ {"ItemNumber" : 1,
                         "Part"
                                    : {"Description" : "One Magic
Christmas",
                                       "UnitPrice" : 19.95,
                                       "UPCCode" : 1313109289},
                                       "Quantity" : 9.0},
                                       {"ItemNumber" : 2,
                                         "Part"
{"Description" : "Lethal Weapon",
"UnitPrice" : 19.95,
             : 8539162892},
"UPCCode"
                                         "Quantity" : 5.0}]}'
```

Then, execute the following cURL command in the command prompt:

```
curl -i -H "Content-Type: application/json" -X POST -d @po1.json "http://localhost:8080/ords/ordstest/demo/test/"
```

The cURL command returns the following response:

```
HTTP/1.1 200 OK
Transfer-Encoding: chunked
```

Generating JSON Object from the Database

This section shows the results of a GET method to fetch the JSON object from the database..

Method: GET

URI Pattern: http://<HOST>:<PORT>/ords/<SchemaAlias>/<module>/<template>/
<parameters>

Example:

To test the RESTful service, in a web browser, enter the URL http://localhost:8080 / ords/ordstest/demo/test/1608 as shown in the following figure:

Figure 5-12 Generating Nested JSON Objects

```
1 http://localhost:8080/ords/... × +
   (i) localhost:8080/ords/ordstest/demo/test/1608
                                                                                                   △ G
Oracle 🔑 Most Visited
  PONumber: 1608,
  Requestor: "Alexis Bull",
  CostCenter: "A50",
 ▼ Address: {
      street: "200 Sporting Green",
      city: "South San Francisco",
      state: "CA",
      zipCode: "99236",
      country: "United States of America"
 ▼ LineItems: [
    ▼ {
          ItemNumber: 1,
        ▼ Part: {
              Description: "One Magic Christmas",
              UnitPrice: 20.
              UPCCode: 1313109289
          Quantity: 9
          ItemNumber: 2,
              Description: "Lethal Weapon",
              UnitPrice: 20,
              UPCCode: 8539162892
          Quantity: 5
          ItemNumber: 1,
        ▼ Part: {
              Description: "One Magic Christmas",
              UnitPrice: 20,
              UPCCode: 1313109289
          Quantity: 9
```

About Working with Dates Using Oracle REST Data Services

Oracle REST Data Services enables developers to create REST interfaces to Oracle Database, Oracle Database 12c JSON Document Store as quickly and easily as possible. When working with Oracle Database, developers can use the AutoREST feature for tables or write custom modules using SQL and PL/SQL routines for more complex operations.

Oracle REST Data Services uses the RFC3339 standard for encoding dates in strings. Typically, the date format used is dd-mmm-yyyy, for example, 15-Jan-2017. Oracle REST Data Services automatically converts JSON strings in the specified format to Oracle date data types when performing operations such as inserting or updating

values in Oracle Database. When converting back to JSON strings, Oracle REST Data Services automatically converts Oracle date data types to the string format.



Oracle Database supports a date data type while JSON does not support a date data type.

This section includes the following topics:

- About Datetime Handling with Oracle REST Data Services
- About Setting the Time Zone



The following page for more information, including details on how time and time zones are handled jsao io dates

About Datetime Handling with Oracle REST Data Services

As data arrives from a REST request, Oracle REST Data Services may parse ISO 8601 strings and convert them to the TIMESTAMP data type in Oracle Database. This occurs with AutoREST (POST and PUT) as well as with bind variables in custom modules. Remember that TIMESTAMP does not support time zone related components, so the DATETIME value is set to the time zone Oracle REST Data Services uses during the conversion process.

When constructing responses to REST requests, Oracle REST Data Services converts DATETIME values in Oracle Database to ISO 8601 strings in Zulu. This occurs with AutoREST (GET) and in custom modules that are mapped to SQL queries (GET). In the case of DATE and TIMESTAMP data types, which do not have time zone related components, the time zone is assumed to be that in which Oracle REST Data Services is running and the conversion to Zulu is made from there.

Here are some general recommendations when working with Oracle REST Data Services for REST (that is, not APEX):

- Ensure that Oracle REST Data Services uses the appropriate time zone as per the data in the database (for example, the time zone you want dates going into the database).
- Do not alter NLS settings (that is, the time zone) mid-stream.

Note that while ISO 8601 strings are mentioned, Oracle REST Data Services actually supports strings. RFC3339 strings are a conformant subset of ISO 8601 strings. The default format returned by JSON.stringify(date) is supported.



•

WARNING:

It is important to keep the time zone that Oracle REST Data Services uses in sync with the session time zone to prevent issues with implicit data conversion to <code>TIMESTAMP</code> WITH <code>TIME ZONE</code> Or <code>TIMESTAMP</code> WITH <code>LOCAL TIME ZONE</code>. Oracle REST Data Services does this automatically by default but developers can change the session time zone with an <code>ALTER SESSION</code> statement.

S

See Aslo:

rfc3339_date_time_format

About Setting the Time Zone

When Oracle REST Data Services is started, the JVM it runs in obtains and caches the time zone Oracle REST Data Services uses for various time zone conversions. By default, the time zone is obtained from the operating system (OS), so an easy way to change the time zone Oracle REST Data Services uses is to change the time zone of the OS and then restart Oracle REST Data Services or the application server on which it is running. Of course, the instructions for changing the time zone vary by the operating system.

If for any reason you do not want to use the same time zone as the OS, it is possible to override the default using the Java environment variable <code>Duser.timezone</code>. Exactly how that variable is set depends on whether you are running in standalone mode or in a Java application server. The following topics show some examples.

Standalone Mode

When running Oracle REST Data Services in standalone mode, it is possible to set Java environment variables by specifying them as command line options before the -jar option.

Example 5-9 Setting the Duser.timezone Java Environment Variable in Standalone Mode

The following code example shows how to set the timezone in standalone mode on the command line.

\$ java -Duser.timezone=America/New_York -jar ords.war standalone

Java Application Server — Tomcat 8

In a Java application server, Tomcat 8, and possibly earlier and later versions too, it is possible to set the time zone using the environment variable <code>CATALINA_OPTS</code>. The recommended way to do this is not to modify the <code>CATALINA_BASE/bin/catalina.sh</code> directly, but instead to set environment variables by creating a script named <code>setenv.sh</code> in <code>CATALINA_BASE/bin</code>.



Example 5-10 Setting the Duser.timezone Java Environment Variable in a Java Application Server

The following code example shows the contents of the setenv.sh script for setting the timezone in a Java Application server — Tomcat 8.

```
CATALINA_TIMEZONE="-Duser.timezone=America/New_York"
CATALINA_OPTS="$CATALINA_OPTS $CATALINA_TIMEZONE
```

Exploring the Sample RESTful Services in Application Express (Tutorial)

Oracle highly recommends to develop Oracle REST Data Services application using SQL Developer because it supports the most recent Oracle REST Data Services releases, that is, 3.0.X. Application Express provides a tutorial that is useful for learning some basic concepts of REST and Oracle REST Data Services. However, the tutorial uses the earlier Oracle REST Data Services releases, that is, 2.0.X. Following are some of the useful tips discussed on how to use the tutorial:

If your Application Express instance is configured to automatically add the sample application and sample database objects to workspaces, then a sample resource module named: <code>oracle.example.hr</code> will be visible in the list of Resource Modules. If that resource module is not listed, then you can click the **Reset Sample Data** task on the right side of the RESTful Services Page to create the sample resource module.

- Click on oracle.example.hr to view the Resource Templates and Resource
 Handlers defined within the module. Note how the module has a URI prefix with
 the value: hr/. This means that all URIs serviced by this module will start with the
 characters hr/.
- 2. Click on the resource template named <code>employees/{id}</code>. Note how the template has a URI Template with the value: <code>employees/{id}</code>. This means that all URIs starting with <code>hr/employees/</code> will be serviced by this Resource Template.
 - The HTTP methods supported by a resource template are listed under the resource template. In this case, the only supported method is the GET method.
- Click on the GET Resource Handler for hr/employees/{id} to view its configuration.

The **Source Type** for this handler is <code>Query One Row</code>. This means that the resource is expected to be mapped to a single row in the query result set. The Source for this handler is:

```
select * from emp
     where empno = :id
```

Assuming that the empno column is unique, the query should only produce a single result (or no result at all if no match is found for :id). To try it out, press the **Test** button. The following error message should be displayed:

400 - Bad Request - Request path contains unbound parameters: id

If you look at the URI displayed in the browser, it will look something like this:

```
https://server:port/ords/workspace/hr/employees/{id}
```

where:



- server is the DNS name of the server where Oracle Application Express is deployed
- port is the port the server is listening on
- workspace is the name of the Oracle Application Express workspace you are logged into

Note the final part of the URI: $hr/employees/\{id\}$. The error message says that this is not a valid URI, the problem is that you did not substitute in a concrete value for the parameter named $\{id\}$. To fix that, press the browser **Back** button, then click **Set Bind Variables**.

4. For the bind variable named :id, enter the value 7369, and press **Test**.

A new browser window appears displaying the following JSON (JavaScript Object Notation):

```
{
  "empno":7369,
  "ename":"SMITH",
  "job":"CLERK",
  "mgr":7902,
  "hiredate":"1980-12-17T08:00:00Z",
  "sal":800,
  "deptno":20
}
```

Note also the URI displayed in the browser for this resource:

```
https://server:port/ords/workspace/hr/employees/7369
```

The $\{id\}$ URI Template parameter is bound to the SQL :id bind variable, and in this case it has been given the concrete value of 7369, so the query executed by the RESTful Service becomes:

```
select * from emp
     where empno = 7369
```

The results of this guery are then rendered as JSON as shown above.



Tip:

Reading JSON can be difficult. To make it easier to read, install a browser extension that *pretty prints* the JSON. For example, Mozilla Firefox and Google Chrome both have extensions:

- jsonview_firefox
- json_formatter_chrome

Now see what happens when you enter the URI of a resource that does not exist.

5. On the Set Bind Variables page, change the value of :id from 7369 to 1111, and press **Test**.

As before, a new window pops up, but instead of displaying a JSON resource, it displays an error message reading:

```
404 - Not Found
```



This is the expected behavior of this handler: when a value is bound to :id that does not exist in the emp table, the query produces no results and consequently the standard HTTP Status Code of 404 - Not Found is returned.

So, you have a service that will provide information about individual employees, if you know the ID of an employee, but how do you discover the set of valid employee ids?

- **6.** Press **Cancel** to return to the previous page displaying the contents of the Resource Module.
- 7. Click on the template named employees/.

The following steps look at the resource it generates, and later text will help you understand its logic.

8. Click on the GET handler beneath employees/, and click **Test**.

A resource similar to the following is displayed (If you haven't already done so, now would be a good time to install a JSON viewer extension in your browser to make it easier to view the output):

```
"next":
{ "$ref":
  "https://server:port/ords/workspace/hr/employees/?page=1"},
"items": [
 "uri":
  {"$ref":
    "https://server:port/ords/workspace/hr/employees/7369"},
 "empno": 7369,
 "ename": "SMITH"
 "uri":
  {"$ref":
    "https://server:port/ords/workspace/hr/employees/7499"},
 "empno": 7499,
 "ename": "ALLEN"
},
. . .
{
 "uri":
   {"$ref":
    "https://server:port/ords/workspace/hr/employees/7782"},
 "empno": 7782,
 "ename": "CLARK"
```

This JSON document contains a number of things worth noting:

- The first element in the document is named next and is a URI pointing to the next page of results. (An explanation of how paginated results are supported appears in later steps)
- The second element is named items and contains a number of child elements.
 Each child element corresponds to a row in the result set generated by the query.



• The first element of each child element is named uri and contains a URI pointing to the service that provides details of each employee. Note how the latter part of the URI matches the URI Template: employees/{id}. In other words, if a client accesses any of these URIs, the request will be serviced by the employees/{id} RESTful service previously discussed.

So, this service addresses the problem of identifying valid employee IDs by generating a resource that lists all valid employee resources. The key thing to realize here is that it does not do this by just listing the ID value by itself and expecting the client to be able to take the ID and combine it with prior knowledge of the $\texttt{employees/\{id}\}$ service to produce an employee URI; instead, it lists the URIs of each employee.

Because the list of valid employees may be large, the service also breaks the list into smaller pages, and again uses a URI to tell the client where to find the next page in the results.

To see at how this service is implemented, continue with the next steps.

9. Press the **Back** button in your browser to return to the GET handler definition.

Note the Source Type is <code>Query</code>, this is the default Source Type, and indicates that the resource can contain zero or more results. The Pagination Size is 7, which means that there will be seven items on each page of the results. Finally, the Source for the handler looks like this:

```
select empno "$uri", empno, ename from (
  select emp.*,
            row_number() over (order by empno) rn
            from emp
) tmp
where
  rn between :row_offset and :row_count
```

In this query:

- The first line states that you want to return three columns. The first column is
 the employee id: empno, but aliased to a column name of \$uri (to be explained
 later), the second column is again the employee ID, and the third column is the
 employee name, ename.
- Columns in result sets whose first character is \$ (dollar sign) are given special treatment. They are assumed to denote columns that must be transformed into URIs, and these are called Hyperlink Columns. Thus, naming columns with a leading \$ is a way to generate hyperlinks in resources.
 - When a Hyperlink Column is encountered, its value is prepended with the URI of the resource in which the column is being rendered, to produce a new URI. For example, recall that the URI of this service is https://server:port/ords/workspace/hr/employees/. If the value of empno in the first row produced by the this service's query is 7369, then the value of \$uri becomes: https://server:port/ords/workspace/hr/employees/7369.
- JSON does not have a URI data type, so a convention is needed to make it clear to clients that a particular value represents a URI. Oracle REST Data Services uses the JSON Reference proposal, which states that any JSON object containing a member named \$ref, and whose value is a string, is a URI. Thus, the column: \$uri and its value: https://server:port/ords/workspace/hr/employees/7369 is transformed to the following JSON object:



The inner query uses the row_number() analytical function to count the number of rows in the result set, and the outer WHERE clause constrains the result set to only return rows falling within the desired page of results.
 Oracle REST Data Services defines two implicit bind parameters, :row_offset and :row_count, that always contain the indicies of the first and last rows that should be returned in a given page's results.

For example, if the current page is the first page and the pagination size is 7, then the value of :row_offset will be 1 and the value of :row_count will be 7.

To see a simpler way to do both hyperlinks and paged results, continue with the following steps.

10. Click on the GET handler of the employeesfeed/ resource template.

Note that the Source Type of this handler is Feed and Pagination Size is 25.

11. Change the pagination size to 7, and click **Apply Changes**.

The Source of the handler is just the following:

```
select empno, ename from emp  \qquad \qquad \text{order by deptno, ename}
```

As you can see, the query is much simpler than the previous example; however, if you click **Test**, you will see a result that is very similar to the result produced by the previous example.

- The Feed Source Type is an enhanced version of the Query Source Type that
 automatically assumes the first column in a result set should be turned into a
 hyperlink, eliminating the need to alias columns with a name starting with \$. In
 this example, the empno column is automatically transformed into a hyperlink
 by the Feed Source Type.
- This example demonstrates the ability of Oracle REST Data Services to automatically paginate result sets if a Pagination Size of greater than zero is defined, and the query does not explicitly dereference the :row_offset or :row_count bind parameters. Because both these conditions hold true for this example, Oracle REST Data Services enhances the query, wrapping it in clauses to count and constrain the number and offset of rows returned. Note that this ability to automatically paginate results also applies to the Query Source Type.

```
See Also:
json_ref
```

Configuring Secure Access to RESTful Services

This section describes how to configure secure access to RESTful Services



RESTful APIs consist of resources, each resource having a unique URI. A set of resources can be protected by a privilege. A privilege defines the set of roles, at least one of which an authenticated user must possess to access a resource protected by a privilege.

Configuring a resource to be protected by a particular privilege requires creating a privilege mapping. A privilege mapping defines a set of patterns that identifies the resources that a privilege protects.

Topics:

- Authentication
- About Privileges for Accessing Resources
- About Users and Roles for Accessing Resources
- About the File-Based User Repository
- Tutorial: Protecting and Accessing Resources

Authentication

Users can be authenticated through first party cookie-based authentication or third party OAuth 2.0-based authentication

Topics:

- First Party Cookie-Based Authentication
- · Third Party OAuth 2.0-Based Authentication

First Party Cookie-Based Authentication

A first party is the author of a RESTful API. A first party application is a web application deployed on the same web origin as the RESTful API. A first party application is able to authenticate and authorize itself to the RESTful API using the same cookie session that the web application is using. The first party application has full access to the RESTful API.

Third Party OAuth 2.0-Based Authentication

A third party is any party other than the author of a RESTful API. A third party application cannot be trusted in the same way as a first party application; therefore, there must be a mediated means to selectively grant the third party application limited access to the RESTful API.

The OAuth 2.0 protocol defines flows to provide conditional and limited access to a RESTful API. In short, the third party application must first be registered with the first party, and then the first party (or an end user of the first party RESTful service) approves the third party application for limited access to the RESTful API, by issuing the third party application a short-lived access token.



ietf_rfc6749



Two-Legged and Three-Legged OAuth Flows

Some flows in OAuth are defined as two-legged and others as three-legged.

Two-legged OAuth flows involve two parties: the party calling the RESTful API (the third party application), and the party providing the RESTful API. Two-legged flows are used in server to server interactions where an end user does not need to approve access to the RESTful API. In OAuth 2.0 this flow is called the client credentials flow. It is most typically used in business to business scenarios.

Three-legged OAuth flows involve three parties: the party calling the RESTful API, the party providing the RESTful API, and an end user party that owns or manages the data to which the RESTful API provides access. Three-legged flows are used in client to server interactions where an end user must approve access to the RESTful API. In OAuth 2.0 the authorization code flow and the implicit flow are three-legged flows. These flows are typically used in business to consumer scenarios.

For resources protected by three-legged flows, when an OAuth client is registering with a RESTful API, it can safely indicate the protected resources that it requires access to, and the end user has the final approval decision about whether to grant the client access. However for resources protected by two-legged flows, the owner of the RESTful API must approve which resources each client is authorized to access.

About Privileges for Accessing Resources

A privilege for accessing resources consists of the following data:

- Name: The unique identifier for the Privilege. This value is required.
- Label: The name of the privilege presented to an end user when the user is being asked to approve access to a privilege when using OAuth. This value is required if the privilege is used with a three-legged OAuth flow.
- Description: A description of the purpose of the privilege. It is also presented to the
 end user when the user is being asked to approve access to a privilege. This value
 is required if the privilege is used with a three-legged OAuth flow.
- Roles: A set of role names associated with the privilege. An authenticated party
 must have at least one of the specified roles in order to be authorised to access
 resources protected by the privilege. A value is required, although it may be an
 empty set, which indicates that a user must be authenticated but that no specific
 role is required to access the privilege.

For two-legged OAuth flows, the third party application (called a *client* in OAuth terminology) must possess at least one of the required roles.

For three-legged OAuth flows, the end user that approves the access request from the third party application must possess at least one of the required roles.

Related Topics

Two-Legged and Three-Legged OAuth Flows

About Users and Roles for Accessing Resources

A privilege enumerates a set of roles, and users can possess roles. but where are these Roles defined? What about the users that possess these roles? Where are they defined?



A privilege enumerates a set of roles, and users can possess roles. Oracle REST Data Services delegates the task of user management to the application server on which Oracle REST Data Services is deployed. Oracle REST Data Services is able to authenticate users defined and managed by the application server and to identify the roles and groups to which the authenticated user belongs. It is the responsibility of the party deploying Oracle REST Data Services on an application server to also configure the user repository on the application server.

Because an application server can be configured in many ways to define a user repository or integrate with an existing user repository, this document cannot describe how to configure a user repository in an application server. See the application server documentation for detailed information.

About the File-Based User Repository

Oracle REST Data Services provides a a simple file-based user repository mechanism. However, this user repository is only intended for the purposes of demonstration and testing, and is not supported for production use.

See the command-line help for the user command for more information on how to create a user in this repository:

```
java -jar ords.war help user
```

Format:

java -jar ords.war user <user> <roles>

Arguments:

- <user> is the user ID of the user.
- <roles> is the list of roles (zero or more) that the user has.

Related Topics

Tutorial: Protecting and Accessing Resources

Tutorial: Protecting and Accessing Resources

This tutorial demonstrates creating a privilege to protect a set of resources, and accessing the protected resource with the following OAuth features:

- Client credentials
- Authorization code
- Implicit flow

It also demonstrates access the resource using first-party cookie-based authentication.

Topics:

- · OAuth Flows and When to Use Each
- Assumptions for This Tutorial
- Steps for This Tutorial



OAuth Flows and When to Use Each

This topic explains when to use various OAuth flow features.

Use *first party cookie-based authentication* when accessing a RESTful API from a web application hosted on the same origin as the RESTful API.

Use the *authorization code* flow when you need to permit third party web applications to access a RESTful API and the third party application has its own web server where it can keep its client credentials secure. This is the typical situation for most web applications, and it provides the most security and best user experience, because the third party application can use refresh tokens to extend the life of a user session without having to prompt the user to reauthorize the application.

Use the *implicit flow* when the third party application does not have a web server where it can keep its credentials secure. This flow is useful for third party single-page-based applications. Because refresh tokens cannot be issued in the Implicit flow, the user will be prompted more frequently to authorize the application.

Native mobile or desktop applications should use the authorization code or implicit flows. They will need to display the sign in and authorization prompts in a web browser view, and capture the access token from the web browser view at the end of the authorization process.

Use the *client credentials* flow when you need to give a third party application direct access to a RESTful API without requiring a user to approve access to the data managed by the RESTful API. The third party application must be a server-based application that can keep its credentials secret. The client credentials flow *must not* be used with a native application, because the client credentials can *always* be discovered in the native executable.

Assumptions for This Tutorial

This tutorial assumes the following:

- Oracle REST Data Services is deployed at the following URL: https://example.com/ords/
- A database schema named ORDSTEST has been enabled for use with Oracle REST Data Services, and its RESTful APIs are exposed under: https:// example.com/ords/ordstest/
- The ORDSTEST schema contains a database table named EMP, which was created as follows:

```
create table emp (
  empno    number(4,0),
  ename    varchar2(10 byte),
  job    varchar2(9 byte),
  mgr    number(4,0),
  hiredate date,
  sal    number(7,2),
  comm    number(7,2),
  deptno    number(2,0),
  constraint pk_emp primary key (empno)
);
```



 The resources to be protected are located under: https://example.com/ords/ ordstest/examples/employees/

Steps for This Tutorial

Follow these steps to protect and access a set of resources.

 Enable the schema. Connect to the ORDSTEST schema and execute the following PL/SQL statements;

```
begin
  ords.enable_schema;
  commit;
end;
```

2. Create a resource. Connect to the ORDSTEST schema and execute the following PL/SQL statements:

```
begin
ords.create_service(
    p_module_name => 'examples.employees' ,
    p_base_path => '/examples/employees/',
    p_pattern => '.' ,
    p_items_per_page => 7,
    p_source => 'select * from emp order by empno desc');
commit;
end;
```

The preceding code creates the <code>/examples/employees/</code> resource, which you will protect with a privilege in a later step.

You can verify the resource by executing following cURL command:

```
curl -i https://example.com/ords/ordstest/examples/employees/
```

The result should be similar to the following (edited for readability):

```
Content-Type: application/json
Transfer-Encoding: chunked
 "items":
"empno":7934,"ename":"MILLER","job":"CLERK","mgr":7782,"hiredate":"1982-01-2
3T00:00:00Z", "sal":1300, "comm":null, "deptno":10},
  ],
 "hasMore":true,
 "limit":7,
 "offset":0,
 "count":7,
 "links":
    {"rel": "self", "href": "https://example.com/ords/ordstest/examples/
employees/"},
    {"rel": "describedby", "href": "https://example.com/ords/ordstest/metadata-
catalog/examples/employees/"},
    {"rel":"first", "href": "https://example.com/ords/ordstest/examples/
employees/"},
    {"rel": "next", "href": "https://example.com/ords/ordstest/examples/
employees/?offset=7"}
```



```
]
```

3. Create a privilege. While connected to the ORDSTEST schema, execute the following PL/SQL statements:

```
begin
  ords.create_role('HR Administrator');

ords.create_privilege(
    p_name => 'example.employees',
    p_role_name => 'HR Administrator',
    p_label => 'Employee Data',
    p_description => 'Provide access to employee HR data');
  commit;
end;
```

The preceding code creates a role and a privilege, which belong to the ORDSTEST schema.

- The role name must be unique and must contain printable characters only.
- The privilege name must be unique and must conform to the syntax specified by the OAuth 2.0 specification, section 3.3 for scope names.
- Because you will want to use this privilege with the three-legged authorization code and implicit flows, you must provide a label and a description for the privilege. The label and description are presented to the end user during the approval phase of three-legged flows.
- The values should be plain text identifying the name and purpose of the privilege.

You can verify that the privilege was created correctly by querying the USER_ORDS_PRIVILEGES view.

```
select id,name from user_ords_privileges where name = 'example.employees';
```

The result should be similar to the following:

```
NAME

----
10260 example.employees
```

TD

The ID value will vary from database to database, but the NAME value should be as shown.

4. Associate the privilege with resources. While connected to the ORDSTEST schema, execute the following PL/SQL statements:

The preceding code associates the example.employees privilege with the resource pattern /examples/employees/.

You can verify that the privilege was created correctly by querying the USER ORDS PRIVILEGE MAPPINGS view.

```
select privilege_id, name, pattern from user_ords_privilege_mappings;
```

The result should be similar to the following:

The PRIVILEGE_ID value will vary from database to database, but the NAME and PATTERN values should be as shown.

You can confirm that the <code>/examples/employees/</code> resource is now protected by the <code>example.employees</code> privilege by executing the following cURL command:

```
curl -i https://example.com/ords/ordstest/examples/employees/
```

The result should be similar to the following (reformatted for readability):

```
HTTP/1.1 401 Unauthorized
Content-Type: text/html
Transfer-Encoding: chunked
<!DOCTYPE html>
<html>
...
</html>
```

You can confirm that the protected resource can be accessed through first party authentication, as follows.

a. Create an end user. Create a test user with the HR Administrator role, required to access the examples.employees privilege using the file-based user repository. Execute the following command at a command prompt

```
java -jar ords.war user "hr_admin" "HR Administrator"
```

When prompted for the password, enter and confirm it.

b. Sign in as the end user. Enter the following URL in a web browser:

```
https://example.com/ords/ordstest/examples/employees/
```

On the page indicating that access is denied, click the link to sign in.

Enter the credentials registered for the HR_ADMIN user, and click Sign In.

Confirm that the page redirects to https://example.com/ords/ordstest/examples/employees/ and that the JSON document is displayed.

5. Register the OAuth client. While connected to the ORDSTEST schema, execute the following PL/SQL statements:



The preceding code registers a client named Client Credentials Example, to access the examples.employees privilege using the client credentials OAuth flow.

You can verify that the client was registered and has requested access to the examples.employees privilege by executing the following SQL statement:

select client_id,client_secret from user_ords_clients where name = 'Client
Credentials Example';

The result should be similar to the following:

```
CLIENT_ID CLIENT_SECRET

O CZBVkEMN23tTB-IddQsQ.. 4BJXceufbmTki-vruYNLIq..
```

The CLIENT_ID and CLIENT_SECRET values represent the secret credentials for the OAuth client. These values must be noted and kept secure. You can think of them as the userid and password for the client application.

6. Grant the OAuth client a required role. While connected to the ORDSTEST schema, execute the following PL/SQL statements:

```
begin
  oauth.grant_client_role(
     'Client Credentials Example',
     'HR Administrator');
  commit;
end;
```

The preceding code registers a client named Client Credentials Example, to access the examples.employees privilege using the client credentials OAuth flow.

You can verify that the client was granted the role by executing the following SQL statement:

```
select * from user_ords_client_roles where client_name = 'Client Credentials
Example';
```

The result should be similar to the following:

```
CLIENT_ID CLIENT_NAME ROLE_ID ROLE_NAME

10286 Client Credentials Example 10222 HR Administrator
```

7. Obtain an OAuth access token using client credentials.

The OAuth protocol specifies the HTTP request that must be used to create an access token using the client credentials flow[rfc6749-4.4.].

The request must be made to a well known URL, called the token endpoint. For Oracle REST Data Services the path of the token endpoint is always oauth/token, relative to the root path of the schema being accessed. The token endpoint for this example is:

https://example.com/ords/ordstest/oauth/token

Execute the following cURL command:

```
curl -i --user clientId:clientSecret --data "grant_type=client_credentials"
https://example.com/ords/ordstest/oauth/token
```

In the preceding command, replace clientId with the CLIENT_ID value in USER_ORDS_CLIENTS for Client Credentials Example, and replace

clientSecret with the CLIENT_SECRET value shown in USER_ORDS_CLIENTS for Client Credentials Example. The output should be similar to the following:

```
HTTP/1.1 200 OK
Content-Type: application/json
{
    "access_token": "2YotnFZFEjrlzCsicMWpAA",
    "token_type": "bearer",
    "expires_in":3600
}
```

In the preceding output, the access token is of type bearer, and the value is specified by the access_token field. This value will be different for every request. The expires_in value indicates the number of seconds until the access token expires; in this case the token will expire in one hour (3600 seconds).

8. Access a protected resource using the access token. Execute the following cURL command:

```
curl -i -H"Authorization: Bearer accessToken" https://example.com/ords/
ordstest/examples/employees/
```

In the preceding command, replace accessToken with the value of the access_token field shown in the preceding step. The output should be similar to the following:

```
Content-Type: application/json
Transfer-Encoding: chunked
 "items":
{"empno":7934,"ename":"MILLER","job":"CLERK","mgr":7782,"hiredate":"1982-01-2
3T00:00:00Z", "sal":1300, "comm":null, "deptno":10},
  ],
 "hasMore":true,
 "limit":7,
 "offset":0,
 "count":7,
 "links":
    {"rel": "self", "href": "https://example.com/ords/ordstest/examples/
employees/"},
    {"rel":"describedby", "href": "https://example.com/ords/ordstest/metadata-
catalog/examples/employees/"},
    {"rel":"first", "href": "https://example.com/ords/ordstest/examples/
employees/"},
    {"rel":"next", "href": "https://example.com/ords/ordstest/examples/
employees/?offset=7"}
  ]
```

9. Register the client for authorization code. While connected to the ORDSTEST schema, execute the following PL/SQL statements:

```
begin
  oauth.create_client(
    p_name => 'Authorization Code Example',
    p_grant_type => 'authorization_code',
```



```
p_owner => 'Example Inc.',
    p_description => 'Sample for demonstrating Authorization Code Flow',
    p_redirect_uri => 'http://example.org/auth/code/example/',
    p_support_email => 'support@example.org',
    p_support_uri => 'http://example.org/support',
    p_privilege_names => 'example.employees'
    );
    commit;
end;
```

The preceding code registers a client named Authorization Code Example, to access the examples.employees privilege using the authorization code OAuth flow. For an actual application, a URI must be provided to redirect back to with the authorization code, and a valid support email address must be supplied; however, this example uses fictitious data and the sample example.org web service.

You can verify that the client is now registered and has requested access to the examples.employees privilege by executing the following SQL statement:

```
select id, client_id, client_secret from user_ords_clients where name =
'Authorization Code Example';
```

The result should be similar to the following:

```
ID CLIENT_ID CLIENT_SECRET

10060 IGHso4BRgrBC3Jwg0Vx_YQ.. GefAsWv8FJdMSB30Eg61Kw..
```

To grant access to the privilege, an end user must approve access. The CLIENT_ID and CLIENT_SECRET values represent the secret credentials for the OAuth client. These values must be noted and kept secure. You can think of them as the userid and password for the client application.

- 10. Obtain an OAuth access token using an authorization code. This major step involves several substeps. (You must have already created the HR_ADMIN end user in a previous step.)
 - a. Obtain an OAuth authorization code.

The end user must be prompted (via a web page) to sign in and approve access to the third party application. The third party application initiates this process by directing the user to the OAuth Authorization Endpoint. For Oracle REST Data Services, the path of the authorization endpoint is always <code>oauth/auth</code>, relative to the root path of the schema being accessed. The token endpoint for this example is:

```
https://example.com/ords/ordstest/oauth/auth
```

The OAuth 2.0 protocol specifies that the Authorization request URI must include certain parameters in the query string:

The response_type parameter must have a value of code.

The client_id parameter must contain the value of the applications client identifier. This is the client_id value determined in a previous step.

The state parameter must contain a unique unguessable value. This value serves two purposes: it provides a way for the client application to uniquely identify each authorization request (and therefore associate any application specific state with the value; think of the value as the application's own session identifier); and it provides a means for the client application to protect



against Cross Site Request Forgery (CSRF) attacks. The state value will be returned in the redirect URI at the end of the authorization process. The client must confirm that the value belongs to an authorization request initiated by the application. If the client cannot validate the state value, then it should assume that the authorization request was initiated by an attacker and ignore the redirect.

To initiate the Authorization request enter the following URL in a web browser:

```
https://example.com/ords/ordstest/oauth/auth?
response_type=code&client_id=cliendId&state=uniqueRandomValue
```

In the preceding URI, replace clientId with the value of the CLIENT_ID column that was noted previously, and replace uniqueRandromValue with a unique unguessable value. The client application must remember this value and verify it against the state parameter returned as part of the redirect at the end of the authorization flow.

If the client_id is recognized, then a sign in prompt is displayed. Enter the credentials of the HR_ADMIN end user, and click Sign In; and on the next page click Approve to cause a redirect to redirect URI specified when the client was registered. The redirect URI will include the authorization code in the query string portion of the URI. It will also include the same state parameter value that the client provided at the start of the flow. The redirect URI will look like the following:

```
http://example.org/auth/code/example/?code=D5doeTSIDgbxWiWkP19UpA..&state=uniqueRandomValue
```

The client application must verify the value of the state parameter and then note the value of the code parameter, which will be used in to obtain an access token.

b. Obtain an OAuth access token.

After the third party application has an authorization code, it must exchange it for an access token. The third party application's server must make a HTTPS request to the Token Endpoint. You can mimic the server making this request by using a cURL command as in the following example:

```
curl --user clientId:clientSecret --data
"grant_type=authorization_code&code=authorizationCode" https://
example.com/ords/ordstest/oauth/token
```

In the preceding command, replace clientId with the value of the CLIENT_ID shown in USER_ORDS_CLIENTS for Authorization Code Example, replace clientSecret with the value of the CLIENT_SECRET shown in USER_ORDS_CLIENTS for Authorization Code Example, and replace authorizationCode with the value of the authorization code noted in a previous step (the value of the code parameter).

The result should be similar to the following:

```
HTTP/1.1 200 OK
Content-Type: application/json
{
    "access_token": "psIGSSEXSBQyib0hozNEdw..",
    "token_type": "bearer",
    "expires_in":3600,
```



```
"refresh_token": "aRMg7AdWPuDvnieHucfV3g.."
}
```

In the preceding result, the access token is specified by the access_token field, and a refresh token is specified by the refresh_token field. This refresh token value can be used to extend the user session without requiring the user to reauthorize the third party application.

c. Access a protected resource using the access token.

After the third party application has obtained an OAuth access token, it can use that access token to access the protected <code>/examples/employees/resource</code>:

```
curl -i -H"Authorization: Bearer accessToken" https://example.com/ords/
ordstest/examples/employees/
```

In the preceding command, accessToken with the value of the access_token field shown in a previous step.

The result should be similar to the following:

```
Content-Type: application/json
Transfer-Encoding: chunked
 "items":
   [
{"empno":7934,"ename":"MILLER","job":"CLERK","mgr":7782,"hiredate":"1982-
01-23T00:00:00Z", "sal":1300, "comm":null, "deptno":10},
   ],
 "hasMore":true,
 "limit":7,
 "offset":0,
 "count":7,
 "links":
    {"rel": "self", "href": "https://example.com/ords/ordstest/examples/
employees/"},
    {"rel":"describedby","href":"https://example.com/ords/ordstest/
metadata-catalog/examples/employees/" } ,
    {"rel":"first","href":"https://example.com/ords/ordstest/examples/
employees/"},
    {"rel": "next", "href": "https://example.com/ords/ordstest/examples/
employees/?offset=7"}
   ]
}
```

d. Extend the session using a refresh token.

At any time, the third party application can use the refresh token value to generate a new access token with a new lifetime. This enables the third party application to extend the user session at will. To do this, the third party application's server must make an HTTPS request to the Token Endpoint. You can mimic the server making this request by using a cURL command as in the following example:

```
curl --user clientId:clientSecret --data
"grant_type=refresh_token&refresh_token=refreshToken" https://
example.com/ords/ordstest/oauth/token
```



In the preceding command, replace clientId with the value of the CLIENT_ID shown in USER_ORDS_CLIENTS for Client Credentials Client, replace clientSecret with the value of the CLIENT_SECRET shown in USER_ORDS_CLIENTS for Client Credentials Client, and replace refreshToken with the value of refresh token obtained in a previous step.

The result should be similar to the following:

```
HTTP/1.1 200 OK
Content-Type: application/json

{
    "access_token": "psIGSSEXSBQyib0hozNEdw..",
    "token_type": "bearer",
    "refresh_token": "aRMg7AdWPuDvnieHucfV3g..",
    "expires_in": 3600
}
```

In the preceding result, the access token is specified by the access_token field, a new refresh token is specified by the refresh_token field. This refresh token value can be used to extend the user session without requiring the user to reauthorize the third party application. (Note that the previous access token and refresh token are now invalid; the new values must be used instead.)

11. Register the client for implicit flow. While connected to the ORDSTEST schema, execute the following PL/SQL statements:

```
begin
  oauth.create_client(
    p_name => 'Implicit Example',
    p_grant_type => 'implicit',
    p_owner => 'Example Inc.',
    p_description => 'Sample for demonstrating Implicit Flow',
    p_redirect_uri => 'http://example.org/implicit/example/',
    p_support_email => 'support@example.org',
    p_support_uri => 'http://example.org/support',
    p_privilege_names => 'example.employees'
    );
    commit;
end;
```

The preceding code registers a client named Implicit Example to access the examples.employees privilege using the implicit OAuth flow. For an actual application, a URI must be provided to redirect back to with the authorization code, and a valid support email address must be supplied; however, this example uses fictitious data and the sample example.org web service.

You can verify that the client is now registered and has requested access to the examples.employees privilege by executing the following SQL statement:

```
select id, client_id, client_secret from user_ords_clients where name =
'Implicit Example';
```

The result should be similar to the following:

To grant access to the privilege, an end user must approve access.



12. Obtain an OAuth access token using implicit flow. (You must have already created the HR_ADMIN end user in a previous step.)

The end user must be prompted (via a web page) to sign in and approve access to the third party application. The third party application initiates this process by directing the user to the OAuth Authorization Endpoint. For Oracle REST Data Services, the path of the authorization endpoint is always <code>oauth/auth</code>, relative to the root path of the schema being accessed. The token endpoint for this example is:

https://example.com/ords/ordstest/oauth/auth

The OAuth 2.0 protocol specifies that the Authorization request URI must include certain parameters in the query string:

The response_type parameter must have a value of token.

The client_id parameter must contain the value of the applications client identifier. This is the client id value determined in a previous step.

The state parameter must contain a unique unguessable value. This value serves two purposes: it provides a way for the client application to uniquely identify each authorization request (and therefore associate any application specific state with the value; think of the value as the application's own session identifier); and it provides a means for the client application to protect against Cross Site Request Forgery (CSRF) attacks. The state value will be returned in the redirect URI at the end of the authorization process. The client must confirm that the value belongs to an authorization request initiated by the application. If the client cannot validate the state value, then it should assume that the authorization request was initiated by an attacker and ignore the redirect.

To initiate the Authorization request enter the following URL in a web browser:

```
https://example.com/ords/ordstest/oauth/auth?response_type=token&client_id=cliendId&state=uniqueRandomValue
```

In the preceding URI, replace clientId with the value of the CLIENT_ID column that was noted previously, and replace uniqueRandromValue with a unique unguessable value. The client application must remember this value and verify it against the state parameter returned as part of the redirect at the end of the authorization flow.

If the client_id is recognized, then a sign in prompt is displayed. Enter the credentials of the HR_ADMIN end user, and click Sign In; and on the next page click Approve to cause a redirect to redirect URI specified when the client was registered. The redirect URI will include the access token in the query string portion of the URI. It will also include the same state parameter value that the client provided at the start of the flow. The redirect URI will look like the following:

```
http://example.org/auth/code/example/
#access_token=D5doeTSIDgbxWiWkPl9UpA..&type=bearer&expires_in=3600&state=uniq
ueRandomValue
```

The client application must verify the value of the state parameter and then note the value of the access token.

13. Access a protected resource using an access token. Execute the following cURL command:

```
curl -i -H "Authorization: Bearer accessToken" https://example.com/ords/
ordstest/examples/employees/
```



In the preceding command, replace <code>accessToken</code> with the value of the <code>access_token</code> field shown in the preceding step. The output should be similar to the following:

```
Content-Type: application/json
Transfer-Encoding: chunked
 "items":
   [
{"empno":7934,"ename":"MILLER","job":"CLERK","mgr":7782,"hiredate":"1982-01-2
3T00:00:00Z", "sal":1300, "comm":null, "deptno":10},
  ],
 "hasMore":true,
 "limit":7,
 "offset":0,
 "count":7,
 "links":
    {"rel": "self", "href": "https://example.com/ords/ordstest/examples/
employees/"},
    {"rel":"describedby","href":"https://example.com/ords/ordstest/metadata-
catalog/examples/employees/"},
    {"rel":"first","href":"https://example.com/ords/ordstest/examples/
employees/"},
    {"rel": "next", "href": "https://example.com/ords/ordstest/examples/
employees/?offset=7"}
   ]
```

Related Topics

Using the Oracle REST Data Services PL/SQL API

About Oracle REST Data Services User Roles

Oracle REST Data Services defines a small number of predefined user roles:

- RESTful Services This is the default role associated with a protected RESTful service.
- OAuth2 Client Developer Users who want to register OAuth 2.0 applications must have this role.
- oracle.dbtools.autorest.any.schema Users who want to access all AutoREST services.
- SQL Developer Users who want to use Oracle SQL Developer to develop RESTful services must have this role.
- SODA Developer This is the default role that is required to access the SODA REST API. For more information about this role, see Oracle REST Data Services SODA for REST Developer's Guide.
- Listener Administrator Users who want to administrate an Oracle REST Data Services instance through Oracle SQL Developer must have this role. Typically, only users created through the java -jar ords.war user command will have this role.



Because the Listener Administrator role enables a user to configure an Oracle REST Data Services instance, and therefore has the capability to affect all Application Express workspaces served through that instance, Application Express users are not permitted to acquire the Listener Administrator role.

Topics:

- About Oracle Application Express Users and Oracle REST Data Services Roles
- Controlling RESTful Service Access with Roles

About Oracle Application Express Users and Oracle REST Data Services Roles

By default, Oracle Application Express users do not have any of the Oracle REST Data Services predefined user roles. This means that, by default, Application Express users cannot:

- Invoke protected RESTful Services
- Register OAuth 2.0 applications
- Use Oracle SQL Developer to develop RESTful services.

This applies to all Application Express users, including Application Express developers and administrators. It is therefore important to remember to follow the steps below to add Application Express users to the appropriate user groups, so that they can successfully perform the above actions.

Topics:

- Granting Application Express Users Oracle REST Data Services Roles
- Automatically Granting Application Express Users Oracle REST Data Services Roles

Granting Application Express Users Oracle REST Data Services Roles

To give an Application Express User any of the roles above, the user must be added to the equivalent Application Express user group. For example, to give the RESTEASY_ADMIN user the RESTful Services role, follow these steps:

- Log in to the RESTEASY workspace as a RESTEASY_ADMIN.
- Navigate to Administration and then Manage Users and Groups.
- Click the Edit icon to the left of the RESTEASY_ADMIN user.
- 4. For User Groups, select RESTful Services.
- 5. Click Apply Changes.

Automatically Granting Application Express Users Oracle REST Data Services Roles

Adding Application Express users to the appropriate user groups can be an easily overlooked step, or can become a repetitive task if there are many users to be managed.



To address these issues, you can configure Oracle REST Data Services to automatically grant Application Express users a predefined set of RESTful Service roles by modifying the defaults.xml configuration file.

In that file, Oracle REST Data Services defines three property settings to configure roles:

- apex.security.user.roles A comma separated list of roles to grant ordinary users, that is, users who are not developers or administrators.
- apex.security.developer.roles A comma separated list of roles to grant users
 who have the Developer account privilege. Developers also inherit any roles
 defined by the apex.security.user.roles setting.
- apex.security.administrator.roles A comma separated list of roles to grant users who have the Administrator account privilege. Administrators also inherit any roles defined by the apex.security.user.roles and apex.security.developer.roles Settings.

For example, to automatically give all users the RESTful Services privilege and all developers and administrators the OAuth2 Client Developer and SQL Developer roles, add the following to the defaults.xml configuration file:

Oracle REST Data Services must be restarted after you make any changes to the defaults.xml configuration file.

Controlling RESTful Service Access with Roles

The built-in RESTful Service role is a useful default for identifying users permitted to access protected RESTful services.

However, it will often also be necessary to define finer-grained roles to limit the set of users who may access a specific RESTful service.

Topics:

- About Defining RESTful Service Roles
- Associating Roles with RESTful Privileges

About Defining RESTful Service Roles

A RESTful Service **role** is an Application Express user group. To create a user group to control access to the Gallery RESTful Service, follow these steps. (

- 1. Log in to the RESTEASY workspace as a workspace administrator.
- 2. Navigate to Administration and then Manage Users and Groups.
- 3. Click the Groups tab.



- 4. Click Create User Group.
- 5. For Name, enter Gallery Users.
- Click Create Group.

Associating Roles with RESTful Privileges

After a user group has been created, it can be associated with a RESTful privilege. To associate the Gallery Users role with the <code>example.gallery</code> privilege, follow these steps.

- 1. Navigate to SQL Workshop and then RESTful Services.
- In the Tasks section, click RESTful Service Privileges.
- Click Gallery Access.
- 4. For Assigned Groups, select Gallery Users.
- 5. Click Apply Changes.

With these changes, users must have the Gallery Users role to be able to access the Gallery RESTful service.



The steps here use the image gallery application in Creating an Image Gallery as an example.

Authenticating Against WebLogic Server User Repositories

Oracle REST Data Services can use APIs provided by WebLogic Server to verify credentials (username and password) and to retrieve the set of groups and roles that the user is a member of.

This section walks through creating a user in the built-in user repositories provided by WebLogic Server, and verifying the ability to authenticate against that user.

This document does not describe how to integrate WebLogic Server with the many popular user repository systems such as LDAP repositories, but Oracle REST Data Services can authenticate against such repositories after WebLogic Server has been correctly configured. See your application server documentation for more information on what user repositories are supported by the application server and how to configure access to these repositories.

Topics:

Authenticating Against WebLogic Server

Authenticating Against WebLogic Server

Authenticating a user against WebLogic Server involves the following major steps:

- Creating a WebLogic Server User
- Verifying the WebLogic Server User



Creating a WebLogic Server User

To create a sample WebLogic Server user, follow these steps:

- 1. Start WebLogic Server if it is not already running
- 2. Access the WebLogic Server Administration Console (typically http://server:7001/console), enter your credentials.
- 3. In the navigation tree on the left, click the **Security Realms** node
- 4. If a security realm already exists, go to the next step. If a security realm does not exist, create one as follows:
 - a. Click New.
 - **b.** For **Name**, enter Test-Realm, then click **OK**.
 - c. Click Test-Realm.
 - d. Click the Providers tab.
 - e. Click New, and enter the following information:

Name: test-authenticator

Type: DefaultAuthenticator

- f. Restart WebLogic Server if you are warned that a restart is necessary.
- g. Click Test-Realm.
- 5. Click the Users and Groups tab.
- **6.** Click **New**, and enter the following information:
 - Name: 3rdparty_dev2
 - Password: Enter and confirm the desired password for this user.
- 7. Click OK.
- 8. Click the **Groups** tab.
- Click New., and enter the following information:
 - Name: OAuth2 Client Developer (case sensitive)
- 10. Click OK.
- 11. Click the Users tab.
- 12. Click the 3rdparty_dev2 user.
- **13.** Click the **Groups** tab.
- 14. In the Chosen list, add OAuth2 Client Developer.
- 15. Click Save.

You have created a user named 3rdparty_dev2 and made it a member of a group named OAuth2 Client Developer. This means the user will acquire the OAuth2 Client Developer role, and therefore will be authorized to register OAuth 2.0 applications.

Now verify that the user can be successfully authenticated.



Verifying the WebLogic Server User

To verify that the WebLogic Server user created can be successfully authenticated, follow these steps:

1. In your browser, go to a URI in the following format: https://server:port/ords/resteasy/ui/oauth2/clients/

2. Enter the credentials of the 3rdparty dev2 user, and click Sign In.

The OAuth 2.0 Client Registration page should be displayed, with no applications listed. If this page is displayed, you have verified that authentication against the WebLogic Server user repository is working.

However, if the sign-on prompt is displayed again with the message User is not authorized to access resource, then you made mistake (probably misspelling the Group List value).

Integrating with Existing Group/Role Models

The examples in other sections demonstrate configuring the built-in user repositories of WebLogic Server. In these situations you have full control over how user groups are named. If a user is a member of a group with the exact same (case sensitive) name as a role, then the user is considered to have that role.

However, when integrating with existing user repositories, RESTful service developers will often not have any control over the naming and organization of user groups in the user repository. In these situations a mechanism is needed to map from existing "physical" user groups defined in the user repository to the "logical" roles defined by Oracle REST Data Services and/or RESTful Services.

In Oracle REST Data Services, this group to role mapping is performed by configuring a configuration file named role-mapping.xml.

Topics:

About role-mapping.xml

About role-mapping.xml

role-mapping.xml is a Java XML Properties file where each property key defines a pattern that matches against a set of user groups, and each property value identifies the roles that the matched user group should be mapped to. It must be located in the same folder as the defaults.xml configuration file. The file must be manually created and edited.

Consider this example:



This role mapping is straightforward, stating that any user who is a member of a group named: webdevs is given the role RESTful Services, meaning that all members of the webdevs group can invoke RESTful Services.

A mapping can apply more than one role to a group. For example:

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE properties SYSTEM "http://java.sun.com/dtd/properties.dtd">
centry key="webdevs">RESTful Services, SQL Developer</entry>
```

This rule gives members of the webdevs group both the RESTful Services and SQL Developer roles.

Topics:

- · Parameterizing Mapping Rules
- Dereferencing Parameters
- Indirect Mappings

Parameterizing Mapping Rules

Having to explicitly map from each group to each role may not be scalable if the number of groups or roles is large. To address this concern, you can parameterize rules. Consider this example:

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE properties SYSTEM "http://java.sun.com/dtd/properties.dtd">
<entry key="{prefix}.webdevs">RESTful Services</entry>
</properties>
```

This example says that any group name that ends with .webdevs will be mapped to the RESTful Services role. For example, a group named: HQ.webdevs would match this rule, as would a group named: EAST.webdevs.

The syntax for specifying parameters in rules is the same as that used for URI Templates; the parameter name is delimited by curly braces ({}).

Dereferencing Parameters

Any parameter defined in the group rule can also be dereferenced in the role rule. Consider this example:

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE properties SYSTEM "http://java.sun.com/dtd/properties.dtd">
centry key="cn={userid},ou={group},dc=MyDomain,dc=com">{group}
```

This example maps the organizational unit component of an LDAP distinguished name to a role. It says that the organizational unit name maps directly to a role with same name. Note that it refers to a $\{userid\}$ parameter but never actually uses it; in effect, it uses $\{userid\}$ as a wildcard flag.



For example, the distinguished name cn=jsmith,ou=Developers,dc=MyDomain,dc=com will be mapped to the logical role named Developers.

Indirect Mappings

To accomplish the desired role mapping, it may sometimes be necessary to apply multiple intermediate rules. Consider this example:

This example maps the organizational unit component of an LDAP distinguished name to some roles. Complicating matters is the fact that users can come from two different organizations, resulting in differing distinguishing name patterns.

- Users from example.com always have a single common name (CN) identifying their user id, followed by the organizational unit (OU) and the domain name (DC). For example: cn=jsmith,ou=Developers,dc=example,dc=com.
- Users from acquired.com have varying numbers of common name (CN) prefixes, but the organizational unit is the field you are interested in. For example: cn=ProductDev,cn=abell,ou=Engineering,dc=acquired,dc=com.
- Both organizations identify software engineers with ou=Developers.

You want to map engineers in both organizations to the $\mathtt{RESTful}$ Services and \mathtt{SQL} Developer roles.

- The first rule maps engineers in the example.com organization to the intermediate Developers role.
- The second rule maps engineers in the acquired.com organization to the intermediate Developers role.
- The final rule maps from the intermediate Developers role to the RESTful Services and SQL Developer roles.

Integrating Oracle REST Data Services and WebLogic Server

Oracle REST Data Services (ORDS) recommends that for complex or enterprise user identity integrations, customers can leverage the capabilities of WebLogic server. WebLogic server has a rich and diverse set of capabilities to integrate with existing enterprise identity solutions. When Oracle REST Data Services is deployed on the WebLogic server, it can leverage the capabilities of WebLogic server to get secure access to ORDS based RESTful Services.

Once ORDS is configured to work with WebLogic server, the WebLogic server can provide the authenticated user identity and roles. Based on the memberships of the user role, ORDS authorizes access to the protected RESTful Services.



Configuring ORDS to Integrate with WebLogic Server

This section explains how to configure ORDS to work with WebLogic server.

To configure ORDS to work with WebLogic server, run the following command to prepare the ords.war file to integrate with WebLogic server:

```
java -jar ords.war oam-config
Run the following command to get help on the oam-config command:
```

java -jar ords.war help oam-config

Using the oam-config Command

The oam-config command re-configures the web.xml deployment descriptor in the ords.war file that helps the WebLogic server to pass any established user identity to ORDS.

After executing the preceding command, the ords.war file must be re-deployed to the WebLogic server.

Determining the Identity and Roles of the User

ORDS uses APIs provided by WebLogic server to retrieve the WLSUser and WLSGroup for the established user identity.

ORDS treats the WLSGroup to be equivalent to the role that the user possesses. For example, if a user or users belongs to a WLSGroup named "Sales Assistant", then ORDS considers such user to have a role named "Sales Assistant".

Retrieving the Authenticated User Information

The user visits the single sign-on login form and obtains a cookie or an access token that asserts the identity and roles. The cookie or the token is then passed to the WebLogic server. The WebLogic server is configured to validate the cookie or token and then map it to a specific user to determine what roles the user possesses. The WebLogic Server performs this operation before passing the request to ORDS. Once ORDS receives the request, it calls the APIs provided by WebLogic server to retrieve the WLSUser and WLSGroup to retrieve the information of the user identity and roles from the WebLogic server.

Related Topics

- Oracle WebLogic APIs
- API to retrieve the WLSUser
- API to retrieve the WLSGroup

Using the Oracle REST Data Services PL/SQL API

Oracle REST Data Services has a PL/SQL API (application programming interface) that you can use as an alternative to the SQL Developer graphical interface for many operations. The available subprograms are included in the following PL/SQL packages:

 Oracle REST Data Services, documented in Oracle REST Data Services PL/SQL Package Reference OAUTH, documented in OAUTH PL/SQL Package Reference

To use the Oracle REST Data Services PL/SQL API, you must first:

- Install Oracle REST Data Services in the database that you will use to develop RESTful services.
- Enable one or more database schemas for REST access.

Topics:

- Creating a RESTful Service Using the PL/SQL API
- Testing the RESTful Service

Related Topics

Automatic Enabling of Schema Objects for REST Access (AutoREST)

Creating a RESTful Service Using the PL/SQL API

You can create a RESTful service by connecting to a REST-enabled schema and using the ORDS.CREATE SERVICE procedure.

The following example creates a simple "Hello-World"-type service:

```
begin
  ords.create_service(
        p_module_name => 'examples.routes' ,
        p_base_path => '/examples/routes/',
        p_pattern => 'greeting/:name',
        p_source => 'select ''Hello '' || :name || '' from '' ||
nvl(:whom,sys_context(''USERENV'',''CURRENT_USER'')) "greeting" from dual');
    commit;
end;
//
```

The preceding example does the following:

- Creates a resource module named examples.routes.
- Sets the base path (also known as the URI prefix) of the module to /examples/ routes/.
- Creates a resource template in the module, with the route pattern greeting/:name.
- Creates a GET handler and sets its source as a SQL query that forms a short greeting:
 - GET is the default value for the p_method parameter, and it is used here because that parameter was omitted in this example.
 - COLLECTION_FEED is the default value for the p_method parameter, and it is used here because that parameter was omitted in this example
- An optional parameter named whom is specified.

Related Topics

ORDS.CREATE SERVICE



Testing the RESTful Service

To test the RESTful service that you created, start Oracle REST Data Services if it is not already started:

```
java -jar ords.war
```

Enter the URI of the service in a browser. The following example displays a "Hello" greeting to Joe, by default from the current user because no whom parameter is specified.:

http://localhost:8080/ords/ordstest/examples/routes/greeting/Joe

In this example:

- Oracle REST Data Services is running on localhost and listening on port 8080.
- Oracle REST Data Services is deployed at the context-path /ords.
- The RESTful service was created by a database schema named ordstest.
- Because the URL does not include the optional whom parameter, the :whom bind
 parameter is bound to the null value, which causes the query to use the value
 of the current database user (sys_context(''USERENV'', ''CURRENT_USER''))
 instead.

If you have a JSON viewing extension installed in your browser, you will see a result like the following:

```
"items": [
  {
   "greeting": "Hello Joe from ORDSTEST"
 ],
 "hasMore": false,
 "limit": 25,
 "offset": 0,
 "count": 1,
 "links": [
   "rel": "self",
   "href": "http://localhost:8080/ords/ordstest/examples/routes/greeting/"
   "rel": "describedby",
   "href": "http://localhost:8080/ords/ordstest/metadata-catalog/examples/routes/
greeting/"
  },
   "rel": "first",
   "href": "http://localhost:8080/ords/ordstest/examples/routes/greeting/Joe"
 ]
}
```

The next example is like the preceding one, except the optional parameter whom is specified to indicate that the greeting is from Jane.

http://localhost:8080/ords/ordstest/examples/routes/greeting/Joe?whom=Jane



This time, the result will look like the following:

```
"items": [
   "greeting": "Hello Joe from Jane"
 ],
 "hasMore": false,
 "limit": 25,
 "offset": 0,
 "count": 1,
 "links": [
   "rel": "self",
   "href": "http://localhost:8080/ords/ordstest/examples/routes/greeting/"
   "rel": "describedby",
   "href": "http://localhost:8080/ords/ordstest/metadata-catalog/examples/routes/
greeting/"
   "rel": "first",
  "href": "http://localhost:8080/ords/ordstest/examples/routes/greeting/Joe"
 ]
}
```

Notice that in this result, what follows "from" is Jane and not ORDSTEST, because the :whom bind parameter was bound to the Jane value.

Oracle REST Data Services Database Authentication

This section describes how to use the database authentication feature to provide basic authentication for PL/SQL gateway calls.

Database authentication feature is similar to dynamic basic authentication provided by mod-plsql where the user is prompted for the database credentials to authenticate and authorize access to PL/SQL stored procedures.

Installing Sample Database Scripts

This section describes how to install the sample database scripts.

The unzipped Oracle REST Data Services installation kit contains the sample database scripts that create a basic demo scenario for the database authentication.

The following code snippet shows how to install the sample database schema:

```
db_auth $ cd sql/
sql $ sql sys as sysdba

SQLcl: Release Release 18.1.1 Production on Fri Mar 23 14:03:18 2018
Copyright (c) 1982, 2018, Oracle. All rights reserved.
Password? (***********) ******
```



Connected to:

Oracle Database 12c Enterprise Edition Release 12.2.0.1.0 - 64bit Production

SQL> @install <chosen-password>



- You need to adjust the SQLcl connect string and the user credentials to suit your environment. For this demo scenario, SQLcl connects to the database with service name orcl
- chosen-password> is the password you assigned to EXAMPLE_USER1 and EXAMPLE_USER2 database users. Make a note of this password value for later reference.

The sample database schema creates the following database users:

- SAMPLE_PLSQL_APP: A database schema where the protected SAMPLE_PROC will be installed.
- **EXAMPLE_USER1**: A database user granted with execute privilege on SAMPLE_PLSQL_APP.SAMPLE_PROC procedure.
- EXAMPLE_USER2: A second database user granted with execute privilege on SAMPLE PLSQL APP.SAMPLE PROC procedure.

Enabling the Database Authentication

This section describes how to enable the database authentication feature.

To enable the database authentication feature, do one of the following:

• For fresh installation of Oracle REST Data Services, update the /u01/ords/params/ords_params properties file with the following entry:

```
jdbc.auth.enabled=true
```

For existing Oracle REST Data Services installation, run the following commands:

```
cd /u01/ords \ $JAVA_HOME/bin/java -jar ords.war set-property jdbc.auth.enabled true
```

This setting is applicable to PL/SQL gateway pools (for example, apex.xml), it does not apply to other pool types such as the <code>ORDS_PUBLIC_USER</code> pool (for example, $apex_pu.xml$).



Note:

The jdbc.auth.enabled setting can be configured per database pool. Alternatively, it can be configured in defaults.xml file so that it is enabled for all pools.

Example 5-11 Setting Enabled for all Pools

This example code snippet shows how jdbc.auth.enabled setting is enabled for all pools.

```
ords $ java -jar ords.war set-property jdbc.auth.enabled true
Mar 23, 2018 2:23:49 PM oracle.dbtools.rt.config.setup.SetProperty
execute
INFO: Modified: /tmp/cd/ords/defaults.xml, setting: jdbc.auth.enabled =
true
```

After you update the configuration settings, restart the Oracle REST Data Services for the changes to take effect.

Configuring the Request Validation Function

This section describes how to temporarily disable the request validation function.

If you want to invoke only a whitelisted set of stored procedures in the database through the PL/SQL gateway, then you must configure Oracle REST Data Services to use a request validation function (especially when you are using Oracle Application Express).

The demo sample procedure used for testing the database authentication feature is not whitelisted, so you must temporarily disable the request validation function.

To disable the request validation function, perform the following steps:

- Locate the folder where the Oracle REST Data Services configuration file is stored.
- Open the defaults.xml file.
- 3. Look for security.requestValidationFunction entry and remove it from the file.
- Save the file.
- 5. Restart Oracle REST Data Services, if it is already running.



In production environment, you must use a custom request validation function that whitelists the stored procedures you want to access for your application



Testing the Database Authenticated User

This section describes how to test if the database user is authenticated.

Assuming that Oracle REST Data Service is running in a standalone mode on local host and on port 8080, access the following URL in your web browser:

```
http://localhost:8080/ords/sample_plsql_app.sample_proc
```

The browser prompts you to enter credentials. Enter <code>example_user1</code> for user name and enter the password value you noted while installing the sample schema.

The browser displays 'Hello EXAMPLE_USER1!' to demonstrate that the database user was authenticated and the identity of the user was propagated to the database through the OWA CGI variable named REMOTE_USER..

Uninstalling the Sample Database Schema

To uninstall the database schema, run the commands as shown in the following code snippet:

```
db_auth $ cd sql/
sql $ sql sys as sysdba

SQLcl: Release Release 18.1.1 Production on Fri Mar 23 14:03:18 2018

Copyright (c) 1982, 2018, Oracle. All rights reserved.

Password? (**************************
Connected to:
Oracle Database 12c Enterprise Edition Release 12.2.0.1.0 - 64bit
Production
SOL> @uninstall
```

Overview of Pre-hook Functions

This section explains how to use PL/SQL based pre-hook functions that are invoked prior to an Oracle REST Data Services (ORDS) based REST call.

A pre-hook function is typically used to implement application logic that needs to be applied across all REST endpoints of an application. For example a pre-hook enables the following functionality:

- Configure application specific database session state: Configure the session to support a VPD policy.
- Custom authentication and authorization: As the pre-hook is invoked prior to dispatching the REST service, it is used to inspect the request headers and determine the user who is making the request, and also find if that user is authorized to make the request.
- Auditing or metrics gathering: To track information regarding the REST APIs invoked.

Topics:



- Configuring the Pre-hook Function
- Using a Pre-hook Function
- · Processing of a Request
- Identity Assertion of a User
- Aborting Processing of a Request
- Ensuring Pre-hook is Executable
- Exceptions Handling by Pre-hook Function
- Pre-hook Function Efficiency
- Pre-Hook Examples

Configuring the Pre-hook Function

This section describes how to configure a pre-hook function.

The pre-hook function is configured using procedure.rest.preHook setting. The value of this setting must be the name of a stored PL/SQL function.

Using a Pre-hook Function

This section explains how the pre-hook function is used.

A pre-hook must be a PL/SQL function with no arguments and must return a BOOLEAN value. The function must be executable by the database user to whom the request is mapped. For example, if the request is mapped to an ORDS enabled schema, then that schema must be granted the execute privilege on the pre-hook function (or to PUBLIC).

If the function returns true, then it indicates that the normal processing of the request must continue. If the function returns false, then it indicates that further processing of the request must be aborted.

ORDS invokes a pre-hook function in an OWA (Oracle Web Agent) that is a PL/SQL Gateway Toolkit environment. This means that the function can introspect the request headers and the OWA CGI environment variables, and use that information to drive its logic. The function can also use the OWA PL/SQL APIs to generate a response for the request (for example, in a case where the pre-hook function needs to abort further processing of the request, and provide its own response).

Processing of a Request

The pre-hook function must return true if it determines that the processing of a request must continue. In such cases, any OWA response produced by the pre-hook function is ignored (except for cases as detailed in the section Identity Assertion of a User), and the REST service is invoked as usual.

Identity Assertion of a User

This section describes how pre-hook function can make assertions about the identity of the user.



When continuing processing, a pre-hook can make assertions about the identity and the roles assigned to the user who is making the request. This information is used in the processing of the REST service. A pre-hook function can determine this by setting one or both of the following OWA response headers.

- X-ORDS-HOOK-USER: Identifies the user making the request, the value is bound to the :current_user implicit parameter and the REMOTE_IDENT OWA CGI environment variable.
- X-ORDS-HOOK-ROLES: Identifies the roles assigned to the user. This information is
 used to determine the authorization of the user to access the REST service. If this
 header is present then X-ORDS-HOOK-USER must also be present.

Note:

X-ORDS-HOOK-USER and X-ORDS-HOOK-ROLES headers are not included in the response of the REST service. These headers are only used internally by ORDS to propagate the user identity and roles.

Using these response headers, a pre-hook can integrate with the role based access control model of ORDS. This enables the application developer to build rich integrations with third party authentication and access control systems.

Aborting Processing of a Request

This section explains how the pre-hook function aborts the processing of a request.

If a pre-hook determines that the processing of the REST service should not continue, then the function must return false value. This value indicates to ORDS that further processing of the request must not be attempted.

If the pre-hook does not produce any OWA output, then ORDS generates a 403 Forbidden error response page. If the pre-hook produces any OWA response, then ORDS returns the OWA output as the response. This enables the pre-hook function to customize the response that client receives when processing of the REST service is aborted.

Ensuring Pre-hook is Executable

If a schema cannot invoke a pre-hook function, then ORDS generates a 503 Service Unavailable response for *any* request against that schema. Since a pre-hook has been configured, it would not be safe for ORDS to continue processing the request without invoking the pre-hook function. It is very important that the pre-hook function is executable by all ORDS enabled schemas. If the pre-hook function is not executable, then the REST services defined in those schemas will not be available.

Exceptions Handling by Pre-hook Function

When a pre-hook raises an error condition, for example, when a run-time error occurs, a NO DATA FOUND exception is raised. In such cases, ORDS cannot proceed with processing of the REST service as it would not be secure. ORDS inteprets any



exception raised by the pre-hook function as a signal that the request is forbidden and generates a 403 Forbidden response, and does not proceed with invoking the REST service. Therefore, if the pre-hook raises an unexpected exception, it forbids access to that REST service. It is highly recommended that all pre-hook functions must have a robust exception handling block so that any unexpected error conditions are handled appropriately and do not make REST Services unavailable.

Pre-hook Function Efficiency

A pre-hook function is invoked for every REST service call. Therefore, the pre-hook function must be designed to be efficient. If a pre-hook function is inefficient, then it has a negative effect on the performance of the REST service call. Invoking the pre-hook involves at least one additional database round trip. It is critical that the ORDS instance and the database are located close together so that the round-trip latency overhead is minimized.

Pre-Hook Examples

This section provides some sample PL/SQL functions that demonstrate different ways in which the pre-hook functionality can be leveraged.

Source code for the examples provided in the following sections is included in the unzipped Oracle REST Data Services distribution archive $examples/pre_hook/sql$ sub-folder.

Installing the Examples

This section describes how to install the pre-hook examples.

To install the pre-hook examples, execute <code>examples/pre_hook/sql/install.sql</code> script. The following code snippet shows how to install the examples using Oracle SQLcl command line interface:

```
pre_hook $ cd examples/pre_hook/sql/
sql $ sql sys as sysdba

SQLcl: Release Release 18.1.1 Production on Fri Mar 23 14:03:18 2018

Copyright (c) 1982, 2018, Oracle. All rights reserved.

Password? (************?) ******

Connected to:
Oracle Database 12c Enterprise Edition Release 12.2.0.1.0 - 64bit
Production

SQL> @install <chosen-password>
```

- You need to adjust the SQLcl connect string and the user credentials to suit your environment. For these demo scenarios, SQLcl connects to the database with service name orcl.
- <chosen-password> is the password you assigned to the PRE_HOOK_TEST database user. Make a note of this password value for later reference.



- The examples/pre_hook/sql/install.sql command creates the following two databases schemas:
 - The PRE_HOOK_DEFNS schema where the pre-hook function is defined along with a database table named custom_auth_users, where user identities are stored. This table is populated with a single user joe.bloggs@example.com, whose password is the value assigned for <chosen-password>.
 - The PRE_HOOK_TESTS schema where ORDS based REST services that are used to demonstrate the pre-hooks are defined.

Example: Denying all Access

The simplest pre-hook is one that unilaterally denies access to any REST Service.

To deny access to any REST service, the function must always return false as shown in the following code snippet:

```
create or replace function deny_all_hook return boolean as
begin
  return false;
end;
/
grant execute on deny_all_hook to public;
```

Where:

- The deny_all_hook pre-hook function always returns false value.
- Execute privilege is granted to all users. So, any ORDS enabled schema can invoke this function

Configuring ORDS

To enable deny_all_hook pre-hook function, perform the following steps:

- Locate the folder where the Oracle REST Data Services configuration file is stored.
- 2. Open the defaults.xml file and add:

```
<entry key="procedure.rest.preHook">pre_hook_defns.deny_all_hook/
entry>
```

- 3. Save the file.
- Restart Oracle REST Data Services.

Try it out

The install script creates an ORDS enabled schema and a REST service which can be accessed at the following URL (assuming ORDS is deployed on <code>localhost</code> and listening on port 8080):

http://localhost:8080/ords/pre hook tests/prehooks/user



Access the URL in a browser. You should get a response similar to the following:

```
403 Forbidden
```

This demonstrates that the <code>deny_all_hook</code> pre-hook function was invoked and it prevented the access to the REST service by returning a <code>false</code> value.

Example: Allowing All Access

Modify the source code of the <code>deny_all_hook</code> pre-hook function to allow access to all REST service requests as shown in the following code snippet:

```
create or replace function deny_all_hook return boolean as
begin
  return true;
end;
/
```

Try it out

Access the following test URL in a browser:

```
http://localhost:8080/ords/pre_hook_tests/prehooks/user
```

The response should include JSON similar to the following code snippet:

```
{
    "authenticated_user": "no user authenticated"
}
```



The REST service executes because the pre-hook function authorized it.

Related Topics

Identity Assertion of a User
 This section describes how pre-hook function can make assertions about the identity of the user.

Example: Asserting User Identity

The following code snippet demonstrates how the pre-hook function makes assertions about the user identity and the roles they possess:

```
create or replace function identity_hook return boolean as
begin
  if custom_auth_api.authenticate_owa then
    custom_auth_api.assert_identity;
    return true;
end if;
```



```
custom_auth_api.prompt_for_basic_credentials('Test Custom Realm');
return false;
end;
```

The pre-hook delegates the task of authenticating the user to the <code>custom_auth_api.authenticate_owa</code> function. If the function indicates that the user is authenticated, then it invokes the <code>custom_auth_api.assert_identity</code> procedure to propagate the user identity and roles to ORDS.

Configuring ORDS

To enable pre-hook function, perform the following steps:

- Locate the folder where the Oracle REST Data Services configuration file is stored.
- 2. Open the defaults.xml file and add:

```
<entry key="procedure.rest.preHook">pre_hook_defns.identity_hook/entry>/entry>
```

- Save the file.
- 4. Restart Oracle REST Data Services.

Try it out

The install script creates an ORDS enabled schema and a REST service that can be accessed at the following URL (assuming ORDS is deployed on localhost and listening on port 8080):

```
http://localhost:8080/ords/pre_hook_tests/prehooks/user
```

In a web browser access the preceding URL.



The first time you access the URL, the browser will prompt you to enter your credentials. Enter the user name as <code>joe.bloggs@example.com</code> and for the password, use the value you assigned for <code><chosen-password></code> when you executed the install script. Click the link to sign in.

In response a JSON document is displayed with the JSON object in it.

```
{ "authenticated_user": "joe.bloggs@example.com" }
```

Uninstalling the Examples

This section explains how to uninstall the examples.

The following code snippet shows how to uninstall the examples:

```
pre_hook $ cd sql/
sql $ sql sys as sysdba
```



Generating Hyperlinks

Oracle REST Data Services (ORDS) provides a mechanism to transform relational result sets into JSON representations, and provides hyperlinks that automatically paginates the result set to allow navigation between the pages of the result set.

For many use cases, it is required to treat certain columns in the result set as hyperlinks. ORDS provides the following simple yet powerful mechanisms for adding hyperlinks to REST resources:

- **Primary Key Hyperlinks**: A column with the reserved alias \$.id identifies the primary key column of a single row in the result set. Such column values are used to form a hyperlink that points to a child resource of the current resource that provides specific details about that particular row in the result set.
- Arbitrary Hyperlinks: A column whose alias starts with the reserved character \$
 is treated as a hyperlink. The subsequent characters in the column alias indicates
 the link relation type.

Primary Key Hyperlinks

This section describes how to add primary key hyperlinks.

Typically, when you are modelling a REST API, you need to model the Resource Collection Pattern that enumerates the hyperlinks to the other resources.

In a simple use case, a query is against a single table that contains a single column with primary key that is used to identify each row. The collection resource provides summary information of each row, and provides a self link for each row. The self link points to the resource that provides more detailed information about the row. For example, if we use the EMP table, we can define a service as shown in the following code snippet:

```
begin
    ords.define_service(
        p_module_name => 'links.example',
        p_base_path => 'emp-collection/',
        p_pattern => '.',
        p_source => 'select empno "$.id", empno id, ename employee_name
from emp order by empno ename';
```



Where:

- The reserved value '.' is used for the p_pattern value. This indicates the path of the resource template in the base path of the resource module, emp-collection/ in this example.
- The EMPNO column is aliased as \$.id, to produce a hyperlink.

Following code snippet shows the output produced after invoking the preceding service:

```
"items": [{
        "id": 7369,
        "employee_name": "SMITH",
        "links": [{
            "rel": "self",
            "href": "http://localhost:8080/ords/ordstest/emp-collection/
7369"
        }]
    },
    . . .
    ],
    "hasMore": false,
    "limit": 25,
    "offset": 0,
    "count": 14,
    "links": [{
        "rel": "self",
        "href": "http://localhost:8080/ords/ordstest/emp-collection/"
        "rel": "describedby",
        "href": "http://localhost:8080/ords/ordstest/metadata-catalog/
emp-collection/"
    }, {
        "rel": "first",
        "href": "http://localhost:8080/ords/ordstest/emp-collection/"
    }]
}
```

Observe that the value of EMPNO column is concatenated with the URL of the service to produce a new hyperlink with relation self. The value is not simply concatenated, it is resolved using the algorithm specified in RFC3986. Therefore, Oracle REST Data Services (ORDS) can take the value of the column, and apply the resolution algorithm to produce a new absolute URL.



Section 5 of rfc3986



If you attempt to navigate to this URL, it results in a 404 HTTP status because a resource handler for that endpoint has not yet been defined. The following code snippet shows a sample resource handler:

```
begin
  ords.define_template(
    p_module_name => 'links.example',
    p_pattern => ':id');
  ords.define_handler(
    p_module_name => 'links.example',
    p_pattern => ':id',
    p_source_type => ords.source_type_collection_item,
    p_source => 'select emp.empno "$.id", emp.* from emp
where empno = :id');
  commit;
end;
```

Composite Primary Keys

This section describes the support for composite primary keys.

If multiple columns in a query form the primary key of a row, then each of those columns must be aliased by \$.id. ORDS combines such values to form the relative path of the item URL.

Related Topics

Route Patterns Specification

Arbitrary Hyperlinks

This section describes how to create hyperlinks to point to a resource one level up in the heirarchy.

Rich hypermedia documents have many different hyperlinks. ORDS provides a mechanism to turn any column value into a hyperlink. Any column whose alias starts with the \$ character is treated as a hyperlink. The following example code snippet shows how an employee resource can provide a hyperlink to their manager:

ORDS treats the column named \$related to a hyperlink and the column value is treated as a path relative to the containing base URI of the resource. Similar to how \$.id column value is transformed into an absolute URI by applying the algorithm specified in RFC 3986.



See Also:

Section 5.2 of rfc3986.

The following example code snippet shows the updated employee resource:

```
{
    "empno": 7369,
    "ename": "SMITH",
    "job": "CLERK",
    "mgr": 7902,
    "hiredate": "1980-12-17T00:00:00Z",
    "sal": 800,
    "comm": null,
    "deptno": 20,
    "links": [{
        "rel": "self",
        "href": "http://localhost:8080/ords/ordstest/emp-collection/
7369"
    }, {
        "rel": "describedby",
        "href": "http://localhost:8080/ords/ordstest/metadata-catalog/
emp-collection/item"
    }, {
        "rel": "collection",
        "href": "http://localhost:8080/ords/ordstest/emp-collection/"
    }, {
        "rel": "related",
        "href": "http://localhost:8080/ords/ordstest/emp-collection/
7902"
    }]
}
```

Note that the new related link points to the manager resource of the employee. The manager resource in turn has a related link that points to their manager, and so on up the management chain until you reach employee number 7839 who is the president of the company and whose ${\tt mgr}$ column is ${\tt null}$. If the column value is null, then ORDS will not create a hyperlink.

```
}, {
    "rel": "describedby",
    "href": "http://localhost:8080/ords/ordstest/metadata-catalog/
emp-collection/item"
}, {
    "rel": "collection",
    "href": "http://localhost:8080/ords/ordstest/emp-collection/"
}]
}
```

About the related Link Relation

This section explains the use of existing registered link relation types instead of extension link relation types.

As per RFC 8288 Section 2.1.2, any extension link relation must be an URI and not a simple value. This means that a link relation such as manager is not a legal link relation according to the specification. A custom link relation type will reduce interoperability. If your application uses a non-registered link relation type, then only a few clients will be able to understand the custom link relation type. Conversely, if you use registered link relation types, then more clients can navigate to your link relations. Oracle recommends using existing registered link relation types instead of extension link relation types.

Related Topics

rfc8288

URL Resolution

This section describes how ORDS resolves column values using URI resolution algorithm.

Related Topics

rfc3986

Child Paths

This section describes how to use the relative paths to refer to the child resources.

Following code snippet shows the use of relative paths to refer to child resources:

```
select'child/resource'"$related" from dual
```

Assuming that the base URL of the containing resource is https://example.com/ords/some_schema_alias/some/resource, then the link is as shown in the following code snippet:

```
{
  "rel": "related",
  "href": "https://example.com/ords/some_schema_alias/some/child/
resource"
}
```



Ancestor Paths

This section provides examples to show how ORDS lets you use . . / and . / syntax to refer to parent paths of the current resource.

Following is an example code snippet:

```
select'../'"$up", './'"$self" from dual
```

Assuming the base URL of the containing resource is https://example.com/ords/some_schema_alias/some/collection/, then the links will be as shown in the following code snippet:

```
{
  "rel": "up",
  "href": "https://example.com/ords/some_schema_alias/some/"
},
{
  "rel": "self",
  "href": "https://example.com/ords/some_schema_alias/some/collection/"
}
```

Absolute URLs

This section provides examples for the absolute paths.

A hyperlink value can be an absolute path or a fully qualified URL as shown in the following code snippet:

```
select'/cool/stuff'"$related", 'https://oracle.com/rest'"$related" from
dual
```

Assuming the base URL of the containing resource is, $https://example.com/ords/some_schema_alias/some/collection/$ the links will be as shown in the following code snippet:

```
{
  "rel": "related",
  "href": "https://example.com/cool/stuff"
},
{
  "rel": "related",
  "href": "https://oracle.com/rest"
}
```

You can have multiple links for the same link relation.

Context Root Relative Paths

This section provides example for the context root relative path.

The context root relative path is the URL of the root resource of an ORDS enabled schema.

The following code snippet shows the context root path for the example discussed in the preceding sections:

```
https://example.com/ords/some_schema_alias/
```

ORDS provides the following syntax to express the resource paths relative to the URL:

```
select'^/another/collection/'"$related"from dual
```

Assuming the base URL of the containing resource is https://example.com/ords/some_schema_alias/some/collection/, the link is as shown in the following code snippet:

```
{
  "rel": "related",
  "href": "https://example.com/ords/some_schema_alias/another/collection"
}
```

Any path starting with ^/1 is resolved relative to the context root path.

Dynamic Paths

This section describes how you can have dynamic values for the hyperlinks.

Examples provided in the preceding sections use literal values for the hyperlinks. The hyperlink value can be completely dynamic, formed from any value that is a string (or can be automatically converted to a string). For example, instead of pointing directly to the employee resource, for managers only, you can point to a more specialized resource that can show additional information such as the total number of reports. The GET handler can be redefined for the <code>emp-collection</code> or <code>:id</code> resource as shown in the following code snippet:

```
begin
  ords.define_handler(
     p_module_name => 'links.example',
     p_pattern => ':id',
     p_source_type => ords.source_type_collection_item,
     p_source => 'select emp.empno "$.id", emp.*,
decode(emp.mgr, null, null, '^/managers/' || emp.mgr) "$related" from emp where empno = :id');
     commit;
end;
```

Where:

The value of the \$related column is formed from ^/managers/: emp.mgr unless
the value of emp.mgr is null. In such a case, a null value is substituted that
causes ORDS not to generate the hyperlink.



The following code snippet shows the updated employee resource:

```
{
    "empno": 7566,
    "ename": "JONES",
    "job": "MANAGER",
    "mgr": 7839,
    "hiredate": "1981-04-01T23:00:00Z",
    "sal": 2975,
    "comm": null,
    "deptno": 20,
    "links": [{
        "rel": "self",
        "href": "http://localhost:8080/ords/ordstest/emp-collection/
7566"
    }, {
        "rel": "describedby",
        "href": "http://localhost:8080/ords/ordstest/metadata-catalog/
emp-collection/item"
    }, {
        "rel": "collection",
        "href": "http://localhost:8080/ords/ordstest/emp-collection/"
        "rel": "related",
        "href": "http://localhost:8080/ords/ordstest/managers/7839"
    }]
}
```

Note:

The related link now points to the dynamically generated path, that is, to the managers/:id resource.

About HTTP Error Responses

ORDS can now generate HTTP error responses in JSON or HTML format. Prior to ORDS release 20.4, only HTML responses were supported. To preserve the backward compatibility, by default, ORDS attempts to automatically determines the best format to render the error responses.

You can configure ${\tt error.responseFormat}$ setting and force ORDS to always render the error responses in either HTML or JSON format.

About error.responseFormat

The error.responseFormat setting is a global setting that supports the following values:

- html Force all error responses to be in HTML format.
- ison Force all error responses to be in JSON format.

 auto (default value) - Automatically determine most appropriate format for a request.

HTML Mode

When error.responseFormat value is set to html, all the error responses are rendered in HTML format. This setting can be used to match the behaviour of ORDS 20.3.1 and prior releases. The HTML format displays properly in web-browsers. However, for non-human clients, HTML format is verbose and challenging to parse.

json Mode

When error.responseFormat value is set to json, all the error responses are rendered in JSON format. The JSON format complies with the Problem Details for HTTP APIs standard. The JSON format is terse, and straightforward for non-human clients to parse. However, it does not display properly in browsers and is not user friendly for non-technical users.

auto Mode

The default value for error.responseFormat is auto. When this value is configured, ORDS applies the following rules and automatically chooses the most appropriate format to use:

- If the client supplies an Accept request header, where application/json or application/problem+json is the most preferred media type, then the response must be in JSON format.
- If the client supplies an Accept request header where text/html is the most preferred media type, then the response must be in HTML format.
- If the client supplies a X-Requested-With header, then the response must be in JSON format. Presence of this header indicates that the request is initiated from the JavaScript code and so JSON would be the appropriate response format.
- If the client supplies an Origin header, then the response must be in JSON format. Presence of this header indicates that the request is initiated from the JavaScript code and so JSON would be the appropriate response format.
 - There is one exception to this rule, if the request method is POST and the Content-Type of the request is application/x-www-form-urlencoded, then the response will be in HTML format.
- If the client supplies a User-Agent header whose value starts with curl/, then
 the response must be in JSON format. cURL is a popular command line tool
 for making the HTTP requests. The terser JSON format is more readable in
 a command line environment. If none of the preceding rules apply, then the
 response will be in HTML format.





6

REST-Enabled SQL Service

The REST-Enabled SQL service is a HTTPS web service that provides access to the Oracle Database SQL engine. You can POST SQL statements to the service. The service then runs the SQL statements against Oracle Database and returns the result to the client in a JSON format.

Statically defined RESTful services use predefined SQL statements that are useful when you need a fixed and repeatable service. The REST- Enabled SQL service enables you to define SQL statements dynamically and run them against the database without predefined SQL statements. This makes your data more accessible over REST.

Typical Use Case: Your Oracle Database is in the cloud and you want to make it available through a REST API over HTTPS.

Predefined REST APIs provide common operations such as returning the results of reports and providing an API for updating common tables in your database. There is a need for client developers to run their own queries or queries that can only be written at run time. In these cases, a REST- Enabled SQL service is useful.



If you have Oracle REST Data Services installed and if you do not have SQL*Net (JDBC, OCI) to establish an network connection to Oracle Database, then a REST-Enabled SQL service provides an easy mechanism to query and run SQL, SQL*Plus, and SQLcl statements against the REST-enabled Oracle Database schema.

Topics:

- REST-Enabled SQL Service Terminology
- Configuring the REST-Enabled SQL Service
- Using cURL with REST-Enabled SQL Service
- Getting Started with the REST-Enabled SQL Service

REST-Enabled SQL Service Terminology

This section introduces some common terms that are used throughout this document.

- REST- Enabled SQL service: A HTTPS web service that provides SQL access to the database. SQL statements can be posted to the service, and the results are returned in a JSON format to the client.
- HTTPS: Hyper Text Transfer Protocol Secure (HTTPS) is the secure version
 of HTTP, the protocol over which data is sent between your browser and the
 website to which you are connected. The 'S' stands for secure. It means that

all communications between your browser and Oracle REST Data Services are encrypted.

- **curl**: curl is a command-line tool used to transfer data. It is free and open source software that can be downloaded from the following location: curl haxx.
- SQL*Net (or Net8): SQL*Net is the networking software of Oracle that enables remote data access between programs and Oracle Database.

Configuring the REST-Enabled SQL Service

By default, the REST- Enabled SQL service is turned off. To configure REST- Enabled SQL service settings, see Configuring REST-Enabled SQL Service Settings.

Using cURL with REST-Enabled SQL Service

This section explains how to use cURL commands to access the REST-Enabled SQL service.

You can use the HTTPS POST method to access the REST-Enabled SQL service. To access the REST-Enabled SQL service, you can use the command-line tool named cURL. This powerful tool is available for most platforms, and enables you to connect and control the data that you send to and receive from a REST-Enabled SQL service.

Example 6-1 Example cURL Command

```
Request: curl -i -X POST --user ORDSTEST:ordstest --data-binary "select
sysdate from dual" -H "Content-Type: application/sql" -k https://
localhost:8088/ords/ordstest/_/sql
```

Where:

- The-i option displays the HTTP headers returned by the server.
- The -k option enables cURL to proceed and operate even for server connections that are otherwise considered to be insecure.

Response:



```
],
        "result":0,
        "resultSet":{
             "metadata":[
                     "columnName": "SYSDATE",
                     "jsonColumnName": "sysdate",
                     "columnTypeName": "DATE",
                     "precision":0,
                     "scale":0,
                     "isNullable":1
                 }
             ],
             "items":[
                 {
                      "sysdate": "2017-07-21T08:06:44Z"
             ],
             "hasMore":false,
             "limit":1500,
             "offset":0,
             "count":1
        }
    }
]
```

Getting Started with the REST-Enabled SQL Service

The REST- Enabled SQL service is provided only through HTTPS POST method.

Topics:

- REST-Enabling the Oracle Database Schema
- REST-Enabled SQL Authentication
- REST-Enabled SQL Endpoint

REST-Enabling the Oracle Database Schema

You must REST-enable the Oracle database schema on which you want to use the REST- Enabled SQL service. To REST-enable the Oracle Database schema, you can use SQL Developer or the PL/SQL API.

The following code snippet shows how to REST-enable the Oracle Database schema ORDSTEST:

```
SQL> CONNECT ORDSTEST/****;
Connected
SQL> exec ords.enable_schema;
anonymous block completed
SQL> commit;
```



Commit complete. SQL>

Related Topics

Auto-Enabling Using the PL/SQL API

REST-Enabled SQL Authentication

This section explains how to authenticate the schema on which you want to use the REST-Enabled SQL service.

Before using the REST-Enabled SQL service, you must authenticate using the SQL Developer role.

The Following are the different types of authentications available:

- First Party Authentication (Basic Authentication): For this authentication, create a user in Oracle REST Data Services with the SQL Developer role. This Oracle REST Data Services user will be able to run SQL for any Oracle database schema that is REST-enabled.
- Schema Authentication: For this authentication, use the Oracle Database schema name in uppercase and the Oracle database schema password (for example, HR and HRPassword). This type of user will be able to run SQL for the specified schema. It will be given the SQL Developer role by Oracle REST Data Services.
- OAuth 2 Client Credentials: For this authentication, perform the following steps to grant the SQL Developer role to the client in Oracle REST Data Services:
 - 1. Create a client using OAUTH.create_client.
 - 2. Grant the SQL Developer role to the client.
 - Acquire the access token using the client_id and client_secret of the client.
 - 4. Specify the access token in subsequent REST-Enabled SQL requests.

REST-Enabled SQL Endpoint

This section shows the format or pattern used to access the REST- Enabled SQL service.

If Oracle REST Data Services is running in a Java EE Application Server, then the REST-Enabled SQL service is only accessible through HTTPS. If Oracle REST Data Services is running in standalone mode, then Oracle REST Data Services can be configured to use HTTPS. The examples in this document use this configuration.

The following example URL locates the REST-Enabled SQL service for the specified schema alias:

Pattern: https://<HOST>/ords/<SchemaAlias>/ /sql

Example: https://host/ords/ordstest//sql

Where: The default port is 443



Content Type and Payload Data Type Supported

The HTTPS POST request consists of the following:

- Header Content-Type
 - application/sql: for SQL statements
 - application/json: for JSON documents
- Payload data type
 - SQL: SQL, PL/SQL, SQL*Plus, SQLcl statements
 - JSON document: A JSON document with SQL statements and other options such as bind variables

REST-Enabled SQL Service Examples

This section provides different HTTPS POST request examples that use Oracle REST Data Services standalone setup with secure HTTPS access.

The payload data of the HTTPS POST request message can be in one of the following formats:

- POST Requests Using application/sql Content-Type
- POST Requests Using application/json Content-Type

POST Requests Using application/sql Content-Type

For POST requests with <code>Content-Type</code> as <code>application/sql</code>, the payload is specified using SQL, SQL*Plus, and SQLcl statements. The payload can be a single line statement, multiple line statements, or a file that consists of multiline statements as shown in the following examples:

- Using a Single SQL Statement
- Using Multiple SQL Statements
- Using a File with cURL

Note:

While evaluating your SQL/PLSQL statements, if you see an error message 555 with the following message, then ensure that you have correctly formed your SQL/PLSQL statement:

" 555 User Defined Resource Error

The request could not be processed because an error occurred whilst attempting to evaluate the SQL statement associated with this resource. Please check the SQL statement is correctly formed and executes without error"



Using a Single SQL Statement

The following example uses Schema Authentication to run a single SQL statement against the demo Oracle Database schema:

Request:

```
curl -i -X POST --user DEMO:demo --data-binary "select sysdate from
dual" -H "Content-Type: application/sql" -k https://localhost:8088/ords/
demo/_/sql
Response:
HTTP/1.1 200 OK
Content-Type: application/json
X-Frame-Options: SAMEORIGIN
Transfer-Encoding: chunked
    "env":{
        "defaultTimeZone":"Europe/London"
    "items":[
            "statementId":1,
            "statementType": "query",
            "statementPos":{
                 "startLine":1,
                 "endLine":2
            },
            "statementText": "select sysdate from dual",
            "response":[
            ],
            "result":0,
            "resultSet":{
                 "metadata":[
                         "columnName": "SYSDATE",
                         "jsonColumnName": "sysdate",
                         "columnTypeName": "DATE",
                         "precision":0,
                         "scale":0,
                         "isNullable":1
                 ],
                 "items":[
                         "sysdate": "2017-07-21T08:06:44Z"
                 ],
                 "hasMore":false,
                 "limit":1500,
                 "offset":0,
                 "count":1
```



```
}
}
]
```

Where:

- DEMO is the Oracle Database schema name.
- demo is the Oracle Database schema password.
- select sysdate from dual is the SQL statement that will run in the DEMO Oracle Database schema.
- Content-Type: application/sql is the content type. Only application/sql and application/json are supported.
- https://localhost:8088/ords/demo/_/sql is the location of the REST- Enabled SQL service for the demo Oracle Database schema.

Using a File with cURL

For multiline SQL statements, using a file as payload data in requests is useful.

```
File: simple_query.sql

SELECT 10

FROM dual;
```

Request:

```
curl -i -X POST --user DEMO:demo --data-binary "@simple_query.sql" -H
"Content-Type: application/sql" -k https://localhost:8088/ords/demo/_/sql
```

Response:

```
HTTP/1.1 200 OK
Content-Type: application/json
X-Frame-Options: SAMEORIGIN
Transfer-Encoding: chunked
    "env":{
        "defaultTimeZone": "Europe/London"
    },
    "items":[
            "statementId":1,
            "statementType": "query",
            "statementPos":{
                "startLine":1,
                "endLine":1
            },
            "statementText": "SELECT 10 FROM dual",
            "response":[
```



```
],
             "result":0,
             "resultSet":{
                 "metadata":[
                          "columnName": "10",
                         "jsonColumnName":"10",
                          "columnTypeName": "NUMBER",
                          "precision":0,
                          "scale":-127,
                         "isNullable":1
                 ],
                 "items":[
                          "10":10
                 ],
                 "hasMore":false,
                 "limit":1500,
                 "offset":0,
                 "count":1
            }
        }
    ]
}
```

Using Multiple SQL Statements

You can run one or more statements in each POST request. Statements are separated similar to Oracle Database SQL*Plus script syntax, such as, end of line for SQL*Plus statements, a semi colon for SQL statements, and forward slash for PL/SQL statements.

```
File: script.sql:

CREATE TABLE T1 (col1 INT);

DESC T1

INSERT INTO T1 VALUES(1);

SELECT * FROM T1;

BEGIN

INSERT INTO T1 VALUES(2);

END;

/

SELECT * FROM T1;

Request:curl -i -X POST --user DEMO:demo --data-binary "@script.sql" -H
"Content-Type: application/sql" -k https://localhost:8088/ords/demo/_/sql

Response:

HTTP/1.1 200 OK
Content-Type: application/json
X-Frame-Options: SAMEORIGIN
```



```
Transfer-Encoding: chunked
    "env":{
        "defaultTimeZone": "Europe/London"
    },
    "items":[
            "statementId":1,
            "statementType":"ddl",
            "statementPos":{
                "startLine":1,
                "endLine":1
            },
            "statementText": "CREATE TABLE T_EXAMPLE1 (col1 INT)",
            "response":[
                "\nTable T_EXAMPLE1 created.\n\n"
            ],
            "result":0
            "statementId":2,
            "statementType": "sqlplus",
            "statementPos":{
                "startLine":2,
                "endLine":2
            },
            "statementText": "DESC T_EXAMPLE1",
            "response":[
                "Name Null\n Type \n---- \nCOL1
NUMBER(38) \n"
            ],
            "result":0
            "statementId":3,
            "statementType": "dml",
            "statementPos":{
                "startLine":3,
                "endLine":3
            },
            "statementText":"INSERT INTO T_EXAMPLE1 VALUES(1)",
            "response":[
                "\n1 row inserted.\n\n"
            ],
            "result":1
            "statementId":4,
            "statementType": "query",
            "statementPos":{
                "startLine":4,
                "endLine":4
            "statementText":"SELECT * FROM T_EXAMPLE1",
```

```
"response":[
            ],
            "result":1,
            "resultSet":{
                 "metadata":[
                         "columnName":"COL1",
                         "jsonColumnName": "col1",
                         "columnTypeName": "NUMBER",
                         "precision":38,
                         "scale":0,
                         "isNullable":1
                 ],
                 "items":[
                         "col1":1
                 ],
                 "hasMore":false,
                 "limit":1500,
                 "offset":0,
                 " count":1
        },
            "statementId":5,
            "statementType":"plsql",
            "statementPos":{
                 "startLine":5,
                 "endLine":8
            "statementText": "BEGIN\n INSERT INTO T_EXAMPLE1
VALUES(2);\nEND;",
            "response":[
                 "\nPL\/SQL procedure successfully completed.\n\n"
            ],
            "result":1
        },
            "statementId":6,
            "statementType": "query",
            "statementPos":{
                 "startLine":9,
                 "endLine":9
            },
            "statementText": "SELECT * FROM T_EXAMPLE1",
            "response":[
            ],
            "result":1,
            "resultSet":{
                 "metadata":[
```

```
"columnName": "COL1",
                     "jsonColumnName": "col1",
                     "columnTypeName": "NUMBER",
                     "precision":38,
                     "scale":0,
                     "isNullable":1
                 }
            ],
             "items":[
                 {
                     "col1":1
                     "col1":2
            ],
            "hasMore":false,
            "limit":1500,
            "offset":0,
            "count":2
    },
        "statementId":7,
        "statementType":"ddl",
        "statementPos":{
            "startLine":10,
            "endLine":10
        },
        "statementText": "DROP TABLE T_EXAMPLE1",
        "response":[
            "\nTable T_EXAMPLE1 dropped.\n\n"
        ],
        "result":1
]
```

POST Requests Using application/json Content-Type

Using a JSON document as the payload enables you to define more complex requests as shown in the following sections:

- Using a File with cURL
- Specifying the Limit Value in a POST Request for Pagination
- Specifying the Offset Value in a POST Request for Pagination
- Defining Binds in a POST Request

Using a File with cURL

The following example posts a JSON document (within the $simple_query.json$ file) to the REST-Enabled SQL service.

```
File: simple_query.json
{ "statementText":"SELECT TO_DATE('01-01-1976','dd-mm-yyyy') FROM dual;"}
Request: curl -i -X POST --user DEMO:demo --data-binary
"@simple_query.json" -H "Content-Type: application/json" -k https://localhost:8088/ords/demo/_/sql
```

Where:

- The statementText holds the SQL statement or statements.
- The Content-Type is application/json.

Response:

```
HTTP/1.1 200 OK
Content-Type: application/json
X-Frame-Options: SAMEORIGIN
Transfer-Encoding: chunked
    "env":{
        "defaultTimeZone": "Europe/London"
    "items":[
            "statementId":1,
            "statementType": "query",
            "statementPos":{
                 "startLine":1,
                 "endLine":1
            "statementText": "SELECT TO_DATE('01-01-1976','dd-mm-yyyy')
FROM dual",
            "response":[
             ],
             "result":0,
            "resultSet":{
                 "metadata":[
                         "columnName": "TO_DATE('01-01-1976','DD-MM-
YYYY')",
                         "jsonColumnName": "to_date('01-01-1976','dd-mm-
уууу')",
                         "columnTypeName": "DATE",
                         "precision":0,
                         "scale":0,
                         "isNullable":1
                 ],
                 "items":[
                         "to_date('01-01-1976','dd-mm-
yyyy')":"1976-01-01T00:00:00Z"
                 ],
                 "hasMore":false,
```



Specifying the Limit Value in a POST Request for Pagination

You can specify the limit value in a POST JSON request for the pagination of a large result set returned from a query.

```
File: limit.json

{
    "statementText": "
    WITH data(r) AS (
    SELECT 1 r FROM dual
    UNION ALL
    SELECT r+1 FROM data WHERE r < 100
    )
    SELECT r FROM data;",
    "limit": 5
}</pre>
```

Request: curl -i -X POST --user DEMO:demo --data-binary "@limit.json" -H "Content-Type: application/json" -k https://localhost:8088/ords/demo/_/sql

Where: The limit is the maximum number of rows returned from a guery.



The maximum number of rows returned from a query is based on the misc.pagination.maxRows value set in defaults.xml file.

Response:

```
HTTP/1.1 200 OK
Content-Type: application/json
X-Frame-Options: SAMEORIGIN
Transfer-Encoding: chunked
{
    "env":{
        "defaultTimeZone":"Europe/London"
    },
    "items":[
        {
            "statementId":1,
            "statementType":"query",
            "statementPos":{
                 "startLine":1,
```



```
"endLine":1
            },
             "statementText": " WITH data(r) AS ( SELECT 1 r FROM dual
UNION ALL SELECT r+1 FROM data WHERE r < 100 ) SELECT r FROM data",
             "response":[
             ],
             "result":0,
             "resultSet":{
                 "metadata":[
                         "columnName":"R",
                         "jsonColumnName": "r",
                         "columnTypeName": "NUMBER",
                         "precision":0,
                         "scale":-127,
                         "isNullable":1
                 ],
                 "items":[
                          "r":1
                          "r":2
                          "r":3
                          "r":4
                          "r":5
                 "hasMore":true,
                 "limit":5,
                 "offset":0,
                 "count":5
    ]
}
```

Related Topics

Configuring the Maximum Number of Rows Returned from a Query

Specifying the Offset Value in a POST Request for Pagination

You can specify the offset value in a POST JSON request. This value specifies the first row that must be returned and is used for pagination of the result set returned from a query.

```
File: offset_limit.json

{
    "statementText": "
    WITH data(r) AS (
    SELECT 1 r FROM dual
    UNION ALL
    SELECT r+1 FROM data WHERE r < 100
    )
    SELECT r FROM data;",
    "offset": 25,
    "limit": 5
}

Request: curl -i -X POST --user DEMO:demo --data-binary
    "@offset_limit.json" -H "Content-Type: application/json" -k https://localhost:8088/ords/demo/_/sql</pre>
```

Where: offset is the first row to be returned in the result set. Typically, this is used to provide the pagination for a large result set that returns the **next** page of rows in the result set.

Note:

Each request made to the REST-Enabled SQL service is performed in its own transaction, which means that you cannot ensure that the rows returned will match the previous request. To avoid these risks, queries that need pagination should use the ORDER BY clause on a primary key.

Response:

```
HTTP/1.1 200 OK
Content-Type: application/json
X-Frame-Options: SAMEORIGIN
Transfer-Encoding: chunked
    "env":{
        "defaultTimeZone":"Europe/London"
    },
    "items":[
            "statementId":1,
            "statementType": "query",
            "statementPos":{
                "startLine":1,
                "endLine":1
            },
            "statementText": " WITH data(r) AS ( SELECT 1 r FROM dual
UNION ALL SELECT r+1 FROM data WHERE r < 100 ) SELECT r FROM data",
            "response":[
            ],
            "result":0,
```



```
"resultSet":{
                 "metadata":[
                         "columnName":"R",
                          "jsonColumnName": "r",
                          "columnTypeName": "NUMBER",
                         "precision":0,
                         "scale":-127,
                          "isNullable":1
                 ],
                 "items":[
                          "r":26
                          "r":27
                          "r":28
                          "r":29
                          "r":30
                 ],
                 "hasMore":true,
                 "limit":5,
                 "offset":25,
                 "count":5
    ]
}
```

Defining Binds in a POST Request

You can define binds in JSON format. This functionality is useful when calling procedures and functions that use binds as the parameters.

Example 6-2 Binds in POST Request

```
File: binds.json

{
    "statementText": "CREATE PROCEDURE TEST_OUT_PARAMETER (V_PARAM_IN INT
IN, V_PARAM_OUT INT OUT) AS BEGIN V_PARAM_OUT := V_PARAM_IN + 10; END;

/

EXEC TEST_OUT_PARAMETER(:var1, :var2)",
    "binds":[
    {"name":"var1","data_type":"NUMBER","value":10},
    {"name":"var2","data_type":"NUMBER","mode":"out"}
```



```
]
Request: curl -i -X POST --user DEMO:demo --data-binary "@binds.json" -H
"Content-Type: application/json" -k https://localhost:8088/ords/demo/_/sql
Response:
HTTP/1.1 200 OK
Content-Type: application/json
X-Frame-Options: SAMEORIGIN
Transfer-Encoding: chunked
    "env":{
        "defaultTimeZone": "Europe/London"
    "items":[
        {
            "statementId":1,
            "statementType": "plsql",
            "statementPos": {
                "startLine":1,
                "endLine":2
            "statementText": "CREATE PROCEDURE TEST OUT PARAMETER
(V_PARAM_IN IN INT, V_PARAM_OUT OUT INT) AS BEGIN V_PARAM_OUT :=
V_PARAM_IN + 10; END;",
            "response":[
                "\nProcedure TEST_OUT_PARAMETER compiled\n\n"
            ],
            "result":0,
            "binds":[
                     "name": "var1",
                     "data_type": "NUMBER",
                     "value":10
                },
                     "name": "var2",
                     "data_type": "NUMBER",
                     "mode": "out",
                     "result":null
            ]
        },
            "statementId":2,
            "statementType": "sqlplus",
            "statementPos":{
                "startLine":3,
                "endLine":3
            "statementText":"EXEC TEST_OUT_PARAMETER(:var1, :var2)",
                "\nPL\/SQL procedure successfully completed.\n\n"
```



```
],
             "result":0,
             "binds":[
                 {
                     "name":"var1",
                     "data_type":"NUMBER",
                     "value":10
                 },
                     "name":"var2",
                     "data_type": "NUMBER",
                     "mode":"out",
                     "result":20
            ]
        }
    ]
}
```

Example 6-3 Complex Bind in POST Request

```
Filecomplex_bind_example.json
    "statementText":"
declare
 type t is table of number index by binary_integer;
 l_in t
            := :IN;
 1_out t;
 begin
   for i in 1..l_in.count loop
  l_{out(i)} := l_{in(i)} * 2;
   end loop;
   :L_OUT := 1_out;
 end;
    "binds":[
             "name":"IN",
             "data_type": "PL/SQL TABLE",
             "type_name":"",
             "type_subname":"",
             "type_components":[
                     "data_type": "NUMBER"
             ],
             "value":[
                 2,
                 4,
        },
             "name": "L_OUT",
```

```
"data_type": "PL/SQL TABLE",
            "type_name":"",
            "type_subname": "",
            "type_components":[
                    "data_type": "NUMBER"
            ],
            "mode":"out"
    ]
}
Request: curl -i -X POST --user DEMO:demo --data-binary
"@complex_bind_example.json" -H "Content-Type: application/json" -k
https://localhost:8088/ords/demo/_/sql
Response:
HTTP/1.1 200 OK
Content-Type: application/json
X-Frame-Options: SAMEORIGIN
Transfer-Encoding: chunked
    "env":{
        "defaultTimeZone": "Europe/London"
    "items":[
            "statementId":1,
            "statementType": "plsql",
            "statementPos":{
                "startLine":2,
                "endLine":12
            "statementText":"declare \n type t is table of number index
by binary_integer; \n l_in t := :IN; \n l_out t; \n begin
    for i in 1..l_in.count loop \n l_out(i) := l_in(i) * 2; \n
end loop;
            \n :L_OUT := l_out; \n end;",
            "response":[
            ],
            "result":1,
            "binds":[
                {
                    "name":"IN",
                    "data_type": "PL/SQL TABLE",
                    "type_components":[
                            "data_type":"NUMBER"
                    ],
                    "type_name":"",
                    "type_subname": "",
                    "value":[
                        2,
```

```
4,
                          7
                      ]
                 },
                      "name": "L_OUT",
                      "data_type": "PL/SQL TABLE",
                      "mode": "out",
                      "type_components":[
                               "data_type":"NUMBER"
                      ],
                      "type_name":"",
                      "type_subname": "",
                      "result":[
                          4,
                          8,
                          14
             ]
    ]
}
```

Specifying Batch Statements in a POST Request

This section shows the examples with batch statements and batch bind values in a POST request.

Example 6-4 Batch statements

```
File: batch_example.json

{
    "statementText":[
        "insert into adhoc_table_simple values(1)",
        "insert into adhoc_table_simple values(2)",
        "delete from adhoc_table_simple"
    ]
}

Request:curl -i -X POST --user DEMO:demo --data-binary
"@batch_example.json" -H "Content-Type: application/json" -k https://localhost:8088/ords/demo/_/sql

Response:

HTTP/1.1 200 OK
Content-Type: application/json
X-Frame-Options: SAMEORIGIN
```



```
Transfer-Encoding: chunked
    "env":{
        "defaultTimeZone": "Europe/London"
    "items":[
            "statementId":1,
            "statementType":"dml",
            "statementPos":{
                 "startLine":0,
                 "endLine":0
            },
            "statementText":[
                 "insert into adhoc_table_simple values(1)",
                 "insert into adhoc_table_simple values(2)",
                 "delete from adhoc_table_simple"
            ],
            "response":[
                 "\n1 row inserted.\n\n",
                 "\n1 row inserted.\n\n",
                "\n2 rows inserted.\n\n"
            ],
            "result":[
                1,
                1,
                 2
    ]
}
```

Example 6-5 Batch bind values



```
"data_type":"DATE",
            "batch":true,
            "value":[
                "2017-02-21T06:12:20Z",
                 "2017-02-21T06:12:20Z",
                 "2017-02-21T06:12:20Z",
                 "2017-02-21T06:12:20Z",
                 "2017-02-21T06:12:20Z"
            ]
        }
    ]
}
Request: curl -i -X POST --user DEMO:demo --data-binary
"@batch_bind_example.json" -H "Content-Type: application/json" -k https://
localhost:8088/ords/demo/ /sql
Response:
HTTP/1.1 200 OK
Content-Type: application/json
X-Frame-Options: SAMEORIGIN
Transfer-Encoding: chunked
    "env":{
        "defaultTimeZone": "Europe/London"
    "items":[
            "statementId":1,
            "statementType": "dml",
            "statementPos":{
                 "startLine":1,
                 "endLine":2
            "statementText": "INSERT INTO ADHOC_TABLE_DATE VALUES(?,?)",
            "response":[
                 "\n1 row inserted.\n\n",
                 "\n1 row inserted.\n\n",
                 "\n1 row inserted.\n\n",
                 "\n1 row inserted.\n\n",
                 "\n1 row inserted.\n\n"
            ],
            "result":[
                1,
                1,
                1,
                1,
                1
            "binds":[
                     "index":1,
                     "data_type": "NUMBER",
                     "batch":true,
```

```
"value":[
                          3,
                          6,
                          9,
                          13,
                          17
                      ]
                 },
                      "index":2,
                      "data_type": "DATE",
                      "batch":true,
                      "value":[
                          "2017-02-21T06:12:20Z",
                          "2017-02-21T06:12:20Z",
                          "2017-02-21T06:12:20Z",
                          "2017-02-21T06:12:20Z",
                          "2017-02-21T06:12:20Z"
                 }
             ]
    ]
}
```

Example POST Request with DATE and TIMESTAMP Format

Example 6-6 Oracle REST Data services Time Zone Set as Europe/London

Oracle Database DATE and TIMESTAMP data types do not have a time zone associated with them. The DATE and TIMESTAMP values are associated with the time zone of the application. Oracle REST Data Services and the REST- Enabled SQL service return values in a JSON format. The standard for JSON is to return date and timestamp values using the UTC Zulu format. Oracle REST Data Services and the REST- Enabled SQL service return Oracle Database DATE and TIMESTAMP values in the Zulu format using the time zone in which Oracle REST Data Services is running.

Oracle recommends running Oracle REST Data Services using the UTC time zone to make this process easier.

```
File: date.json
{
    "statementText":"SELECT TO_DATE('2016-01-01 10:00:03','yyyy-mm-
dd hh24:mi:ss') winter, TO_DATE('2016-07-01 10:00:03','yyyy-mm-dd
hh24:mi:ss') summer FROM dual;"
}

Request: curl -i -X POST --user DEMO:demo --data-binary "@date.json" -H
"Content-Type: application/json" -k https://localhost:8088/ords/demo/_/sql
```



Response:

Note:

In this example, both DATE values are specified as 10 a.m. The "summer" value is returned as 9 a.m. Zulu time. This is due to British Summer Time.

```
HTTP/1.1 200 OK
Date: Wed, 26 Jul 2017 14:59:27 GMT
Content-Type: application/json
X-Frame-Options: SAMEORIGIN
Transfer-Encoding: chunked
Server: Jetty(9.2.21.v20170120)
    "env":{
        "defaultTimeZone": "Europe/London"
    "items":[
             "statementId":1,
            "statementType": "query",
            "statementPos":{
                 "startLine":1,
                 "endLine":1
            "statementText":"SELECT TO_DATE('2016-01-01 10:00:03','yyyy-
mm-dd hh24:mi:ss') winter, TO DATE('2016-07-01 10:00:03','yyyy-mm-dd
hh24:mi:ss' ) summer FROM dual",
            "response":[
             ],
            "result":0,
            "resultSet":{
                 "metadata":[
                         "columnName": "WINTER",
                         "jsonColumnName": "winter",
                         "columnTypeName": "DATE",
                         "precision":0,
                         "scale":0,
                         "isNullable":1
                         "columnName": "SUMMER",
                         "jsonColumnName": "summer",
                         "columnTypeName":"DATE",
                         "precision":0,
                         "scale":0,
                         "isNullable":1
                 ],
                 "items":[
                         "winter": "2016-01-01T10:00:03Z",
                         "summer": "2016-07-01T09:00:03Z"
```

Data Types and Formats Supported

The following code snippet shows the different data types and the formats supported:

```
?,?,?,?,?,?,?,?,?,?,?,?,?,?,? FROM dual",
   "binds":[
          "index":1,
          "data_type": "NUMBER",
          "value":1233
          "index":2,
          "data_type": "NUMERIC",
          "value":123
          "index":3,
          "data_type": "DECIMAL",
          "value":123
          "index":4,
          "data_type": "DEC",
          "value":123
          "index":5,
          "data_type": "NUMBER",
          "value":123
          "index":6,
          "data_type":"INTEGER",
          "value":123
          "index":7,
          "data_type":"INT",
          "value":123
      },
```

```
{
    "index":8,
    "data_type": "SMALLINT",
    "value":123
    "index":9,
    "data_type":"FLOAT",
    "value":123
    "index":10,
    "data_type": "DOUBLE PRECISION",
    "value":123
    "index":11,
    "data_type": "REAL",
    "value":123
    "index":12,
    "data_type": "BINARY_FLOAT",
    "value":123
    "index":13,
    "data_type": "BINARY_DOUBLE",
    "value":123
    "index":14,
    "data_type": "CHAR",
    "value": "abc"
    "index":15,
    "data_type": "CHARACTER",
    "value": "abc"
    "index":16,
    "data_type": "VARCHAR",
    "value": "abc"
    "index":17,
    "data_type": "VARCHAR2",
    "value": "abc"
    "index":18,
    "data_type": "CHAR VARYING",
    "value": "abc"
},
```

```
"index":19,
    "data_type": "CHARACTER VARYING",
    "value": "abc"
    "index":20,
    "data_type": "NCHAR",
    "value": "abc"
    "index":21,
    "data_type": "NATIONAL CHAR",
    "value": "abc"
    "index":22,
    "data_type": "NATIONAL CHARACTER",
    "value": "abc"
    "index":23,
    "data_type": "NVARCHAR",
    "value": "abc"
    "index":24,
    "data_type": "NVARCHAR2",
    "value": "abc"
    "index":25,
    "data_type": "NCHAR VARYING",
    "value": "abc"
    "index":26,
    "data_type": "NATIONAL CHAR VARYING",
    "value": "abc"
    "index":27,
    "data_type": "NATIONAL CHARACTER VARYING",
    "value": "abc"
    "index":28,
    "data_type":"DATE",
    "value": "01-Jan-2016"
    "index":29,
    "data_type": "TIMESTAMP",
    "value":"1976-02-01T00:00:00Z"
},
```

```
{
    "index":30,
    "data_type": "TIMESTAMP",
    "value":"1976-02-01T00:00:00Z"
    "index":31,
    "data_type": "TIMESTAMP WITH LOCAL TIME ZONE",
    "value":"1976-02-01T00:00:00Z"
    "index":32,
    "data_type": "TIMESTAMP WITH TIME ZONE",
    "value": "1976-02-01T00:00:00Z"
    "index":33,
    "data_type":"INTERVALYM",
    "value": "P10Y10M"
    "index":34,
    "data_type":"INTERVAL YEAR TO MONTH",
    "value": "P10Y10M"
    "index":35,
    "data_type":"INTERVAL YEAR(2) TO MONTH",
    "value": "P10Y10M"
    "index":36,
    "data_type": "INTERVALDS",
    "value": "P11DT10H10M10S"
    "index":37,
    "data_type": "INTERVAL DAY TO SECOND",
    "value": "P11DT10H10M10S"
    "index":38,
    "data_type":"INTERVAL DAY(2) TO SECOND(6)",
    "value": "P11DT10H10M10S"
    "index":39,
    "data_type": "ROWID",
    "value":1
    "index":40,
    "data_type": "RAW",
    "value": "AB"
},
```

```
{
    "index":41,
    "data_type":"LONG RAW",
    "value":"AB"
},
{
    "index":42,
    "data_type":"CLOB",
    "value":"clobvalue"
},
{
    "index":43,
    "data_type":"NCLOB",
    "value":"clobvalue"
},
{
    "index":45,
    "data_type":"LONG",
    "value":"A"
}
]
```

REST-Enabled SQL Request and Response Specifications

The following sections provide REST-Enabled SQL request and response specifications:

- Request Specification
- Response Specification

Request Specification

Request Specification for application/sql

The body of the request is in plain UTF8 text. Statements can be separated by their usual SQL*Plus terminator.

Specification for application/json

JSONPath	Typ e	Description	Example	Default Value	Possible Values
\$.statementTex t	Strin g	Specifies the SQL statements to	"select 1 from dual"	Not applicable	Not applicable



JSONPath	Typ e	Description	Example	Default Value	Possible Values
\$.statementTex t	Array	Specifies batch DML statements using an array. One DML statement is specified per string in an array.	["insert into test1 values(1)", "update test1 set col1=2"]	Not applicable	Not applicable
\$.offset	Num ber	Specifies the number of rows to offset the query result. This is used for pagination of the result set returned from a query.	25	0	Between 0 to misc.pagination .maxRows.
<pre>\$.limit</pre>	Num ber	Specifies the maximum number of rows returned from a query. Values greater than the value of the misc.paginatio n.maxRows property, specified in the defaults.xml, is ignored.	500	misc.pag ination. maxRows	Between 0 to misc.pagination .maxRows.
\$.binds	Array	Specifies an array of objects specifying the bind information.	"binds": [{ "name": "mybind1", "data_type" :"NUMBER", "mode":"out " }, { "name":"m ybind2", "data_type" :"NUMBER", "value":7 }]	Not applicable	Not applicable
<pre>\$.binds[*].nam e</pre>	Strin g	Specifies the name of the bind, when you are using named notation.	"mybind"	Not applicable	Not applicable
<pre>\$.binds[*].ind ex</pre>	Num ber	Specifies the index of bind, when you are using positional notation.	1	Not applicable	Between 1 to n



JSONPath	Typ e	Description	Example	Default Value	Possible Values
<pre>\$.binds[*].dat a_type</pre>	Strin g	Specifies Oracle data type of the bind.	"NUMBER"	Not applicable	For more information, refer to Oracle Built-in Types
<pre>\$.binds[*].val ue</pre>	Any valu e	Specifies the value of the bind.	"value to insert"	null	Can be one of the following datatypes: Number String Array For more information, refer to Oracle Built-in Types
<pre>\$.binds[*].mod e</pre>	Strin g	Specifies the mode in which the bind is used.	"out"	"in"	["in" , "inout", "out"]
<pre>\$.binds[*].bat ch</pre>	Bool ean	Specifies whether or not you want to perform a batch bind. If you want to perform a batch bind, then set the value to true. If the value is set to true, then \$binds[*] must consist of an array of values.	true	false	[true, false]
<pre>\$.binds[*].typ e_name</pre>	Strin g	Required when you are using \$binds[*]. data_type = "PL/SQL TABLE" Currently, only an empty string is accepted as the value.	п п	Not applicable	Not applicable
<pre>\$.binds[*].typ e_subname</pre>	Strin g	Required when you are using \$binds[*]. data_type = "PL/SQL TABLE" Currently, only an empty string is accepted as the value.	н н	Not applicable	Not applicable



JSONPath	Typ e	Description	Example	Default Value	Possible Values
<pre>\$.binds[*].typ e_components</pre>	Array	Specifies an array of data types in the PL/SQL TABLE	[{"data_typ e":"NUMBER" }]		Not applicable
		Required when you are using \$binds[*]. data_type = "PL/SQL TABLE"			
<pre>\$.binds[*].typ e_components[*].data_type</pre>		Specifies Oracle data type of a column in the PL/SQL TABLE. Required when you are using \$binds[*]. data_type = "PL/SQL TABLE"	"NUMBER"	Not applicable	For more information, refer to Oracle Built-in Types

Response Specification

JSONPath	Data type	Description	Example Values	Possible values
\$.env	Object	Specifies the information about the Oracle REST Data Services environment.	Not applicable	Not applicable
<pre>\$.env.defaultTimeZone</pre>	String	Specifies the timezone in which Oracle REST Data Services server is running on.	"Europe/ London"	Not applicable
\$.items	Array	Specifies that there is one item for each statement executed.	Not applicable	Not applicable
<pre>\$.items[*].statementI d</pre>	Number	Specifies the sequence number of the statement.	1	Not applicable
<pre>\$.items[*].statementT ype</pre>	String	Specifies the type of statement.	"query"	["query" , "dml", "ddl", "plsql" , "sqlplus" , "ignore", "transaction- control", "session- control", "system- control", "jdbc", "other"]



JSONPath	Data type	Description	Example Values	Possible values
<pre>\$.items[*].statementP os</pre>	Object	Specifies information about the position of a specified statement.	Not applicable	Not applicable
<pre>\$.items[*].statementP os.startLine</pre>	Number	Specifies start line of the statement.	Not applicable	Not applicable
<pre>\$.items[*].statementP os.endLine</pre>	Number	Specifies end line of the statement.	Not applicable	Not applicable
<pre>\$items[*].statementTe xt</pre>	String	Specifies the SQL statement to be executed.	"select 1 from dual"	Not applicable
<pre>\$items[*].statementTe xt</pre>	Array	Specifies batch DML statements can be specified using an array. One DML statement specified per string in an array.	<pre>["insert into test1 values(1) ","update test1 set col1=2"]</pre>	Not applicable
<pre>\$.items[*].response</pre>	Array	Specifies array of Strings. The response generated when running the statement.	<pre>["\n1 row inserted. \n\n"]</pre>	Not applicable
<pre>\$.items[*].result</pre>	Number	Specifies the result generated when running the statement. For DML statements, this will be the number of rows affected.	5	Not applicable
<pre>\$.items[*].result</pre>	Array	Specifies the result generated when running each of the batch statements. For DML statements, this will be the number of rows affected.	[1, 1, 2]	Not applicable
<pre>\$.items[*].resultSet</pre>	Object	Specifies information about the result set generated from a query.	Not applicable	Not applicable



JSONPath	Data type	Description	Example Values	Possible values
\$.items[*].resultSet. metadata	Array	Specifies each object in the array provides information about the metadata of a column.	Not applicable	Not applicable
<pre>\$.items[*].resultSet. metadata[*].columnNam e</pre>	String	Specifies the name of the column used in the Oracle Database.	Not applicable	Not applicable
<pre>\$.items[*].resultSet. metadata[*].jsonColum nName</pre>	String	Specifies the name of the column used in \$.items[*].resu ltSet.items[*]. <columnname></columnname>	Not applicable	Not applicable
<pre>\$.items[*].resultSet. metadata[*].columnTyp eName</pre>	String	Specifies the Oracle Database data type of the column.	Not applicable	Not applicable
<pre>\$.items[*].resultSet. metadata[*].precision</pre>	Number	Specifies the precision of the column.	Not applicable	Not applicable
<pre>\$.items[*].resultSet. metadata[*].scale</pre>	Number	Specifies the scale of the column.	Not applicable	Not applicable
<pre>\$.items[*].resultSet. metadata[*].isNullabl e</pre>	Number	Specifies whether the column is nullable or not. 0, if the column is not nullable. 1, if the column is nullable.	Not applicable	Not applicable
<pre>\$.items[*].resultSet. items</pre>	Array	Specifies the list of all rows returned in the result set.	Not applicable	Not applicable
<pre>\$.items[*].resultSet. items[*].<columnname></columnname></pre>	Any type	Specifies the value of a particular column and row in the result set.	Not applicable	Not applicable



JSONPath	Data type	Description	Example Values	Possible values
<pre>\$.items[*].resultSet. hasMore</pre>	Boolean	Specifies whether result set has more rows. Value is set to true if the result set has more rows, otherwise set to false.	false	[true , false]
		The rows in the result set depend on misc.pagination .maxRows value configured in defaults.xml file or as specified in the request.		
<pre>\$.items[*].resultSet. count</pre>	Number	Specifies the number of rows returned.	Not applicable	Not applicable
<pre>\$.items[*].resultSet. offset</pre>	Number	Specifies the number of rows to offset the query result. This is used for pagination of the result set returned from a query.	25	Between 0 to misc.pagination .maxRows
<pre>\$.items[*].resultSet. limit</pre>	Number	Specifies the maximum number of rows returned from a query. Values greater than misc.pagination .maxRows value specified in defaults.xml file are ignored.	500	Between 0 to misc.pagination .maxRows



JSONPath	Data type	Description	Example Values	Possible values
\$.items[*].binds	Array	Specifies an array of objects specifying the bind information.	<pre>"binds": [{ "name ":"mybind 1", "data_typ e":"NUMBE R", "mode":"o ut" }, { "name": "mybind2" , "data_typ e":"NUMBE R", "value":7 }]</pre>	Not applicable
<pre>\$.items[*].binds[*].n ame</pre>	String	Specifies the name of the bind, when you are using named notation.	"mybind"	Not applicable
<pre>\$.items[*].binds[*].i ndex</pre>	Number	specifies ilndex of bind, when you are using positional notation.	1	1 - n
<pre>\$.items[*].binds[*].d ata_type</pre>	String	Specifies the Oracle data type of the bind.	"NUMBER"	For more information, refer to Oracle Built-in Types
<pre>\$.items[*].binds[*].v alue</pre>	Any type	Specifies the value of the bind.	"value to insert"	Can be one of the following data types: Number String Array For more information, refer to Oracle Built-in Types
<pre>\$.items[*].binds[*].r esult</pre>	Any type	Specifies the result of an OUT bind.	Not applicable	Not applicable
<pre>\$.items[*].binds[*].m ode</pre>	String	Specifies the mode in which the bind is used.	"out"	["in" , "inout", "out"]



Data type	Description	Example Values	Possible values
Boolean	Specifies whether or not you want to perform a batch bind. If you want to perform a batch bind, then set the value to true.	true	[true, false]
	If a batch bind is to be performed, then the value is set to true.		
	If the value is set to true, then \$binds[*] value must be an array of values.		
String	Required when using \$binds[*]. data_type = "PL/SQL TABLE".	н н	Not applicable
	Currently, only an empty string is accepted as the value.		
String	Required when using \$binds[*]. data_type = "PL/SQL TABLE".	11 11	Not applicable
	Currently, only an empty string is accepted as the value.		
Array	Array of data types in the PL/SQL TABLE	[{"data_t ype":"NUM BER"}]	Not applicable
	Required when using \$binds[*]. data_type = "PL/SQL TABLE".		
String	The Oracle data type of a column in the PL/SQL TABLE.	"NUMBER"	For more information, refer to Oracle Built-in Types
	Required when using \$binds[*]. data_type = "PL/SQL TABLE"		
	Boolean String Array	Boolean Specifies whether or not you want to perform a batch bind. If you want to perform a batch bind, then set the value to true. If a batch bind is to be performed, then the value is set to true, then \$binds[*] value must be an array of values. String Required when using \$binds[*]. data_type = "PL/SQL TABLE". Currently, only an empty string is accepted as the value. String Required when using \$binds[*]. data_type = "PL/SQL TABLE". Currently, only an empty string is accepted as the value. Array Array of data types in the PL/SQL TABLE ". Currently, only an empty string is accepted as the value. Array Array of data types in the PL/SQL TABLE ". String The Oracle data type of a column in the PL/SQL TABLE ". String The Oracle data type of a column in the PL/SQL TABLE ". Required when using \$binds[*]. data_type = "PL/SQL TABLE". Required when using \$binds[*]. data_type = "PL/SQL TABLE".	Boolean Specifies whether or not you want to perform a batch bind. If you want to perform a batch bind, then set the value to true. If a batch bind is to be performed, then the value is set to true. If the value is set to true, then \$binds[*] value must be an array of values. String Required when using \$binds[*]. data_type = "PL/SQL TABLE". Currently, only an empty string is accepted as the value. String Required when using \$binds[*]. data_type = "PL/SQL TABLE". Currently, only an empty string is accepted as the value. Array Array of data types in the PL/SQL TABLE ". Required when using \$binds[*]. data_type = "PL/SQL TABLE". String The Oracle data type of a column in the PL/SQL TABLE. Required when using \$binds[*]. data_type = "PL/SQL TABLE". String The Oracle data type of a column in the PL/SQL TABLE. Required when using \$binds[*]. data_type = "PL/SQL TABLE". String The Oracle data type of a column in the PL/SQL TABLE. Required when using \$binds[*]. data_type = "PL/SQL TABLE. Required when using \$binds[*]. data_type = "PL/SQL TABLE. Required when using \$binds[*]. data_type = "PL/SQL TABLE.



Supported SQL, SQL*Plus, and SQLcl Statements

This section lists all the supported SQL, SQL*Plus and SQLcl statements for REST-Enabled SQL service.

Topics

- Supported SQL Statements
- Supported PL/SQL Statements
- Supported SQL*Plus Statements
- Supported SQLcl Statements

Supported SQL Statements

This section describes the SQL statements that the REST- Enabled SQL service supports.

REST- Enabled SQL service supports all SQL commands. If the specified Oracle Database schema has the appropriate privileges, then you can run them. Oracle REST Data Services makes all queries into in-line views before execution to provide pagination support. Queries are made in-line irrespective of the format in which you provide the query. All the other nonquery SQL statements are executed as they are.

In-line views have the following limitations:

- All column names in a query must be unique because the views and in-line views cannot have ambiguous column names.
- Cursor expressions are not displayed in view or in-line views.
- WITH FUNCTION clause is not supported in in-line views.

Related Topics

SQL_statements_ref

Supported PL/SQL Statements

The REST- Enabled SQL service supports PL/SQL statements and blocks.

Example 6-7 PL/SQL Statement

```
DECLARE v_message VARCHAR2(100) := 'Hello World';
BEGIN
   FOR i IN 1..3 LOOP
      DBMS_OUTPUT.PUT_LINE (v_message);
   END LOOP;
END;
//
```

Related Topics

plsql_block



Supported SQL*Plus Statements

This section lists all the SQL*Plus statements that the REST- Enabled SQL service supports.

REST- Enabled SQL service supports most of the SQL*Plus statements except those statements that are related to formatting. The specific Oracle Database schema must have the appropriate privileges to run the SQL*Plus statemments.

The following is a list of supported SQL*Plus statements:

• SET system_variable value



system_variable and value represent one of the clauses described in Set System Variables section.

- / (slash)
- DEF[INE] [variable] | [variable = text]
- DESC[RIBE] {[schema.]object[@connect_identifier]}
- EXEC[UTE] statement
- HELP | ? [topic]
- PRINT [variable ...]
- PRO[MPT] [text]
- REM[ARK]
- SHO[W] [option]
- TIMI[NG] [START text | SHOW | STOP]
- UNDEF[INE] variable ...
- VAR[IABLE] [variable [type][=value]]

Related Topics

sqlplus_commands

Set System Variables

The following is a list of possible values for system_variable and value:



The command SET CMDS[EP] {; | c | ON | OFF} is obsolete.

- SET APPI[NFO]{ON | OFF | text}
- SET AUTOP[RINT] {ON | OFF}



- SET AUTOT[RACE] {ON | OFF | TRACE[ONLY]} [EXP[LAIN]] [STAT[ISTICS]]
 SET BLO[CKTERMINATOR] {. | c | ON | OFF}
- SET CMDS[EP] {; | c | ON | OFF}
- SEI CMDS[EP] (/ C | ON | OFF
- SET COLINVI[SIBLE] [ON | OFF]
- SET CON[CAT] {. | c | ON | OFF}
- SET COPYC[OMMIT] {0 | n}
- SET DEF[INE] {& | c | ON | OFF}
- SET DESCRIBE [DEPTH $\{1 \mid n \mid ALL\}$] [LINENUM $\{ON \mid OFF\}$] [INDENT $\{ON \mid OFF\}$]
- SET ECHO {ON | OFF}
- SET ERRORL[OGGING] {ON | OFF} [TABLE [schema.]tablename] [TRUNCATE] [IDENTIFIER identifier]
- SET ESC[APE] {\ | c | ON | OFF}
- SET FEED[BACK] {6 | n | ON | OFF | ONLY}]
- SET SERVEROUT[PUT] {ON | OFF} [SIZE {n | UNL[IMITED]}] [FOR[MAT] {WRA[PPED] | WOR[D_WRAPPED] | TRU[NCATED]}]
- SET SHOW[MODE] {ON | OFF}
- SET SQLBL[ANKLINES] {ON | OFF}
- SET SQLP[ROMPT] {SQL> | text}
- SET TI[ME] {ON | OFF}
- SET TIMI[NG] {ON | OFF}
- SET VER[IFY] {ON | OFF}

Related Topics

set-system_var_summary

Show System Variables

This section lists the possible values for option which is either a term or a clause used in the SHO[W] option command.

The following is a list of possible values for the option variable:



The commands SHOW CMDSEP and SHOW DESCR[IBE] are obsolete.

- SHOW system_variable
- SHOW EDITION
- SHOW ERR[ORS] [{ ANALYTIC VIEW | ATTRIBUTE DIMENSION | HIERARCHY | FUNCTION | PROCEDURE | PACKAGE | PACKAGE BODY | TRIGGER | VIEW | TYPE | TYPE BODY | DIMENSION | JAVA CLASS } [schema.]name]



- SHOW PDBS
- SHOW SGA
- SHOW SQLCODE
- SHOW COLINVI[SIBLE]
- SHOW APPIN[FO]
- SHOW AUTOT[RACE]
- SHOW BINDS
- SHOW BLO[CK TERMINATOR]
- SHOW CMDSEP
- SHOW COPYTYPECHECK
- SHOW COPYCOMMIT
- SHOW DEFINE
- SHOW DEFINES
- SHOW DESCR[IBE]
- SHOW ECHO
- SHOW EDITION
- SHOW ERRORL[OGGING]
- SHOW ESC[APE]
- SHOW FEEDBACK
- SHOW CONCAT
- SHOW SHOW[MODE]
- SHOW RECYC[LEBIN]
- SHOW RELEASE
- SHOW SQLBL[ANKLINES]
- SHOW SCAN
- SHOW SERVEROUT[PUT]
- SHOW SPACE
- SHOW TABLES
- SHOW TIMI[NG]
- SHOW USER
- SHOW VER[IFY]
- SHOW XQUERY

Related Topics

show_command



Supported SQLcl Statements

This section lists the SQLcl statements that the REST- Enabled SQL service supports.

REST- Enabled SQL service supports some of the SQLcl statements. The specific Oracle Database schema must have the appropriate privileges to run the SQLcl statements.

The following is a list of supported SQLcl statements:

- CTAS
- DDL
- SET DDL



7

Migrating from mod_plsql to ORDS

This chapter demonstrates how a mod_plsql application is migrated to Oracle REST Data Services (ORDS).

Oracle REST Data Services is a Java EE-based alternative for Oracle HTTP Server and mod_plsql. An Oracle HTTP Server mod_plsql application can be migrated to ORDS by defining new ORDS configuration files. The mod_plsql database resources such as before procedures, after procedures, request validation functions, owa_custom packages, doc upload procedures and doc tables require no change when you are migrating to ORDS.

Topics:

- Oracle HTTP Server mod plsql Authentication
- Example Oracle HTTP Server DAD file
- Mapping mod_plsql Settings to ORDS
- Example ORDS Configuration Files
- Example ORDS URL Mapping
- Example ORDS Default Configuration
- ORDS Authentication
- ORDS Features

Oracle HTTP Server mod_plsql Authentication

Oracle HTTP Server mod_plsql applications are configured in a database access descriptor (DAD) file.

The following example mod_plsql application provides the methods to authenticate the requests against the Oracle Database:

- Basic authentication: The username and password are stored in the DAD file
 and so the end user is not required to log in. This method is useful for web pages
 that provide public information.
- Basic dynamic authentication: The users provide credentials in a browser HTTP basic authentication dialog box. The only way to log out is to close all the instances of the browser.
- Custom authentication: Enables applications to invoke a user-written authentication function to authenticate the users within the application and not at the database level.

Related Topics

Oracle HTTP Server mod_plsql

Example Oracle HTTP Server DAD file

This section provides an example Oracle HTTP Server DAD file.

The following dads.conf file includes three locations demonstrating the basic, basic dynamic and custom authentications and the following directives:

- PlsqlBeforeProcedure
- PlsqlAfterProcedure
- PlsqlRequestValidationFunction
- PlsqlDocumentTablename
- PlsqlDocumentProcedure

Example 7-1 dads.conf file

```
______
#
                   mod_plsql DAD Configuration File
#
______
<Location /pls/basic_auth>
 SetHandler pls_handler
 Order deny,allow
 Allow from all
 AllowOverride
                                None
 PlsqlDatabaseUsername
                                PRIVILEGED_USER
 PlsqlDatabasePassword
                                passwordFOR$ORD5Example
 PlsqlDatabaseConnectString
                                oracle-ee:1521:ORCLPDB1
ServiceNameFormat
 PlsqlAuthenticationMode
                                Basic
 PlsqlBeforeProcedure
                                sample_plsql_app_metadata.beforeProc
 PlsqlAfterProcedure
                                sample_plsql_app_metadata.afterProc
 PlsqlRequestValidationFunction
sample_plsql_app_metadata.validationFunc
 PlsqlDocumentTablename
                                privileged_user.doc_table
 PlsqlDocumentProcedure
                                privileged_user.upload
</Location>
<Location /pls/basic_dynamic_auth>
 SetHandler pls_handler
 Order deny, allow
 Allow from all
 AllowOverride
                                None
 PlsqlDatabaseConnectString
                                oracle-ee:1521:ORCLPDB1
ServiceNameFormat
 PlsqlAuthenticationMode
 PlsqlBeforeProcedure
                                sample_plsql_app_metadata.beforeProc
 PlsqlAfterProcedure
                                sample_plsql_app_metadata.afterProc
 PlsqlRequestValidationFunction
sample_plsql_app_metadata.validationFunc
```



</location> <Location /pls/custom_auth> SetHandler pls_handler Order deny, allow Allow from all AllowOverride None PlsqlDatabaseUsername PRIVILEGED_USER PlsqlDatabasePassword passwordF0R\$0RD5Example oracle-ee:1521:ORCLPDB1 PlsqlDatabaseConnectString ServiceNameFormat PlsqlAuthenticationMode CustomOwa sample_plsql_app_metadata.beforeProc PlsqlBeforeProcedure PlsqlAfterProcedure sample_plsql_app_metadata.afterProc PlsqlRequestValidationFunction sample_plsql_app_metadata.validationFunc </location>

Mapping mod_plsql Settings to ORDS

This section shows the mappings of mod_plsql settings to ORDS.

ORDS allows you to specify configuration files that are similar to a location defined in an Oracle HTTP Server mod_plsql DAD file. Each configuration file is defined in ords_conf/ords/conf directory and the configuration file is then mapped to a particular URL using the ords_conf/ords/url-mapping.xml file. ORDS provides the following configurable parameters that can be used when migrating mod_plsql directives:

Table 7-1 Mappings of mod_plsql Directives to ORDS Settings

mod_plsql Setting	ORDS Setting	Description
PlsqlDatabaseUserName	db.username	Specifies the username to use to log in to the database.
		ORDS and mod_plsql are equivalent.
PlsqlDatabasePassword	db.password	Specifies the password to use to log in to the database. ORDS and mod_plsql are equivalent.
PlsqlDatabaseConnectStr ing	Multiple Settings such as: db.hostname db.port db.servicename db.sid	Specifies the connection to an Oracle database. ORDS and mod_plsql are equivalent.



Table 7-1 (Cont.) Mappings of mod_plsql Directives to ORDS Settings

mod_plsql Setting	ORDS Setting	Description
PlsqlAuthenticationMode	security.requestAuthent icationFunction	Specifies the authentication mode to use to allow access. When security.requestAuthent icationFunction is not specified, ORDS behavior is same as Basic mode of mod_plsql. When security.requestAuthent icationFunction is specified, ORDS can perform the same action as example dad directive PlsqlAuthenticationMode CustomOwaof mod_plsql. Example ORDS equivalent configuration parameter: <entry key="security.requestAuthenticationFunction">r rivileged_user.owa_custom.authorize</entry> ORDS and mod_plsql are
PlsqlBeforeProcedure	procedure.preProcess	equivalent. Specifies the procedure to be invoked before calling the requested procedure. ORDS and mod_plsql are equivalent.
PlsqlAfterProcedure	procedure.postProcess	Specifies the procedure to be invoked after calling the requested procedure. ORDS and mod_plsql are equivalent.
PlsqlRequestValidationF unction	security.requestValidat ionFunction	Specifies an application-defined PL/SQL function that can allow or disallow further processing of the requested procedure. ORDS and mod_plsql are equivalent.
PlsqlDocumentTablename	owa.docTable	Specifies the table in the database to which all documents are uploaded. ORDS and mod_plsql are equivalent.



Table 7-1 (Cont.) Mappings of mod_plsql Directives to ORDS Settings

mod_plsql Setting	ORDS Setting	Description
PlsqlDocumentProcedure	N/A	Specifies the procedure to call when a document download is initiated.
		In ORDS the document procedure is the requested resource. It is not defined in the configuration file.
		ORDS and mod_plsql are equivalent.
PlsqlDocumentPath	N/A	ORDS has no equivalent.
PlsqlDefaultPage	misc.defaultPage	Specifies the default procedure to call if none is specified in the URL. ORDS and mod_plsql are
		equivalent.
PlsqlErrorStyle	debug.printDebugToScree n	Specifies the error reporting mode for mod_plsql errors.
		debug.printDebugToScree n is equivalent to PlsqlErrorStyle DebugStyle, otherwise there is no equivalent.
		ORDS and mod_plsql are equivalent.
PlsqlExclusionList	security.exclusionList	Specifies a pattern for procedures, packages, or schema names which are forbidden to be directly run from a browser.
		See Understanding Configurable Parameters.
		ORDS and mod_plsql are equivalent.
PlsqlIdleSessionCleanup Interval	jdbc.InactivityTimeout	Specifies the time (in minutes) in which the idle database sessions should be closed and cleaned.
		Value can be 0 to N seconds. Where, 0 (default) means that the idle connections are not removed from pool.
		ORDS and mod_plsql are equivalent.



Table 7-1 (Cont.) Mappings of mod_plsql Directives to ORDS Settings

mod_plsql Setting	ORDS Setting	Description
PlsqlMaxRequestsPerSess ion	jdbc.MaxConnectionReuse Count	Specifies the maximum number of requests a pooled database connection should service before it is closed and re-opened.
		Default value is 1000. ORDS and mod_plsql are equivalent.
PlsqlInfoLogging	N/A	See Understanding Configurable Parameters.
PlsqlLogDirectory	N/A	See Understanding Configurable Parameters.
PlsqlLogEnable	N/A	See Understanding Configurable Parameters.
PlsqlSessionStateManage ment	N/A	Specifies how package and session state should be cleaned up at the end of each request.
		ORDS always performs: dbms_session.modify_pac kage_state(dbms_session.reinitialize) at the end of each request.
PlsqlAlwaysDescribeProc edure	N/A	Specifies whether the mod_plsql application should describe a procedure before trying to run it.
		ORDS always describes procedure on first access, and then the definition is cached. Changes in signature are detected and recached.
PlsqlConnectionValidati on	N/A	Specifies the mechanism the mod_plsql module should use to detect terminated connections in its connection pool. ORDS always validates
PlsqlFetchBufferSize	N/A	connections on borrow. Specifies the number of rows of content to fetch from the database for each trip, using either owa_util.get_page or owa_util.get_page_raw.
		ORDS materializes results as a 32K VARCHAR or CLOB if results are greater than 32K, so not applicable.



Table 7-1 (Cont.) Mappings of mod_plsql Directives to ORDS Settings

mod_plsql Setting	ORDS Setting	Description
PlsqlNLSLanguage	N/A	Specifies the NLS_LANG variable.
		ORDS, Java, and JDBC use unicode.
PlsqlTransferMode	N/A	PlsqlTransferMode specifies the transfer mode for data from the database back to the mod_plsql application.
		ORDS always uses unicode.
PlsqlBindBucketLengths	N/A	Specifies the rounding size to use while binding the number of elements in a collection bind.
		Rarely used in mod_plsql, and JDBC has no equivalent concept.
PlsqlBindBucketWidths	N/A	Specifies the rounding size to use while binding the number of elements in a collection bind.
		Rarely used in mod_plsql and JDBC has no equivalent concept.
PlsqlCacheCleanupTime	N/A	ORDS has no equivalent.
PlsqlDMSEnable	N/A	ORDS does not support DMS.
PlsqlSessionCookieName	N/A	ORDS does not offer session management for PL/SQL Gateway calls.
PlsqlCacheDirectory	N/A	ORDS has no equivalent.
PlsqlCacheEnable	N/A	ORDS has no equivalent.
PlsqlCacheMaxAge	N/A	ORDS has no equivalent.
PlsqlCacheMaxSize	N/A	ORDS has no equivalent.
PlsqlCacheTotalSize	N/A	ORDS has no equivalent.
PlsqlCGIEnvironmentList	N/A	ORDS has no equivalent.
PlsqlConnectionTimeout	N/A	ORDS has no equivalent.
PlsqlPathAlias	N/A	ORDS has no equivalent.
PlsqlPathAliasProcedure	N/A	ORDS has no equivalent.
PlsqlUploadAsLongRaw	N/A	ORDS has no equivalent.



Example ORDS Configuration Files

The following sections show how the example mod_plsql application can be migrated to ORDS.

Topics:

- Example Configuration File for Basic Authentication
- Example Configuration File for Basic Dynamic Authentication
- Example Configuration file for Custom Authentication

Example Configuration File for Basic Authentication

Example 7-2 ords_conf/ords/conf/basic_auth.xml

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<!DOCTYPE properties SYSTEM "http://java.sun.com/dtd/properties.dtd">
properties>
    <comment>Saved on Wed Jul 25 10:22:37 UTC 2018/comment>
    <entry key="db.username">PRIVILEGED_USER</entry>
    <entry key="db.password">!passwordFOR$ORD5Example</entry>
    <!-- Example url -->
    <!-- See url-mapping.xml -->
    <!-- http://localhost:8086/ords/pls/basic_auth/
sample_plsql_app.sample_public_proc-->
    <!-- http://localhost:8086/ords/pls/basic_auth/
sample_plsql_app.privileged_public_proc-->
    <entry
key="procedure.postProcess">sample_plsql_app_metadata.afterProc</entry>
key="procedure.preProcess">sample_plsql_app_metadata.beforeProc</entry>
    <entry
key="security.requestValidationFunction">sample_plsql_app_metadata.valid
ationFunc</entry>
    <entry key="owa.docTable">sample_plsql_app.doc_table/entry>
</properties>
```

Example Configuration File for Basic Dynamic Authentication

Example 7-3 ords_conf/ords/conf/basic_dynamic_auth.xml

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<!DOCTYPE properties SYSTEM "http://java.sun.com/dtd/properties.dtd">
comment>Saved on Wed Jul 25 10:22:37 UTC 2018</comment>
     <!-- NOTE THAT IF THIS USER HAS EXECUTE PRIVILEGE ON THE RESOURCE
THEN jdbc.auth.enabled IS IGNORED -->
     <!-- IF THIS USER DOES NOT HAVE EXECUTE PRIVILEGE ON THE RESOURCE
THEN jdbc.auth.enabled IS INVOKED AND THE CREDENTIALS OF A PRIVILEGED</pre>
```



```
USER HAS TO BE PROVIDED -->
    <entry key="db.username">NON_PRIVILEGED_USER</entry>
    <entry key="db.password">!passwordFOR$ORD5Example</entry>
    <entry key="jdbc.auth.enabled">true</entry>
    <!-- Example url -->
    <!-- See url-mapping.xml -->
    <!-- INVOKE jdbc.auth.enabled :
                                     http://localhost:8086/ords/pls/
basic_dynamic_auth/sample_plsql_app.sample_privileged_proc -->
    <!-- IGNORE jdbc.auth.enabled : http://localhost:8086/ords/pls/
basic_dynamic_auth/sample_plsql_app.sample_public_proc
    <!-- Because jdbc.auth.enabled is ignored when referencing the
sample_public_app, the beforeProc,afterProc and validationFunc must be
accessible by NON_PRIVILEGED_USER -->
    <!-- The following objects are executed by the same credentials
used to access the resource -->
    <!-- If the resource can be accessed by the db.username then that
connection is used to access these methods -->
    <!-- If the resource cannot be accessed by the db.username then
jdbc.auth.enabled is invoked and those credentials as used to access
these methods -->
    <entry
key="procedure.postProcess">sample_plsql_app_metadata.afterProc</entry>
    <entry
key="procedure.preProcess">sample_plsql_app_metadata.beforeProc</entry>
key="security.requestValidationFunction">sample_plsql_app_metadata.valid
ationFunc</entry>
</properties>
```

Example Configuration file for Custom Authentication

Example 7-4 ords_confs/ords/conf/custom_auth.xml

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<!DOCTYPE properties SYSTEM "http://java.sun.com/dtd/properties.dtd">
cproperties>
    <comment>Saved on Wed Jul 25 10:22:37 UTC 2018/comment>
    <entry key="db.username">PRIVILEGED USER</entry>
    <entry key="db.password">!passwordF0R$0RD5Example</entry>
    <!-- Example url -->
    <!-- See url-mapping.xml -->
    <!-- http://localhost:8086/ords/pls/custom_auth/
sample_plsql_app.sample_proc -->
    <!-- privileged_user.owa_custom.authorize requires the following as
the custom login -->
    <entry
key="procedure.postProcess">sample_plsql_app_metadata.afterProc</entry>
key="procedure.preProcess">sample_plsql_app_metadata.beforeProc</entry>
key="security.requestValidationFunction">sample_plsql_app_metadata.valid
ationFunc</entry>
    <entry
```

```
key="security.requestAuthenticationFunction">privileged_user.owa_custom.
authorize</entry>
</properties>
```

Example ORDS URL Mapping

This section shows the example mapping between base-path url and the configuration files.

Example 7-5 ords_conf/ords/url-mapping.xml

Example ORDS Default Configuration

This section shows the example default configuration setting for ORDS.

The defaults.xml file provides the database connection details used by all configurations.



To turn off procedure validation caching, set security.maxEntries value to
0. This is necessary to emulate Oracle HTTP Server mod_plsql.

Example 7-6 ords_conf/ords/defaults.xml

ORDS Authentication

ORDS has the ability to perform HTTP Basic Authentication by providing a one to one mapping from mod_plsql. In ORDS more secure methods of authentication are available.

Topics:

- Basic Authentication
- Basic Dynamic Authentication
- Custom Authentication

Related Topics

Developing Oracle REST Data Services Applications

Basic Authentication

This section describes the basic authentication implemented using ORDS.

The database credentials are specified in the ORDS configuration file. The db.username must have the required privileges to access the resources.



The entry security.requestAuthenticationFunction is not specified.

Basic Dynamic Authentication

This section describes how basic dynamic authentication is implemented using ORDS.

A default db.username and db.password must be specified in ORDS configuration file when providing basic dynamic authentication for accessing the resources.

The resources that cannot be accessed using this type of authentication can be accessed if the following conditions are satisfied:

- The value for <entry key="jdbc.auth.enabled">true</entry> entry must be true..
- The security.requestAuthenticationFunction entry must not be specified.
- When ORDS response prompts a Basic HTTP Authentication dialog box in a browser, the credentials provided by the user must have the required privileges, then the resource is made available.





If the credentials are provided through the browser HTTP authentication dialog box, then the only way to log out is to close all the instances of the browser.

Custom Authentication

This section describes how custom authentication is implemented using ORDS.

A function is specified to perform the custom authentication. This function has access to the owa variables. Resources are only available if the following function returns a TRUE value:

```
<entry
key="security.requestAuthenticationFunction">privileged_user.owa_custom.au
thorize</entry>
```

The authentication function must have signature as shown in the following code snippet:

```
/**
* OWA_CUSTOM used in mod_plsql when the following is used in the dad
configuration file
  PlsqlAuthenticationMode
                                Custom
  In ORDS environment this can reside in any schema as long as the
connection has execute privileges
  In mod_plsql this has to reside in the connections schema as you
cannot specify the name of the schema, package or function
  ex: PlsqlAuthenticationMode
                                        CustomOwa
CREATE OR REPLACE PACKAGE OWA_CUSTOM AS
 * Response:
  >IF Failed
  WWW-Authenticate in response header
   Authorization Required
   You are not authorized to access the requested resource. Check the
supplied credentials (e.g., username and password).
 * /
FUNCTION authorize RETURN BOOLEAN;
END OWA_CUSTOM ;
```

ORDS Features

This section describes the ORDS features that are useful when you are migrating from a mod_plsql application to ORDS.

Topics:

Request Validation Function

- Pre Process Feature
- Post Process Feature
- File Upload Feature

Request Validation Function

This section explains the use of request validation function.

The request validation function restricts the access to resources. The request validation function is provided with the name of the resource being requested and returns TRUE or FALSE value in response.

If the request validation function returns a ${\tt FALSE}$ value, then ORDS terminates the request.

Example 7-7 security.requestValidationFunction

<entry

key="security.requestValidationFunction">sample_plsql_app_metadata.valid
ationFunc</entry>

You can choose any name for the validation function. However, the signature must be in the following format:

CREATE OR REPLACE FUNCTION validationfunc(procedure_name VARCHAR2) RETURN BOOLEAN IS.

Pre Process Feature

This section describes the procedure preProcess ORDS configuration parameter.

The procedure preprocess ORDS configuration parameter allows a comma delimited list of procedures that are executed before the requested resource.

Example 7-8 procedure.preProcess

Following example code snippet shows a use case for logging in:

<entry key="procedure.preProcess">sample_plsql_app_metadata.beforeProc/
entry>

Post Process Feature

This section describes the procedure.postProcess ORDS configuration parameter.

The procedure.postProcess ORDS configuration parameter allows a comma delimited list of procedures that are executed after the requested resource.

Example 7-9 procedure.postProcess

Following example code snippet shows a use case for logging out:

<entry key="procedure.postProcess">sample_plsql_app_metadata.afterProc/
entry>



File Upload Feature

This section describes the ORDS file upload feature.

The ORDS configuration parameter owa.docTable, defines the table name where the uploaded files persist.

Example 7-10 Table upload

```
CREATE TABLE DOC_TABLE (
                                    UNIQUE NOT NULL,
    NAME
                      VARCHAR (256)
    MIME_TYPE
                      VARCHAR(128),
    DOC_SIZE
                     NUMBER,
    DAD CHARSET
                    VARCHAR(128),
    LAST UPDATED
                     DATE,
    CONTENT_TYPE
                      VARCHAR(128),
    CONTENT
                      LONG RAW,
    BLOB CONTENT
                      BLOB );
```

Example 7-11 Procedure upload

You can choose to have any name for the upload function. However, the signature must match the following POST request:

```
--The parameters of the procedure should match the parameters of the request
--The procedure is called after ORDS performs the file upload/insert.
--This procedure can rollback the file INSERT as it is in the same transaction as the INSERT
CREATE OR REPLACE PROCEDURE upload (filename VARCHAR2 DEFAULT NULL)
```

Example 7-12 Curl command for file upload

```
curl -i -X POST -F 'filename=@helloworld.txt' "http://localhost:8086/
ords/pls/basic_auth/example_user1.upload
```

Cross-Origin Resource Sharing Feature

This section describes the Cross-Origin Resource Sharing (CORS) feature.

By default ORDS does not allow cross-origin calls to its PL/SQL gateway.

Trusted origins can be configured through the

security.externalSessionTrustedOrigins configuration parameter that defines a comma separated list of origins that are trusted to make CORS request. If this parameter is empty or not configured, then no CORS requests are allowed for the PL/SQL gateway and results in a 403 Unauthorized status.

<entry key="security.externalSessionTrustedOrigins">http://example.com,
https://example.com:8443



8

Oracle REST Data Services PL/SQL Package Reference

The Oracle REST Data Services PL/SQL package contains subprograms (procedures and functions) for developing RESTful services using Oracle REST Data Services.

Related Topics

Using the Oracle REST Data Services PL/SQL API

ORDS.CREATE_ROLE

Format

```
ORDS.CREATE_ROLE(
    p_role_name IN sec_roles.name%type);
```

Description

CREATE ROLE creates an Oracle REST Data Services role with the specified name.

Parameters

p_role_name

Name of the role.

Usage Notes

After the role is created, it can be associated with any Oracle REST Data Services privilege.

Examples

The following example creates a role.

```
EXECUTE ORDS.CREATE_ROLE(p_role_name=>'Tickets User');
```

ORDS.CREATE_SERVICE



ORDS.CREATE_SERVICE is deprecated. Use ORDS.DEFINE_SERVICE instead

Format

Description

Creates a new RESTful service.

Parameters

p module name

The name of the RESTful service module. Case sensitive. Must be unique.

p_base_path

The base of the URI that is used to access this RESTful service. Example: hr/ means that all URIs starting with hr/ will be serviced by this resource module.

p_pattern

A matching pattern for the resource template. For example, a pattern of / objects/:object/:id? will match /objects/emp/101 (matches a request for the item in the emp resource with id of 101) and will also match /objects/emp/ (matches a request for the emp resource, because the :id parameter is annotated with the ? or question mark modifier, which indicates that the id parameter is optional).

p method

The HTTP method to which this handler will respond. Valid values: GET (retrieves a representation of a resource), POST (creates a new resource or adds a resource to a collection), PUT (updates an existing resource), DELETE (deletes an existing resource).

p_source_type

The HTTP request method for this handler. Valid values:

- source_type_collection_feed. Executes a SQL query and transforms the result set into an Oracle REST Data Services Standard JSON representation. Available when the HTTP method is GET. Result Format: JSON
- source_type_collection_item. Executes a SQL query returning one row of data into a Oracle REST Data Services Standard JSON representation. Available when the HTTP method is GET. Result Format: JSON



- source_type_media. Executes a SQL query conforming to a specific format and turns the result set into a binary representation with an accompanying HTTP Content-Type header identifying the Internet media type of the representation. Result Format: Binary
- source_type_plsql. Executes an anonymous PL/SQL block and transforms any OUT or IN/OUT parameters into a JSON representation. Available only when the HTTP method is DELETE. PUT. or POST. Result Format: JSON
- source_type_query || source_type_csv_query. Executes a SQL query and transforms the result set into either an Oracle REST Data Services legacy JavaScript Object Notation (JSON) or CSV representation, depending on the format selected. Available when the HTTP method is GET. Result Format: JSON or CSV
- source_type_query_one_row. Executes a SQL query returning one row of data into an Oracle REST Data Services legacy JSON representation. Available when the HTTP method is GET. Result Format: JSON
- source_type_feed. Executes a SQL query and transforms the results into a
 JSON Feed representation. Each item in the feed contains a summary of a
 resource and a hyperlink to a full representation of the resource. The first column
 in each row in the result set must be a unique identifier for the row and is used
 to form a hyperlink of the form: path/to/feed/{id}, with the value of the first
 column being used as the value for {id}. The other columns in the row are
 assumed to summarize the resource and are included in the feed. A separate
 resource template for the full representation of the resource should also be
 defined. Result Format: JSON

p source

The source implementation for the selected HTTP method.

p items per page

The default pagination for a resource handler HTTP operation GET method, that is, the number of rows to return on each page of a JSON format result set based on a database query. Default: NULL (defers to the resource module setting).

p_status

The publication status. Valid values: 'PUBLISHED' (default) or 'NOT_PUBLISHED'.

p_etag_type

A type of entity tag to be used by the resource template. An entity tag is an HTTP Header that acts as a version identifier for a resource. Use entity tag headers to avoid retrieving previously retrieved resources and to perform optimistic locking when updating resources. Valid values: 'HASH' or 'QUERY' or 'NONE'.

- HASH Known as Secure HASH: The contents of the returned resource representation are hashed using a secure digest function to provide a unique fingerprint for a given resource version.
- QUERY Manually define a query that uniquely identifies a resource version.
 A manually defined query can often generate an entity tag more efficiently than hashing the entire resource representation.
- NONE Do not generate an entity tag.

p_etag_query

A guery that is used to generate the entity tag.



p_mimes_allowed

A comma-separated list of MIME types that the handler will accept. Applies to PUT and POST only.

p_module_comments

Comment text.

p_template_comments

Comment text.

p_handler_comments

Comment text.

Usage Notes

Creates a resource module, template, and handler in one call.

This procedure is deprecated. Use ORDS.DEFINE_SERVICE instead.

Examples

The following example creates a simple service.

ORDS.DEFINE_HANDLER

Format

```
ORDS.DEFINE_HANDLER(

p_module_name IN ords_modules.name%type,

p_pattern IN ords_templates.uri_template%type,

p_method IN ords_handlers.method%type DEFAULT 'GET',

p_source_type IN ords_handlers.source_type%type

DEFAULT ords.source_type_collection_feed,

p_source IN ords_handlers.source%type,

p_items_per_page IN ords_handlers.items_per_page%type DEFAULT NULL,

p_mimes_allowed IN ords_handlers.mimes_allowed%type DEFAULT NULL);

p_comments IN ords_handlers.comments%type DEFAULT NULL);
```

Description

DEFINE_HANDLER defines a module handler. If the handler already exists, then the handler and any existing handlers will be replaced by this definition; otherwise, a new handler is created.



Parameters

p_module_name

Name of the owning RESTful service module. Case sensitive.

p_pattern

Matching pattern for the owning resource template.

p method

The HTTP method to which this handler will respond. Valid values: GET (retrieves a representation of a resource), POST (creates a new resource or adds a resource to a collection), PUT (updates an existing resource), DELETE (deletes an existing resource).

p source type

The HTTP request method for this handler. Valid values:

- source_type_collection_feed. Executes a SQL query and transforms the result set into an Oracle REST Data Services Standard JSON representation. Available when the HTTP method is GET. Result Format: JSON
- source_type_collection_item. Executes a SQL query returning one row of data into a Oracle REST Data Services Standard JSON representation. Available when the HTTP method is GET. Result Format: JSON
- source_type_media. Executes a SQL query conforming to a specific format and turns the result set into a binary representation with an accompanying HTTP Content-Type header identifying the Internet media type of the representation. Result Format: Binary
- source_type_plsql. Executes an anonymous PL/SQL block and transforms any OUT or IN/OUT parameters into a JSON representation. Available only when the HTTP method is DELETE, PUT, or POST. Result Format: JSON
- source_type_query || source_type_csv_query. Executes a SQL query and transforms the result set into either an Oracle REST Data Services legacy JavaScript Object Notation (JSON) or CSV representation, depending on the format selected. Available when the HTTP method is GET. Result Format: JSON or CSV
- source_type_query_one_row. Executes a SQL query returning one row of data into an Oracle REST Data Services legacy JSON representation. Available when the HTTP method is GET. Result Format: JSON
- source_type_feed. Executes a SQL query and transforms the results into a
 JSON Feed representation. Each item in the feed contains a summary of a
 resource and a hyperlink to a full representation of the resource. The first column
 in each row in the result set must be a unique identifier for the row and is used
 to form a hyperlink of the form: path/to/feed/{id}, with the value of the first
 column being used as the value for {id}. The other columns in the row are
 assumed to summarize the resource and are included in the feed. A separate
 resource template for the full representation of the resource should also be
 defined. Result Format: JSON

p_source

The source implementation for the selected HTTP method.



p_items_per_page

The default pagination for a resource handler HTTP operation GET method, that is, the number of rows to return on each page of a JSON format result set based on a database query. Default: NULL (defers to the resource module setting).

p mimes allowed

Comma-separated list of MIME types that the handler will accept. Applies to PUT and POST only.

p_comments

Comment text.

Usage Notes

Only one handler for each HTTP method (source type) is permitted.

Examples

The following example defines a POST handler to the /my/tickets/ resource to accept new tickets.

```
BEGIN
 ORDS.DEFINE_HANDLER(
   p_module_name => 'my.tickets',
   p_pattern => '.',
   p_method => 'POST',
   p_mimes_allowed => 'application/json',
   p_source_type => ords.source_type_plsql,
   p_source => '
      declare
        1 owner varchar2(255);
        l payload blob;
       l id number;
      begin
        l_payload := :body;
        l_owner := :owner;
        if ( l_owner is null ) then
          l_owner := :current_user;
        end if;
        l_id := ticket_api.create_ticket(
          p_json_entity => l_payload,
         p_author => l_owner
        :location := ''./'' || l_id;
        :status := 201;
      end;
  );
END;
```

ORDS.DEFINE_MODULE

Format



Description

DEFINE_MODULE defines a resource module. If the module already exists, then the module and any existing templates will be replaced by this definition; otherwise, a new module is created.

Parameters

p module name

Name of the owning RESTful service module. Case sensitive.

p_base_path

The base of the URI that is used to access this RESTful service. Example: hr/ means that all URIs starting with hr/ will be serviced by this resource module.

p_items_per_page

The default pagination for a resource handler HTTP operation GET method, that is, the number of rows to return on each page of a JSON format result set based on a database query. Default: 25.

p_status

Publication status. Valid values: PUBLISHED (default) or NOT PUBLISHED.

p_comments

Comment text.

Usage Notes

(None.)

Examples

The following example creates a simple module.

```
BEGIN
   ORDS.DEFINE_MODULE(
     p_module_name => 'my.tickets',
     p_base_path => '/my/tickets/'
);
END;
```

ORDS.DEFINE_PARAMETER

Format

```
ORDS.DEFINE_PARAMETER(

p_module_name IN ords_modules.name%type,

p_pattern IN ords_templates.uri_template%type,

p_method IN ords_handlers.method%type,

p_name IN ords_parameters.name%type ,

p_bind_variable_name IN ords_parameters.bind_variable_name%type

DEFAULT NULL,

p_source_type IN ords_parameters.source_type%type DEFAULT 'HEADER',

p_param_type IN ords_parameters.param_type%type DEFAULT 'STRING',
```

Description

DEFINE_PARAMETER defines a module handler parameter. If the parameter already exists, then the parameter will be replaced by this definition; otherwise, a new parameter is created.

Parameters

p_module_name

Name of the owning RESTful service module. Case sensitive.

p pattern

Matching pattern for the owning resource template.

p_method

The owning handler HTTP Method. Valid values: GET (retrieves a representation of a resource), POST (creates a new resource or adds a resource to a collection), PUT (updates an existing resource), DELETE (deletes an existing resource).

p name

The name of the parameter, as it is named in the URI Template or HTTP Header. Used to map names that are not valid SQL parameter names.

p_bind_variable_name

The name of the parameter, as it will be referred to in the SQL. If NULL is specified, then the parameter is unbound.

p_source_type

The type that is identified if the parameter originates in the URI Template or a HTTP Header. Valid values: HEADER, RESPONSE, URI.

p_param_type

The native type of the parameter. Valid values: STRING, INT, DOUBLE, BOOLEAN, LONG, TIMESTAMP.

p_access_method

The parameter access method. Indicates if the parameter is an input value, output value, or both. Valid values: IN, OUT, INOUT.

p_comments

Comment text.

Usage Notes

All parameters must have unique names and variable names for the same handler.

Examples

The following example defines an outbound parameter on the POST handler to store the location of the created ticket.

```
BEGIN
  ORDS.DEFINE_PARAMETER(
    p_module_name => 'my.tickets',
    p_pattern => '.',
```



```
p_method => 'POST',
    p_name => 'X-APEX-FORWARD',
    p_bind_variable_name => 'location',
    p_source_type => 'HEADER',
    p_access_method => 'OUT'
);
END;
/
```

The following example defines an outbound parameter on the POST handler to store the HTTP status of the operation.

```
BEGIN
ORDS.DEFINE_PARAMETER(
    p_module_name => 'my.tickets',
    p_pattern => '.',
    p_method => 'POST',
    p_name => 'X-APEX-STATUS-CODE',
    p_bind_variable_name => 'status',
    p_source_type => 'HEADER',
    p_access_method => 'OUT'
);
END;
//
```

ORDS.DEFINE_PRIVILEGE

Format

```
ORDS.DEFINE_PRIVILEGE(
  p roles
                IN owa.vc arr,
  p_patterns
                IN owa.vc_arr,
 p_modules
                IN owa.vc_arr,
  p_label
                IN sec_privileges.label%type DEFAULT NULL,
  p_description IN sec_privileges.description%type DEFAULT NULL, p_comments IN sec_privileges.comments%type DEFAULT NULL);
ORDS.DEFINE_PRIVILEGE(
  p_roles
p_patterns
p_label
                 IN owa.vc_arr,
                IN owa.vc_arr,
                IN sec_privileges.label%type DEFAULT NULL,
  p_description IN sec_privileges.description%type DEFAULT NULL,
                 IN sec_privileges.comments%type DEFAULT NULL);
  p_comments
or
ORDS.DEFINE_PRIVILEGE(
 p_comments
                IN sec_privileges.comments%type DEFAULT NULL);
```

Description

DEFINE_PRIVILEGE defines an Oracle REST Data Services privilege. If the privilege already exists, then the privilege and any existing patterns and any associations with modules and roles will be replaced by this definition; otherwise, a new privilege is created.

Parameters

p_privilege_name

Name of the privilege. No spaces allowed.

p roles

The names of the roles, at least one of which the privilege requires. May be empty, in which case the user must be authenticated but does not require any specific role; however, must not be null. Unauthenticated users will be denied access.

p_patterns

A list of patterns.

p modules

A list of module names referencing modules created for the current schema.

p label

Name of this security constraint as displayed to an end user. May be null.

p_description

A brief description of the purpose of the resources protected by this constraint.

p comments

Comment text.

Usage Notes

<code>p_roles</code>, <code>p_patterns</code>, and <code>p_modules</code> do not accept null values. If no value is to be passed, then either choose the appropriate procedure specification or pass an empty <code>owa.vc_arr value</code>.

Examples

The following example creates a privilege connected to roles, patterns, and modules:

```
DECLARE
 l_priv_roles owa.vc_arr;
 l_priv_patterns owa.vc_arr;
 l_priv_modules owa.vc_arr;
 l priv roles(1) := 'Tickets User';
 l_priv_patterns(1) := '/my/*';
 l_priv_patterns(2) := '/comments/*';
 l_priv_patterns(3) := '/tickets_feed/*';
 l_priv_patterns(4) := '/tickets/*';
 l_priv_patterns(5) := '/categories/*';
  l_priv_patterns(6) := '/stats/*';
  l_priv_modules(1) := 'my.tickets';
  ords.create_role('Tickets User');
  ords.define_privilege(
   p_privilege_name => 'tickets.privilege',
   P_modules => l_priv_modules,
p_label => 'Task Ticketing Access',
p_description => 'Provides the ability to create, ' ||
```



The following example creates a privilege connected to roles and patterns:

```
DECLARE
 l_priv_roles owa.vc_arr;
 l_priv_patterns owa.vc_arr;
BEGIN
  l_priv_roles(1) := 'Tickets User';
  l_priv_patterns(1) := '/my/*';
  1_priv_patterns(2) := '/comments/*';
  l_priv_patterns(3) := '/tickets_feed/*';
  l_priv_patterns(4) := '/tickets/*';
  l_priv_patterns(5) := '/categories/*';
  l_priv_patterns(6) := '/stats/*';
  ords.create_role('Tickets User');
  ords.define_privilege(
   p_privilege_name => 'tickets.privilege',
   p_roles
                      => l_priv_roles,
   p_patterns
                      => l_priv_patterns,
                      => 'Task Ticketing Access',
   p_label
                      => 'Provides the ability to create, ' ||
   p_description
                          'update and delete tickets ' ||
                           'and post comments on tickets'
  );
END;
```

The following example creates a privilege connected to roles:

```
DECLARE
 l_priv_roles owa.vc_arr;
BEGIN
 l_priv_roles(1) := 'Tickets User';
 ords.create_role('Tickets User');
  ords.define_privilege(
   p_privilege_name => 'tickets.privilege',
                       => l_priv_roles,
   p_roles
                       => 'Task Ticketing Access',
   p_label
   p_description
                      => 'Provides the ability to create, ' ||
                           'update and delete tickets ' ||
                           'and post comments on tickets'
  );
END;
```

ORDS.DEFINE_SERVICE

Format



Description

DEFINE_SERVICE defines a resource module, template, and handler in one call. If the module already exists, then the module and any existing templates will be replaced by this definition; otherwise, a new module is created.

Parameters

p_module_name

Name of the RESTful service module. Case sensitive. Must be unique.

p_base_path

The base of the URI that is used to access this RESTful service. Example: hr/ means that all URIs starting with hr/ will be serviced by this resource module.

p_pattern

A matching pattern for the resource template. For example, a pattern of / objects/:object/:id? will match /objects/emp/101 (matches a request for the item in the emp resource with id of 101) and will also match /objects/emp/. (Matches a request for the emp resource, because the :id parameter is annotated with the ? modifier, which indicates that the id parameter is optional.)

p method

The HTTP Method to which this handler will respond. Valid values: GET (retrieves a representation of a resource), POST (creates a new resource or adds a resource to a collection), PUT (updates an existing resource), DELETE (deletes an existing resource).

p source type

The HTTP request method for this handler. Valid values:

- source_type_collection_feed. Executes a SQL query and transforms the result set into an Oracle REST Data Services Standard JSON representation. Available when the HTTP method is GET. Result Format: JSON
- source_type_collection_item. Executes a SQL query returning one row of data into a Oracle REST Data Services Standard JSON representation. Available when the HTTP method is GET. Result Format: JSON
- source_type_media. Executes a SQL query conforming to a specific format and turns the result set into a binary representation with an accompanying HTTP Content-Type header identifying the Internet media type of the representation. Result Format: Binary



- source_type_plsql. Executes an anonymous PL/SQL block and transforms any OUT or IN/OUT parameters into a JSON representation. Available only when the HTTP method is DELETE, PUT, or POST. Result Format: JSON
- source_type_query || source_type_csv_query. Executes a SQL query and transforms the result set into either an Oracle REST Data Services legacy JavaScript Object Notation (JSON) or CSV representation, depending on the format selected. Available when the HTTP method is GET. Result Format: JSON or CSV
- source_type_query_one_row. Executes a SQL query returning one row of data into an Oracle REST Data Services legacy JSON representation. Available when the HTTP method is GET. Result Format: JSON
- source_type_feed. Executes a SQL query and transforms the results into a JSON Feed representation. Each item in the feed contains a summary of a resource and a hyperlink to a full representation of the resource. The first column in each row in the result set must be a unique identifier for the row and is used to form a hyperlink of the form: path/to/feed/{id}, with the value of the first column being used as the value for {id}. The other columns in the row are assumed to summarize the resource and are included in the feed. A separate resource template for the full representation of the resource should also be defined. Result Format: JSON

p_source

The source implementation for the selected HTTP method.

p_items_per_page

The default pagination for a resource handler HTTP operation GET method, that is, the number of rows to return on each page of a JSON format result set based on a database query. Default: NULL (defers to the resource module setting).

p status

Publication status. Valid values: PUBLISHED (default) or NOT PUBLISHED.

p_etag_type

A type of entity tag to be used by the resource template. An entity tag is an HTTP Header that acts as a version identifier for a resource. Use entity tag headers to avoid retrieving previously retrieved resources and to perform optimistic locking when updating resources. Valid values are HASH, QUERY, NONE:

- HASH (known as Secure HASH): The contents of the returned resource representation are hashed using a secure digest function to provide a unique fingerprint for a given resource version.
- QUERY: Manually define a query that uniquely identifies a resource version. A manually defined query can often generate an entity tag more efficiently than hashing the entire resource representation.
- NONE: Do not generate an entity tag.

p_etag_query

Query that is used to generate the entity tag.

p mimes allowed

Comma-separated list of MIME types that the handler will accept. Applies to PUT and POST only.



p_module_comments

Comment text.

p_template_comments

Comment text.

p handler comments

Comment text.

Usage Notes

Creates a resource module, template, and handler in one call.

Use this procedure instead of the deprecated ORDS.CREATE SERVICE procedure.

Examples

The following example defines a REST service that retrieves the current user's tickets.

The following example defines a REST service that retrieves tickets filtered by category.

ORDS.DEFINE TEMPLATE

Format

```
ORDS.DEFINE_TEMPLATE(

p_module_name IN ords_modules.name%type,

p_pattern IN ords_templates.uri_template%type,

p_priority IN ords_templates.priority%type DEFAULT 0,

p_etag_type IN ords_templates.etag_type%type DEFAULT 'HASH',

p_etag_query IN ords_templates.etag_query%type DEFAULT NULL,

p_comments IN ords_templates.comments%type DEFAULT NULL);
```



Description

DEFINE_TEMPLATE defines a resource template. If the template already exists, then the template and any existing handlers will be replaced by this definition; otherwise, a new template is created.

Parameters

p module name

Name of the owning RESTful service module. Case sensitive.

p_pattern

A matching pattern for the resource template. For example, a pattern of / objects/:object/:id? will match /objects/emp/101 (matches a request for the item in the emp resource with id of 101) and will also match /objects/emp/. (Matches a request for the emp resource, because the :id parameter is annotated with the ? modifier, which indicates that the id parameter is optional.)

p_priority

The priority for the order of how the resource template should be evaluated: 0 (low priority, the default) through 9 (high priority).

p_etag_type

A type of entity tag to be used by the resource template. An entity tag is an HTTP Header that acts as a version identifier for a resource. Use entity tag headers to avoid retrieving previously retrieved resources and to perform optimistic locking when updating resources. Valid values are HASH, QUERY, NONE:

- HASH (known as Secure HASH): The contents of the returned resource representation are hashed using a secure digest function to provide a unique fingerprint for a given resource version.
- QUERY: Manually define a query that uniquely identifies a resource version. A
 manually defined query can often generate an entity tag more efficiently than
 hashing the entire resource representation.
- NONE: Do not generate an entity tag.

p_etag_query

Query that is used to generate the entity tag.

p_comments

Comment text.

Usage Notes

he resource template pattern must be unique with a resource module.

Examples

The following example defines a resource for displaying ticket items.

```
BEGIN
  ORDS.DEFINE_TEMPLATE(
    p_module_name => 'my.tickets',
    p_pattern => '/:id'
);
```



```
END;
```

ORDS.DELETE_MODULE

Format

```
ORDS.DELETE_MODULE(
    p_module name IN ords modules.name%type);
```

Description

DELETE_MODULE deletes a resource module.

Parameters

p_module_name

Name of the owning RESTful service module. Case sensitive.

Usage Notes

If the module does not already exist or is accessible to the current user, then no exception is raised.

Examples

The following example deletes a resource module.

```
EXECUTE ORDS.DELETE_MODULE(p_module_name=>'my.tickets');
```

ORDS.DELETE PRIVILEGE

Format

```
ORDS.DELETE_PRIVILEGE(
    p_name IN sec_privileges.name%type);
```

Description

DELETE_PRIVILEGE deletes a provilege.

Parameters

p_name

Name of the privilege.

Usage Notes

If the privilege does not already exist or is not accessible to the current user, then no exception is raised.

Examples

The following example deletes a privilege.

```
EXECUTE ORDS.DELETE_PRIVILEGE(p_name=>'tickets.privilege');
```



ORDS.DELETE_ROLE

Format

```
ORDS.DELETE_ROLE(
    p_role_name IN sec_roles.name%type);
```

Description

DELETE ROLE deletes the named role.

Parameters

p_name

Name of the role.

Usage Notes

This will also delete any association between the role and any privileges that reference the role.

No exception is produced if the role does not already exist.

Examples

The following example deletes a role.

```
EXECUTE ORDS.DELETE_ROLE(p_role_name=>'Tickets User');
```

ORDS.DROP_REST_FOR_SCHEMA

Format

```
ORDS.DROP_REST_FOR_SCHEMA(
p_schema ords_schemas.parsing_schema%type_DEFAULT_NULL);
```

Description

DROP_REST_FOR_SCHEMA deletes all auto-REST Oracle REST Data Services metadata for the associated schema.

Parameters

p_schema

Name of the schema.

Usage Notes

This procedure effectively "undoes" the actions performed by the <code>ORDS.Enable_Schema</code> procedure.

Examples

The following example deletes all auto-REST Oracle REST Data Services metadata for the TICKETS schema.

```
EXECUTE ORDS.DROP_REST_FOR_SCHEMA('tickets');
```



Related Topics

ORDS.ENABLE_SCHEMA

ORDS.ENABLE_OBJECT

Format

Description

ENABLE_OBJECT enables Oracle REST Data Services access to a specified table or view in a schema.

Parameters

p enabled

TRUE to enable access; FALSE to disable access.

p schema

Name of the schema for the table or view.

p object

Name of the table or view.

p_object_type

Type of the object: TABLE (default) or VIEW.

p_object_alias

Alias of the object.

p_auto_rest_auth

Controls whether Oracle REST Data Services should require user authorization before allowing access to the Oracle REST Data Services metadata for this object. If this value is TRUE, then the service is protected by the following roles:

- oracle.dbtools.autorest.any.schema
- oracle.dbtools.role.autorest.<SCHEMANAME>.<OBJECTNAME>

Usage Notes

Only database users with the DBA role can enable/access to objects that they do now own.

Examples

The following example enables a table named CATEGORIES.

```
EXECUTE ORDS.ENABLE_OBJECT(p_object=>'CATEGORIES');
```

The following example enables a view named TICKETS_FEED.



```
BEGIN
  ORDS.ENABLE_OBJECT(
    p_object => 'TICKETS_FEED',
    p_object_type => 'VIEW'
);
END;
```

ORDS.DROP REST FOR OBJECT

Format

```
ORDS.DROP_REST_FOR_OBJECT(
    p_object ords_objects.parsing_object%type);
```

Description

DROP_REST_FOR_OBJECT deletes all auto-REST Oracle REST Data Services metadata for the associated schema object.

Parameters

p_object

Name of the table or view.

Usage Notes

This procedure effectively "undoes" the actions performed by the <code>ORDS.ENABLE_OBJECT</code> procedure.

Examples

The following example deletes all auto-REST Oracle REST Data Services metadata for the curent user CATEGORIES table.

```
BEGIN
   ORDS.DROP_REST_FOR_OBJECT(
     p_object=>'CATEGORIES'
   );
END;
//
```

ORDS.ENABLE SCHEMA

Format

```
ORDS.ENABLE_SCHEMA

p_enabled IN boolean DEFAULT TRUE,

p_schema IN ords_schemas.parsing_schema%type DEFAULT NULL,

p_url_mapping_type IN ords_url_mappings.type%type DEFAULT 'BASE_PATH',

p_url_mapping_pattern IN ords_url_mappings.pattern%type DEFAULT NULL,

p_auto_rest_auth IN boolean DEFAULT NULL);
```

Description

ENABLE_SCHEMA enables Oracle REST Data Services to access the named schema.



Parameters

p enabled

TRUE to enable Oracle REST Data Services access; FALSE to disable Oracle REST Data Services access.

p_schema

Name of the schema. If the p_schema parameter is omitted, then the current schema is enabled.

p_url_mapping_type

URL Mapping type: BASE_PATH or BASE_URL.

p_url_mapping_pattern

URL mapping pattern.

p auto rest auth

For a schema, controls whether Oracle REST Data Services should require user authorization before allowing access to the Oracle REST Data Services metadata catalog of this schema.

Usage Notes

Only database users with the DBA role can enable or disable a schema other than their own.

Examples

The following example enables the current schema.

```
EXECUTE ORDS.ENABLE_SCHEMA;
```

ORDS.PUBLISH_MODULE

Format

Description

PUBLISH_MODULE changes the publication status of an Oracle REST Data Services resource module.

Parameters

p module name

Current name of the RESTful service module. Case sensitive.

p status

Publication status. Valid values: PUBLISHED (default) or NOT_PUBLISHED.

Usage Notes

(None.)



Examples

The following example publishes a previously defined module named my.tickets.

```
EXECUTE ORDS.PUBLISH_MODULE(p_module_name=>'my.tickets');
```

ORDS.RENAME_MODULE

Format

Description

RENAME_MODULE lets you change the name or the base path, or both, of an Oracle REST Data Services resource module.

Parameters

p_module_name

Current name of the RESTful service module. Case sensitive.

p_new_name

New name to be assigned to the RESTful service module. Case sensitive. If this parameter is null, the name is not changed.

p_new_base_path

The base of the URI to be used to access this RESTful service. Example: hr/ means that all URIs starting with hr/ will be serviced by this resource module. If this parameter is null, the base path is not changed.

Usage Notes

Both the new resource module name and the base path must be unique within the enabled schema.

Examples

The following example renames resource module my.tickets to old.tickets.

```
BEGIN
   ORDS.RENAME_MODULE(
     p_module_name =>'my.tickets',
     p_new_name=>'old.tickets',
     p_new_base_path=>'/old/tickets/');
END;
//
```



ORDS.RENAME_PRIVILEGE

Format

Description

RENAME_PRIVILEGE renames a privilege.

Parameters

p_name

Current name of the privilege.

p_new_name

New name to be assigned to the privilege.

Usage Notes

(None.)

Examples

The following example renames the privilege tickets.privilege to old.tickets.privilege.

```
BEGIN
  ORDS.RENAME_PRIVILEGE(
    p_name =>'tickets.privilege',
    p_new_name=>'old.tickets.privilege');
END;
//
```

ORDS.RENAME ROLE

Format

Description

RENAME_ROLE renames a role.

Parameters

p_role_name

Current name of the role.

p_new_name

New name to be assigned to the role.

Usage Notes

p_role_name must exist.

Examples

The following example renames an existing role.

```
BEGIN
   ORDS.RENAME_ROLE(
     p_role_name=>'Tickets User',
     p_new_name=>'Legacy Tickets User');
END;
//
```

ORDS.SET_MODULE_ORIGINS_ALLOWED

Format

Description

SET_MODULE_ORIGINS_ALLOWED configures the allowed origins for a resource module. Any existing allowed origins will be replaced.

Parameters

p_module_name

Name of the resource module.

p_origins_allowed

A comma-separated list of URL prefixes. If the list is empty, any existing origins are removed.

Usage Notes

To indicate no allowed origins for a resource module (and remove any existing allowed origins), specify an empty p_origins_allowed value.

Examples

The following restricts the resource module my.tickets to two specified origins.

```
BEGIN
   ORDS.SET_MODULE_ORIGINS_ALLOWED(
    p_module_name => 'my.tickets',
    p_origins_allowed => 'http://example.com,https://example.com');
END;
//
```



ORDS.SET_URL_MAPPING

Format

Description

SET_URL_MAPPING configures how the specified schema is mapped to request URLs.

Parameters

p schema

Name of the schema to map. The default is the schema of the current user.

p_url_mapping_type

URL Mapping type: BASE_PATH or BASE_URL.

p_url_mapping_pattern

URL mapping pattern.

Usage Notes

Only DBA users can update the mapping of a schema other than their own.

Examples

The following example creates a BASE_PATH mapping for the current user.

```
BEGIN
ORDS.SET_URL_MAPPING(
    p_url_mapping_type => 'BASE_PATH',
    p_url_mapping_pattern => 'https://example.com/ords/ticketing'
);
END;
```

ORDS.SET_SESSION_DEFAULTS

Format

Description

Set defaults that apply for the duration of the database session.



Parameters

p schema

Name of the schema to map. The default is the schema of the current user.

p runtime user

Sets a runtime user as the target when you REST enable or disable the schemas. Otherwise all runtime users are targeted.

Usage Notes

NULL values have no effect. Use RESET_SESSION_DEFAULTS to reset values and start again.

Examples

The following example sets the ${\tt HR}$ user as the only grantee target for the "connect through" proxy privilege when a schema is REST enabled or disabled:

```
BEGIN
   ORDS.SET_SESSION_DEFAULTS(
     p_runtime_user => 'HR');
END;
//
```

ORDS.RESET_SESSION_DEFAULTS

Format

```
ORDS.RESET_SESSION_DEFAULTS;
```

Description

Reset session defaults back to the initial values.

Parameters

None.

Usage Notes

Use the SET_SESSION_DEFAULTS function to set the default values that are reset using this function.

Examples

The following example resets all the session default values:

```
BEGIN
                ORDS.RESET_SESSION_DEFAULTS;
END;
//
```



9

Oracle REST Data Services Administration PL/SQL Package Reference

The Oracle REST Data Services (ORDS) ADMIN PL/SQL package contains subprograms (procedures and functions) for developing and administering the RESTful services using Oracle REST Data Services for a privileged user.

Before a database user can invoke the <code>ORDS_ADMIN</code> package, they must be granted the <code>ORDS_ADMINISTRATOR_ROLE</code> database role.

The following example grants the ORDS_ADMINISTRATOR_ROLE role to the ADMIN user:

```
GRANT ORDS_ADMINSTRATOR_ROLE TO ADMIN;
```

The ORDS_ADMIN package is identical to the ORDS package except for the AUTHID CURRENT_USER right, without the deprecated methods and a p_schema parameter for every method where the target schema must be specified and some additional methods.

Related Topics

Oracle REST Data Services PL/SQL Package Reference

ORDS_ADMIN.CREATE_ROLE

Format

Description

CREATE_ROLE creates an Oracle REST Data Services role with the specified name.

Parameters

p schema

Name of the schema. This parameter is mandatory.

p_role_name

Name of the role.

Usage Notes

After the role is created, it can be associated with any Oracle REST Data Services privilege.

Examples

The following example creates a role.

```
BEGIN
  ORDS_ADMIN.CREATE_ROLE(
    p_schema => 'tickets',
    p_role_name => 'Tickets User'
};
END;
//
```

ORDS_ADMIN.DEFINE_HANDLER

Format

```
ORDS_ADMIN.DEFINE_HANDLER(

p_schema IN ords_schemas.parsing_schema%type,

p_module_name IN ords_modules.name%type,

p_pattern IN ords_templates.uri_template%type,

p_method IN ords_handlers.method%type DEFAULT 'GET',

p_source_type IN ords_handlers.source_type%type

DEFAULT ords_admin.source_type_collection_feed,

p_source IN ords_handlers.source%type,

p_items_per_page IN ords_handlers.items_per_page%type DEFAULT NULL,

p_mimes_allowed IN ords_handlers.mimes_allowed%type DEFAULT NULL);

p_comments IN ords_handlers.comments%type DEFAULT NULL);
```

Description

DEFINE_HANDLER defines a module handler. If the handler already exists, then the handler and any existing handlers will be replaced by this definition; otherwise, a new handler is created.

Parameters

p_schema

Name of the schema. This parameter is mandatory.

p_module_name

Name of the owning RESTful service module. Case sensitive.

p pattern

Matching pattern for the owning resource template.

p_method

The HTTP method to which this handler will respond. Valid values: GET (retrieves a representation of a resource), POST (creates a new resource or adds a resource to a collection), PUT (updates an existing resource), DELETE (deletes an existing resource).

p_source_type

The HTTP request method for this handler. Valid values:



- source_type_collection_feed. Executes a SQL query and transforms the result set into an Oracle REST Data Services Standard JSON representation. Available when the HTTP method is GET. Result Format: JSON
- source_type_collection_item. Executes a SQL query returning one row of data into a Oracle REST Data Services Standard JSON representation. Available when the HTTP method is GET. Result Format: JSON
- source_type_media. Executes a SQL query conforming to a specific format and turns the result set into a binary representation with an accompanying HTTP Content-Type header identifying the Internet media type of the representation. Result Format: Binary
- source_type_plsql. Executes an anonymous PL/SQL block and transforms any OUT or IN/OUT parameters into a JSON representation. Available only when the HTTP method is DELETE, PUT, or POST. Result Format: JSON
- source_type_query || source_type_csv_query. Executes a SQL query and transforms the result set into either an Oracle REST Data Services legacy JavaScript Object Notation (JSON) or CSV representation, depending on the format selected. Available when the HTTP method is GET. Result Format: JSON or CSV
- source_type_query_one_row. Executes a SQL query returning one row of data into an Oracle REST Data Services legacy JSON representation. Available when the HTTP method is GET. Result Format: JSON
- source_type_feed. Executes a SQL query and transforms the results into a JSON Feed representation. Each item in the feed contains a summary of a resource and a hyperlink to a full representation of the resource. The first column in each row in the result set must be a unique identifier for the row and is used to form a hyperlink of the form: path/to/feed/{id}, with the value of the first column being used as the value for {id}. The other columns in the row are assumed to summarize the resource and are included in the feed. A separate resource template for the full representation of the resource should also be defined. Result Format: JSON

p source

The source implementation for the selected HTTP method.

p items per page

The default pagination for a resource handler HTTP operation GET method, that is, the number of rows to return on each page of a JSON format result set based on a database guery. Default: NULL (defers to the resource module setting).

p_mimes_allowed

Comma-separated list of MIME types that the handler will accept. Applies to PUT and POST only.

p_comments

Comment text.

Usage Notes

Only one handler for each HTTP method (source type) is permitted.



Examples

The following example defines a POST handler to the /my/tickets/ resource to accept new tickets.

```
BEGIN
  ORDS_ADMIN.DEFINE_HANDLER(
   p_schema => 'tickets',
    p_module_name => 'my.tickets',
    p_pattern => '.',
    p_method => 'POST',
    p_mimes_allowed => 'application/json',
    p_source_type => ords_admin.source_type_plsql,
    p_source => '
      declare
        l_owner varchar2(255);
        l_payload blob;
        l_id number;
      begin
        l_payload := :body;
        l_owner := :owner;
        if ( l_owner is null ) then
          l_owner := :current_user;
        end if;
        l_id := ticket_api.create_ticket(
          p_json_entity => l_payload,
         p_author => l_owner
        :location := ''./'' || l_id;
        :status := 201;
      end;
  );
END;
```

ORDS_ADMIN.DEFINE_MODULE

Format

Description

DEFINE_MODULE defines a resource module. If the module already exists, then the module and any existing templates will be replaced by this definition; otherwise, a new module is created.



Parameters

p_schema

Name of the schema. This parameter is mandatory.

p module name

Name of the owning RESTful service module. Case sensitive.

p_base_path

The base of the URI that is used to access this RESTful service. Example: hr/ means that all URIs starting with hr/ will be serviced by this resource module.

p_items_per_page

The default pagination for a resource handler HTTP operation GET method, that is, the number of rows to return on each page of a JSON format result set based on a database query. Default: 25.

p_status

Publication status. Valid values: PUBLISHED (default) or NOT PUBLISHED.

p_comments

Comment text.

Usage Notes

(None.)

Examples

The following example creates a simple module.

```
BEGIN
  ORDS_ADMIN.DEFINE_MODULE(
    p_schema => 'tickets',
    p_module_name => 'my.tickets',
    p_base_path => '/my/tickets/'
);
END;
//
```

ORDS ADMIN.DEFINE PARAMETER

Format



Description

DEFINE_PARAMETER defines a module handler parameter. If the parameter already exists, then the parameter will be replaced by this definition; otherwise, a new parameter is created.

Parameters

p_schema

Name of the schema. This parameter is mandatory.

p_module_name

Name of the owning RESTful service module. Case sensitive.

p_pattern

Matching pattern for the owning resource template.

p_method

The owning handler HTTP Method. Valid values: GET (retrieves a representation of a resource), POST (creates a new resource or adds a resource to a collection), PUT (updates an existing resource), DELETE (deletes an existing resource).

p name

The name of the parameter, as it is named in the URI Template or HTTP Header. Used to map names that are not valid SQL parameter names.

p_bind_variable_name

The name of the parameter, as it will be referred to in the SQL. If NULL is specified, then the parameter is unbound.

p_source_type

The type that is identified if the parameter originates in the URI Template or a HTTP Header. Valid values: HEADER, RESPONSE, URI.

p_param_type

The native type of the parameter. Valid values: STRING, INT, DOUBLE, BOOLEAN, LONG, TIMESTAMP.

p_access_method

The parameter access method. Indicates if the parameter is an input value, output value, or both. Valid values: IN, OUT, INOUT.

p_comments

Comment text.

Usage Notes

All parameters must have unique names and variable names for the same handler.

Examples

The following example defines an outbound parameter on the POST handler to store the location of the created ticket.

```
BEGIN
  ORDS_ADMIN.DEFINE_PARAMETER(
   p_schema => 'tickets',
```



```
p_module_name => 'my.tickets',
p_pattern => '.',
p_method => 'POST',
p_name => 'X-APEX-FORWARD',
p_bind_variable_name => 'location',
p_source_type => 'HEADER',
p_access_method => 'OUT'
);
END;
//
```

The following example defines an outbound parameter on the POST handler to store the HTTP status of the operation.

```
BEGIN
ORDS_ADMIN.DEFINE_PARAMETER(
    p_schema => 'tickets',
    p_module_name => 'my.tickets',
    p_pattern => '.',
    p_method => 'POST',
    p_name => 'X-APEX-STATUS-CODE',
    p_bind_variable_name => 'status',
    p_source_type => 'HEADER',
    p_access_method => 'OUT'
);
END;
//
```

ORDS_ADMIN.DEFINE_PRIVILEGE

Format

```
ORDS_ADMIN.DEFINE_PRIVILEGE(
  IN owa.vc_arr,
  p_roles
  p_patterns
p_modules
                IN owa.vc_arr,
                IN owa.vc_arr,
  p_label
                IN sec_privileges.label%type DEFAULT NULL,
  p_description
                 IN sec_privileges.description%type DEFAULT NULL,
                 IN sec_privileges.comments%type DEFAULT NULL);
  p_comments
ORDS_ADMIN.DEFINE_PRIVILEGE(
  p_roles IN owa.vc_arr,
  IN sec_privileges.label%type DEFAULT NULL,
  p_description IN sec_privileges.description%type DEFAULT NULL, p_comments IN sec_privileges.comments%type DEFAULT NULL):
ORDS_ADMIN.DEFINE_PRIVILEGE(
  p_schema
                IN ords_schemas.parsing_schema%type,
  p_roles
                IN owa.vc_arr,
                IN sec_privileges.label%type DEFAULT NULL,
  p_label
  p_description IN sec_privileges.description%type DEFAULT NULL, p_comments IN sec_privileges.comments%type DEFAULT NULL);
```



Description

DEFINE_PRIVILEGE defines an Oracle REST Data Services privilege. If the privilege already exists, then the privilege and any existing patterns and any associations with modules and roles will be replaced by this definition; otherwise, a new privilege is created.

Parameters

p schema

Name of the schema. This parameter is mandatory.

p_privilege_name

Name of the privilege. No spaces allowed.

p_roles

The names of the roles, at least one of which the privilege requires. May be empty, in which case the user must be authenticated but does not require any specific role; however, must not be null. Unauthenticated users will be denied access.

p patterns

A list of patterns.

p_modules

A list of module names referencing modules created for the current schema.

p_labe

Name of this security constraint as displayed to an end user. May be null.

p description

A brief description of the purpose of the resources protected by this constraint.

p_comments

Comment text.

Usage Notes

<code>p_roles</code>, <code>p_patterns</code>, and <code>p_modules</code> do not accept null values. If no value is to be passed, then either choose the appropriate procedure specification or pass an empty <code>owa.vc_arr</code> value.

Examples

The following example creates a privilege connected to roles, patterns, and modules:

DECLARE

```
l_priv_roles owa.vc_arr;
l_priv_patterns owa.vc_arr;
l_priv_modules owa.vc_arr;
BEGIN
l_priv_roles(1) := 'Tickets User';
l_priv_patterns(1) := '/my/*';
l_priv_patterns(2) := '/comments/*';
l_priv_patterns(3) := '/tickets_feed/*';
l_priv_patterns(4) := '/tickets/*';
l_priv_patterns(5) := '/categories/*';
l_priv_patterns(6) := '/stats/*';
```



```
l_priv_modules(1) := 'my.tickets';
 ords_admin.create_role(
   p_schema => 'tickets',
   p_role_name => 'Tickets User'
 ords_admin.define_privilege(
   p_schema => 'tickets',
   => l_priv_patterns,
   p_patterns
   P_modules
                    => l_priv_modules,
                    => 'Task Ticketing Access',
   p_label
   p_description
                   => 'Provides the ability to create, ' ||
                       'update and delete tickets ' ||
                       'and post comments on tickets'
 );
END;
```

The following example creates a privilege connected to roles and patterns:

```
DECLARE
 l_priv_roles owa.vc_arr;
 l_priv_patterns owa.vc_arr;
 l_priv_roles(1) := 'Tickets User';
 l_priv_patterns(1) := '/my/*';
 l_priv_patterns(2) := '/comments/*';
 l_priv_patterns(3) := '/tickets_feed/*';
 l priv patterns(4) := '/tickets/*';
 l_priv_patterns(5) := '/categories/*';
 l_priv_patterns(6) := '/stats/*';
 ords_admin.create_role(
   p_schema => 'tickets',
   p_role_name => 'Tickets User'
 ords_admin.define_privilege(
   => 'Task Ticketing Access',
   p_label
   p_description
                   => 'Provides the ability to create, ' ||
                        'update and delete tickets ' ||
                        'and post comments on tickets'
 );
END;
```

The following example creates a privilege connected to roles:

```
DECLARE
    l_priv_roles owa.vc_arr;
BEGIN
    l_priv_roles(1) := 'Tickets User';
    ords_admin.create_role(
```



ORDS_ADMIN.DEFINE_SERVICE

Format

Description

DEFINE_SERVICE defines a resource module, template, and handler in one call. If the module already exists, then the module and any existing templates will be replaced by this definition; otherwise, a new module is created.

Parameters

p_schema

Name of the schema. This parameter is mandatory.

p_module_name

Name of the RESTful service module. Case sensitive. Must be unique.

p_base_path

The base of the URI that is used to access this RESTful service. Example: hr/ means that all URIs starting with hr/ will be serviced by this resource module.



p_pattern

A matching pattern for the resource template. For example, a pattern of / objects/:object/:id? will match /objects/emp/101 (matches a request for the item in the emp resource with id of 101) and will also match /objects/emp/. (Matches a request for the emp resource, because the :id parameter is annotated with the ? modifier, which indicates that the id parameter is optional.)

p method

The HTTP Method to which this handler will respond. Valid values: GET (retrieves a representation of a resource), POST (creates a new resource or adds a resource to a collection), PUT (updates an existing resource), DELETE (deletes an existing resource).

p_source_type

The HTTP request method for this handler. Valid values:

- source_type_collection_feed. Executes a SQL query and transforms the result set into an Oracle REST Data Services Standard JSON representation. Available when the HTTP method is GET. Result Format: JSON
- source_type_collection_item. Executes a SQL query returning one row of data into a Oracle REST Data Services Standard JSON representation. Available when the HTTP method is GET. Result Format: JSON
- source_type_media. Executes a SQL query conforming to a specific format and turns the result set into a binary representation with an accompanying HTTP Content-Type header identifying the Internet media type of the representation. Result Format: Binary
- source_type_plsql. Executes an anonymous PL/SQL block and transforms any OUT or IN/OUT parameters into a JSON representation. Available only when the HTTP method is DELETE, PUT, or POST. Result Format: JSON
- source_type_query || source_type_csv_query. Executes a SQL query and transforms the result set into either an Oracle REST Data Services legacy JavaScript Object Notation (JSON) or CSV representation, depending on the format selected. Available when the HTTP method is GET. Result Format: JSON or CSV
- source_type_query_one_row. Executes a SQL query returning one row of data into an Oracle REST Data Services legacy JSON representation. Available when the HTTP method is GET. Result Format: JSON
- source_type_feed. Executes a SQL query and transforms the results into a JSON Feed representation. Each item in the feed contains a summary of a resource and a hyperlink to a full representation of the resource. The first column in each row in the result set must be a unique identifier for the row and is used to form a hyperlink of the form: path/to/feed/{id}, with the value of the first column being used as the value for {id}. The other columns in the row are assumed to summarize the resource and are included in the feed. A separate resource template for the full representation of the resource should also be defined. Result Format: JSON

p_source

The source implementation for the selected HTTP method.



p_items_per_page

The default pagination for a resource handler HTTP operation GET method, that is, the number of rows to return on each page of a JSON format result set based on a database query. Default: NULL (defers to the resource module setting).

p status

Publication status. Valid values: PUBLISHED (default) or NOT PUBLISHED.

p_etag_type

A type of entity tag to be used by the resource template. An entity tag is an HTTP Header that acts as a version identifier for a resource. Use entity tag headers to avoid retrieving previously retrieved resources and to perform optimistic locking when updating resources. Valid values are HASH, QUERY, NONE:

- HASH (known as Secure HASH): The contents of the returned resource representation are hashed using a secure digest function to provide a unique fingerprint for a given resource version.
- QUERY: Manually define a query that uniquely identifies a resource version. A
 manually defined query can often generate an entity tag more efficiently than
 hashing the entire resource representation.
- NONE: Do not generate an entity tag.

p etag query

Query that is used to generate the entity tag.

p mimes allowed

Comma-separated list of MIME types that the handler will accept. Applies to PUT and POST only.

p_module_comments

Comment text.

p_template_comments

Comment text.

p_handler_comments

Comment text.

Usage Notes

Creates a resource module, template, and handler in one call.

Examples

The following example defines a REST service that retrieves the current user's tickets.



The following example defines a REST service that retrieves tickets filtered by category.

ORDS_ADMIN.DEFINE_TEMPLATE

Format

Description

DEFINE_TEMPLATE defines a resource template. If the template already exists, then the template and any existing handlers will be replaced by this definition; otherwise, a new template is created.

Parameters

p_schema

Name of the schema. This parameter is mandatory.

p_module_name

Name of the owning RESTful service module. Case sensitive.

p_pattern

A matching pattern for the resource template. For example, a pattern of / objects/:object/:id? will match /objects/emp/101 (matches a request for the item in the emp resource with id of 101) and will also match /objects/emp/. (Matches a request for the emp resource, because the :id parameter is annotated with the ? modifier, which indicates that the id parameter is optional.)

p_priority

The priority for the order of how the resource template should be evaluated: 0 (low priority. the default) through 9 (high priority).

p_etag_type

A type of entity tag to be used by the resource template. An entity tag is an HTTP Header that acts as a version identifier for a resource. Use entity tag headers to avoid retrieving previously retrieved resources and to perform optimistic locking when updating resources. Valid values are HASH, QUERY, NONE:

- HASH (known as Secure HASH): The contents of the returned resource representation are hashed using a secure digest function to provide a unique fingerprint for a given resource version.
- QUERY: Manually define a query that uniquely identifies a resource version. A
 manually defined query can often generate an entity tag more efficiently than
 hashing the entire resource representation.
- NONE: Do not generate an entity tag.

p etag query

Query that is used to generate the entity tag.

p_comments

Comment text.

Usage Notes

he resource template pattern must be unique with a resource module.

Examples

The following example defines a resource for displaying ticket items.

```
BEGIN
  ORDS_ADMIN.DEFINE_TEMPLATE(
    p_schema => 'tickets',
    p_module_name => 'my.tickets',
    p_pattern => '/:id'
);
END;
//
```

ORDS_ADMIN.DELETE_MODULE

Format

Description

DELETE_MODULE deletes a resource module.

Parameters

p schema

Name of the schema. This parameter is mandatory.

p_module_name

Name of the owning RESTful service module. Case sensitive.



Usage Notes

If the module does not already exist or is accessible to the current user, then no exception is raised.

Examples

The following example deletes a resource module.

```
BEGIN
  ORDS_ADMIN.DELETE_MODULE(
    p_schema => 'tickets',
    p_module_name => 'my.tickets'
);
END;
//
```

ORDS_ADMIN.DELETE_PRIVILEGE

Description

DELETE_PRIVILEGE deletes a privilege.

Parameters

p_schema

Name of the schema. This parameter is mandatory.

p_name

Name of the privilege.

Usage Notes

If the privilege does not already exist, then no exception is raised.

Examples

The following example deletes a privilege.

```
BEGIN
   ORDS_ADMIN.DELETE_PRIVILEGE(
    p_schema => 'tickets',
    p_name => 'tickets.privilege'
   );
END;
//
```

ORDS_ADMIN.DELETE_ROLE

Format



Description

DELETE_ROLE deletes the named role.

Parameters

p_name

Name of the role.

Usage Notes

This will also delete any association between the role and any privileges that reference the role.

No exception is produced if the role does not already exist.

Examples

The following example deletes a role.

```
BEGIN
  ORDS_ADMIN.DELETE_ROLE(
    p_schema => 'tickets',
    p_role_name => 'Tickets User'
  );
END;
//
```

ORDS_ADMIN.DROP_REST_FOR_SCHEMA

Format

```
ORDS_ADMIN.DROP_REST_FOR_SCHEMA(
    p_schema ords_schemas.parsing_schema%type);
```

Description

DROP_REST_FOR_SCHEMA deletes all auto-REST Oracle REST Data Services metadata for the associated schema.

Parameters

p_schema

Name of the schema.

Usage Notes

This procedure effectively "undoes" the actions performed by the ${\tt ORDS.Enable_Schema}$ procedure.

Examples

The following example deletes all auto-REST Oracle REST Data Services metadata for the TICKETS schema.

```
BEGIN
ORDS_ADMIN.DROP_REST_FOR_SCHEMA(
    p_schema => 'tickets'
```



```
);
END;
```

ORDS_ADMIN.ENABLE_OBJECT

Format

```
ORDS_ADMIN.ENABLE_OBJECT(

p_enabled IN boolean DEFAULT TRUE,

p_schema IN ords_schemas.parsing_schema*,

p_object IN ords_objects.parsing_object*type,

p_object_type IN ords_objects.type*type DEFAULT 'TABLE',

p_object_alias IN ords_objects.object_alias*type DEFAULT NULL,

p_auto_rest_auth IN boolean DEFAULT NULL);
```

Description

ENABLE_OBJECT enables Oracle REST Data Services access to a specified table or view in a schema.

Parameters

p enabled

TRUE to enable access; FALSE to disable access.

p schema

Name of the schema for the table or view. This parameter is mandatory.

p_object

Name of the table or view.

p_object_type

Type of the object: TABLE (default) or VIEW.

p object alias

Alias of the object.

p_auto_rest_auth

Controls whether Oracle REST Data Services should require user authorization before allowing access to the Oracle REST Data Services metadata for this object. If this value is TRUE, then the service is protected by the following roles:

- oracle.dbtools.autorest.any.schema
- oracle.dbtools.role.autorest.<SCHEMANAME>.<OBJECTNAME>

Usage Notes

None.

Examples

The following example enables a table named CATEGORIES.

```
BEGIN
ORDS_ADMIN.ENABLE_OBJECT(
    p_schema => 'tickets',
    p_object=>'CATEGORIES'
```



```
);
END;
/
```

The following example enables a view named TICKETS_FEED.

```
BEGIN
ORDS_ADMIN.ENABLE_OBJECT(
    p_schema => 'tickets',
    p_object => 'TICKETS_FEED',
    p_object_type => 'VIEW'
);
END;
```

ORDS_ADMIN.DROP_REST_FOR_OBJECT

Format

Description

DROP_REST_FOR_OBJECT deletes all auto-REST Oracle REST Data Services metadata for the associated schema object.

Parameters

p schema

Name of the schema.

p_object

Name of the table or view.

Usage Notes

This procedure effectively "undoes" the actions performed by the ORDS_ADMIN.ENABLE_OBJECT procedure.

Examples

The following example deletes all auto-REST Oracle REST Data Services metadata for the TICKETS schema CATEGORIES table.

```
BEGIN
   ORDS_ADMIN.DROP_REST_FOR_OBJECT(
    p_schema => 'tickets',
    p_object=>'CATEGORIES'
   );
END;
//
```



ORDS_ADMIN.ENABLE_SCHEMA

Format

```
ORDS_ADMIN.ENABLE_SCHEMA

p_enabled IN boolean DEFAULT TRUE,

p_schema IN ords_schemas.parsing_schema%type,

p_url_mapping_type IN ords_url_mappings.type%type DEFAULT 'BASE_PATH',

p_url_mapping_pattern IN ords_url_mappings.pattern%type DEFAULT NULL,

p_auto_rest_auth IN boolean DEFAULT NULL);
```

Description

ENABLE_SCHEMA enables Oracle REST Data Services to access the named schema.

Parameters

p_enabled

TRUE to enable Oracle REST Data Services access; FALSE to disable Oracle REST Data Services access.

p_schema

Name of the schema. This parameter is mandatory.

p_url_mapping_type

URL Mapping type: BASE_PATH or BASE_URL.

p_url_mapping_pattern

URL mapping pattern.

p auto rest auth

For a schema, controls whether Oracle REST Data Services should require user authorization before allowing access to the Oracle REST Data Services metadata catalog of this schema.

Usage Notes

None.

Examples

The following example enables the current schema.

```
BEGIN
  ORDS_ADMIN.ENABLE_SCHEMA(
   p_schema => 'tickets'
);
END;
/
```



ORDS_ADMIN.PUBLISH_MODULE

Format

Description

PUBLISH_MODULE changes the publication status of an Oracle REST Data Services resource module.

Parameters

p schema

Name of the schema. This parameter is mandatory.

p_module_name

Current name of the RESTful service module. Case sensitive.

p_status

Publication status. Valid values: PUBLISHED (default) or NOT PUBLISHED.

Usage Notes

(None.)

Examples

The following example publishes a previously defined module named my.tickets.

```
BEGIN
  ORDS_ADMIN.PUBLISH_MODULE(
    p_schema => 'tickets',
    p_module_name => 'my.tickets'
);
END;
```

ORDS ADMIN.RENAME MODULE

Format

Description

RENAME_MODULE lets you change the name or the base path, or both, of an Oracle REST Data Services resource module.



Parameters

p_schema

Name of the schema. This parameter is mandatory.

p_module_name

Current name of the RESTful service module. Case sensitive.

p_new_name

New name to be assigned to the RESTful service module. Case sensitive. If this parameter is null, the name is not changed.

p_new_base_path

The base of the URI to be used to access this RESTful service. Example: hr/ means that all URIs starting with hr/ will be serviced by this resource module. If this parameter is null, the base path is not changed.

Usage Notes

Both the new resource module name and the base path must be unique within the enabled schema.

Examples

The following example renames resource module my.tickets to old.tickets.

```
BEGIN
  ORDS_ADMIN.RENAME_MODULE(
    p_schema => 'tickets',
    p_module_name =>'my.tickets',
    p_new_name=>'old.tickets',
    p_new_base_path=>'/old/tickets/');
END;
//
```

ORDS_ADMIN.RENAME_PRIVILEGE

Format

Description

RENAME_PRIVILEGE renames a privilege.

Parameters

p schema

Name of the schema. This parameter is mandatory.

p_name

Current name of the privilege.



p_new_name

New name to be assigned to the privilege.

Usage Notes

(None.)

Examples

The following example renames the privilege tickets.privilege to old.tickets.privilege.

```
BEGIN
ORDS_ADMIN.RENAME_PRIVILEGE(
    p_schema => 'tickets',
    p_name => 'tickets.privilege',
    p_new_name=> 'old.tickets.privilege');
END;
//
```

ORDS ADMIN.RENAME ROLE

Format

Description

RENAME_ROLE renames a role.

Parameters

p schema

Name of the schema. This parameter is mandatory.

p_role_name

Current name of the role.

p_new_name

New name to be assigned to the role.

Usage Notes

p_role_name must exist.

Examples

The following example renames an existing role.

```
BEGIN
  ORDS_ADMIN.RENAME_ROLE(
    p_schema=>'tickets',
    p_role_name=>'Tickets User',
    p_new_name=>'Legacy Tickets User');
END;
//
```



ORDS_ADMIN.SET_MODULE_ORIGINS_ALLOWED

Format

Description

SET_MODULE_ORIGINS_ALLOWED configures the allowed origins for a resource module. Any existing allowed origins will be replaced.

Parameters

p schema

Name of the schema. This parameter is mandatory.

p_module_name

Name of the resource module.

p_origins_allowed

A comma-separated list of URL prefixes. If the list is empty, any existing origins are removed.

Usage Notes

To indicate no allowed origins for a resource module (and remove any existing allowed origins), specify an empty p_origins_allowed value.

Examples

The following restricts the resource module my.tickets to two specified origins.

ORDS_ADMIN.SET_URL_MAPPING

Format

```
ORDS_ADMIN.SET_URL_MAPPING

p_schema IN ords_schemas.parsing_schema%,

p_url_mapping_type IN ords_url_mappings.type%type,

p_url_mapping_pattern IN ords_url_mappings.pattern%type);
```

Description

SET_URL_MAPPING configures how the specified schema is mapped to request URLs.



Parameters

p_schema

Name of the schema to map. This parameter is mandatory.

p_url_mapping_type

URL Mapping type: BASE_PATH or BASE_URL.

p url mapping pattern

URL mapping pattern.

Usage Notes

(None.)

Examples

The following example creates a BASE_PATH mapping for the tickets user.

ORDS_ADMIN.ENABLE_HOUSEKEEPING_JOB

Format

ORDS_ADMIN.ENABLE_HOUSEKEEPING_JOB(p_enabled IN boolean DEFAULT TRUE);

Description

ENABLE_HOUSEKEEPING_JOB creates and enables or disables the ORDS DBMS_SCHEDULER housekeeping job. The job name is ORDS_HOUSEKEEPING_JOB which replaces the deprecated job, CLEAN_OLD_ORDS_SESSIONS.

Parameters

p_enabled

TRUE to enable ORDS HOUSEKEEPING_JOB; FALSE to disable it. A NULL value will create and enable the job if it does not already exist otherwise its enablement state will remain changed.

Usage Notes

The job runs every hour and performs housekeeping actions on the ORDS metadata repository. No commit is required.

Examples

The following example enables the housekeeping job:

```
EXECUTE ORDS_ADMIN.ENABLE_HOUSEKEEPING_JOB;
```



ORDS_ADMIN.DROP_HOUSEKEEPING_JOB

Format

ORDS_ADMIN.DROP_HOUSEKEEPING_JOB;

Description

DROP_HOUSEKEEPING_JOB drops the ORDS DBMS_SCHEDULER housekeeping job. The job name is ORDS_HOUSEKEEPING_JOB.

Parameters

None.

Usage Notes

No commit is required.

Examples

The following example drops the housekeeping job:

EXECUTE ORDS_ADMIN.DROP_HOUSEKEEPING_JOB;

ORDS_ADMIN.PERFORM_HOUSEKEEPING

Format

ORDS_ADMIN.PERFORM_HOUSEKEEPING;

Description

PERFORM_HOUSEKEEPING performs ORDS housekeeping actions immediately. The following action is performed:

Removes expired sessions that are older than one day.

Parameters

None.

Usage Notes

No commit is required.

Examples

The following example performs the housekeeping actions immediately against the ORDS metadata repository:

EXECUTE ORDS_ADMIN.PERFORM_HOUSEKEEPING;



ORDS_ADMIN.SET_SESSION_DEFAULTS

Format

Description

Sets the default values that apply for the duration of the database session.

Parameters

p_runtime_user

Sets a runtime user as the target while REST enabling or disabling the schemas. Otherwise all runtime users are targeted.

Usage Notes

NULL values have no effect. Use RESET_SESSION_DEFAULTS function to reset the values and start again.

Examples

The following example sets the ${\tt HR}$ user as the only grantee target for the "connect through" proxy privilege when a schema is REST enabled or disabled:

```
BEGIN
  ORDS_ADMIN.SET_SESSION_DEFAULTS(
    p_runtime_user => 'HR');
END;
//
```

ORDS_ADMIN.RESET_SESSION_DEFAULTS

Format

```
ORDS_ADMIN.RESET_SESSION_DEFAULTS
```

Description

Resets the session defaults back to the initial values.

Parameters

None.

Usage Notes

Use SET_SESSION_DEFAULTS function to set the default values that were reset using this function.

Examples

The following example resets all the session default values:



```
BEGIN
   ORDS_ADMIN.RESET_SESSION_DEFAULTS;
END;
/
```

ORDS_ADMIN.PROVISION_ADMIN_ROLE

Format

Description

Provision a database user with the ORDS Administrator role so that it can administer ORDS.

Parameters

p_user

The name of the user to be provisioned.

Usage Notes

User ORDS_PUBLIC_USER cannot be configured using this interface.

Examples

The following example provisions the ORDS administrator role to the HR user:

```
BEGIN
   ORDS_ADMIN.PROVISION_ADMIN_ROLE(
   p_user => 'HR'
   );
END;
/
```

ORDS_ADMIN.PROVISION_RUNTIME_ROLE

Format

Description

Provision a database user so that it can act as an ORDS runtime user.

Parameters

p_user

The name of the user to be provisioned.



p_proxy_enabled_schemas

When the value is set to \mathtt{TRUE} , "connect through" proxy grants are added for any enabled schemas.

Usage Notes

ORDS_PUBLIC_USER is an example of a runtime user. Additional changes to the ORDS configuration are required to use a user other than the ORDS_PUBLIC_USER.

Examples

The following example provisions the ORDS runtime role to the HR user and grants it the "connect through" proxy privilege for all the enabled schemas:

```
BEGIN
  ORDS_ADMIN.PROVISION_RUNTIME_ROLE(
  p_user => 'HR',
  p_proxy_enabled_schemas => TRUE
);
END;
//
```

ORDS_ADMIN.UNPROVISION_ ROLES

Format

```
ORDS_ADMIN.UNPROVISION_ROLES(

p_user IN varchar2,

p_administrator_role IN boolean DEFAULT NULL,

p_runtime_role IN boolean DEFAULT NULL);
```

Description

Unprovision the ORDS database roles.

Parameters

p_user

The name of the user to be unprovisioned.

p administrator role

Unprovision as an admin user.

p_runtime_role

Unprovision as a runtime user.

Usage Notes

 ${ t NULL}$ boolean values are evaluated to ${ t TRUE}$ unless any value is set to ${ t TRUE}$. In such case, ${ t NULL}$ values are evaluated to ${ t FALSE}$. So, by default all the roles are unprovisioned unless an explicit choice is made.

Examples

The following example unprovisions the ORDS administrator role from the HR user:



```
BEGIN
  ORDS_ADMIN.UNPROVISION_ROLES (
    p_user => 'HR',
    p_administrator_role => TRUE);
END;
//
```



10

Implicit Parameters

This chapter describes the implicit parameters used in REST service handlers that are not explicitly declared. Oracle REST Data Services (ORDS) adds these parameters automatically to the resource handlers.

List of Implicit Parameters

The following table lists the implicit parameters:



Parameter names are case sensitive. For example, :CURRENT_USER is not a valid implicit parameter.

Table 10-1 List of Implicit Parameters

Name	Туре	Access Mode		Descri ption	Introdu ced
:body	BLOB	IN	N/A	Specifie s the body of the request as a tempora ry BLOB.	2.0
:body_ text	CLOB	IN	N/A	Specifie s the body of the request as a tempora ry CLOB.	18.3

Table 10-1 (Cont.) List of Implicit Parameters

Name	Туре	Access Mode	HTTP Header	Descri ption	Introdu ced
:conte nt_typ e	VARCH AR	IN	Conten t-Type	-	2.0
:curre nt_use r	VARCH AR	IN	N/A	Specifie s the authenti cated user for the request. If no user is authenti cated, then the value is set to null.	2.0
:forwa rd_loc ation	VARCH AR	OUT	X- ORDS- FORWAR D- LOCATI ON	where	18.3



Table 10-1 (Cont.) List of Implicit Parameters

Name	Туре	Access Mode	HTTP Header	Descri ption	Introdu ced
:fetch _offse t	NUMBE R	IN	N/A	Specifie s the zero-based offset of the first row to be displaye d on a page.	18.3
:fetch _size	NUMBE R	IN	N/A	Specifie s the maximu m number of rows to be retrieve d on a page.	18.3
<pre>:page_ offset</pre>	NUMBE R	IN	N/A	Specifie s the zero based page offset in a paginat ed request. Note: The :p age_of fset paramet er is depreca ted. Use :r ow_off set paramet er instead.	2.0



Table 10-1 (Cont.) List of Implicit Parameters

Name	Туре	Access Mode	HTTP Header	Descri ption	Introdu ced
:page_ size	NUMBE R	IN	N/A	Specifie s the maximu m number of rows to be retrieve d on a page. The :pa ge_siz e paramet er is depreca ted. Use :f etch_s ize parame ter	2.0
:row_o ffset	NUMBE R	IN	N/A	instead. Specifie s the one-based index of the first row to be displaye d in a paginat ed	3.0
:row_c ount	NUMBE R	IN	N/A	request. Specifie s the one-based index of the last row to be displaye d in a paginat ed request.	3.0



Table 10-1 (Cont.) List of Implicit Parameters

Name	Туре		HTTP Header		Introdu ced
:statu s_code	NUMBE R	OUT	X- ORDS- STATUS -CODE	Specifie s the HTTP status code for the request.	18.3

About the :body parameter

The :body implicit parameter is used in the resource handlers to receive the contents of the request body as a temporary BLOB.



Only POST or PUT requests can have a request body. The HTTP specification does not permit request bodies on GET or DELETE requests.

Example 10-1 Example

The following example illustrates a PL/SQL block that stores the request body in a database table:

```
begin
  insert into tab (content) values (:body);
end;
```



The :body implicit parameter **must** be dereferenced exactly once in a PL/SQL block. If it is dereferenced more than once, then the second and subsequent dereferences will appear to be empty. This is because the client sends the request body only once.

The following example will **not** work as intended because it dereferences the :body parameter twice:

```
begin
  insert into tab1(content) values (:body); -- request body will be
inserted
  insert into tab2(content) values (:body); -- an empty blob will be
inserted
end;
```



To avoid this limitation, the :body parameter value must be assigned to a local PL/SQL variable before it is used. This enables the local variable to be dereferenced more than once:

```
declare
  l_content blob := :body;
begin
  insert into tabl(content) values(l_content);
  insert into tab2(content) values(l_content);
end;
```

About the :body_text Parameter

The :body_text implicit parameter is used in the resource handlers to receive the contents of the request body as a temporary CLOB. Typically, the content of the request body is textual (for example JSON or HTML content) and so, receiving the request body as a CLOB saves the resource handler author from the effort of converting the :body BLOB parameter to a CLOB instance. Similar to the :body parameter, the :body_text parameter must be dereferenced only once in a PL/SQL block.

It is recommended to assign the :body_text value to a local PL/SQL variable, and the PL/SQL variable is used throughout the PL/SQL block.

About the :content_type Parameter

The :content_type implicit parameter provides the value of the Content-Type request header supplied with the request. If no Content-Type header is present in the request, then a null value is returned.

About the :current_user Parameter

The :current_user implicit parameter provides the identity of the user authenticated for the request.



In a scenario, where the user is not authenticated, the value is set to null. For example, if the request is for a public resource, then the value will be set to null.

About the :status_code Parameter

The :status_code implicit parameter enables a resource handler to indicate the HTTP status code value to include in a response. The value must be one of the numeric values defined in the HTTP Specification document.

About the :forward_location Parameter

The :forward_location implicit parameter provides a mechanism for PL/SQL based resource handlers to produce a response for a request.

Consider a POST request that results in the creation of a new resource. Typically, the response of a POST request for REST APIs contains the location of the newly created resource (in the Location response header) along with the representation of the new resource. The presence of the Location header in the response indicates that there must be a GET resource handler that can produce a response for the specified location.

Instead of applying logic to the POST resource handler to render the representation of the new resource in the response, the resource handler can delegate that task to the existing GET Resource Handler.

The following resource handler defines a POST handler that delegates the generation of the response to a GET resource handler:

```
ords.define_handler(
 p_module_name => 'tickets.collection',
 p_pattern => '.',
 p_method => 'POST',
 p_mimes_allowed => 'application/json',
 p_source_type => ords.source_type_plsql,
 p_source => '
   declare
    l_owner varchar2(255);
    l_payload clob;
    l_id number;
   begin
    l_payload := :body_text;
    l_owner := :current_user;
    l_id := ticket_api.create_ticket(
      p_json_entity => l_payload,
      p_author => l_owner
    );
    :forward_location := ''./'' || l_id;
    :status_code := 201;
   end;
);
```

Where:

- The ords.define_handler API is used to add a POST handler to an existing resource module named tickets.collection.
- The p_pattern with value '.' indicates that the POST handler should be bound to the root resource of the resource module. If the base path of the tickets.collection' is /tickets/, then the POST handler is bound to the / tickets/ URL path.



- The p_mimes_allowed value indicates that the POST request must have a Content-Type header value of application/json'.
- The p_source_type value indicates that the source of the POST handler is a PL/SQL block.
- The p_source value contains the source of the PL/SQL block:

Where:

Note:

The :body_text implicit parameter is assigned to a local variable, so that it can be dereferenced more than once.

- The identity of the user, making the POST request, is determined from the :current user implicit parameter.
- The PL/SQL block, delegates the task of storing the request payload to a PL/SQL package level function. The PL/SQL block should only contain logic to bridge from the HTTP request to the PL/SQL package invocation.

Note:

When all the data modification operations are wrapped in a PL/SQL API, the PL/SQL block can be independently unit tested. Long and complicated PL/SQL blocks are an anti-pattern indicative of code that is difficult to test and maintain.

- The PL/SQL package level function returns the ID of the newly created resource.
- The :forward_location implicit parameter is assigned the value of './' || 1_id. For example, if the value of 1_id is 4256, then the value of :forward_location is /tickets/4256.

When ORDS evaluates the preceding PL/SQL block and checks the value assigned to the :forward_location implicit parameter, it initiates a GET request against the specified location (for example, /tickets/4256) and return the response generated by the GET request as the response of the POST request. In addition, ORDS includes a location response header with the fully resolved URL of the :forward_location value.

 The :status_code implicit parameter is assigned the HTTP response status code value. The 201 (Created) status code indicates that a new resource is created. This value will override the status code generated by the GET request.

About the Pagination Implicit Parameters

The following table lists the pagination implicit parameters:



Oracle REST Data Services reserves the use of the query parameters, page, offset, and limit. It is not permitted to define REST services that use named bind parameters with any of the preceding query parameter names. Alternatively, REST services must use the appropriate pagination implicit parameters defined in the following table:

Table 10-2 Pagination Implicit Parameters

Description	Status
Specifies the zero based page offset in a pagination request.	Deprecated
Specifies the maximum number of rows to be retrieved on a page.	Deprecated
Specifies the index of the first row to be displayed in a pagination request.	Not Recommended
Specifies the index of the last row to displayed in a pagination request.	Not Recommended
Specifies the zero based index of the first row to be displayed on a page.	Recommended
Specifies the maximum number of rows to be retrieved on a page.	Recommended
	Specifies the zero based page offset in a pagination request. Specifies the maximum number of rows to be retrieved on a page. Specifies the index of the first row to be displayed in a pagination request. Specifies the index of the last row to displayed in a pagination request. Specifies the zero based index of the first row to be displayed on a page. Specifies the maximum number of rows to be retrieved

About the :page_offset Parameter

The :page_offset implicit parameter is provided for backward compatibility, so it is used only with source_type_query source type resource handlers.

Note:

- The source_type_query source type is deprecated, instead use the source_type_collection feed parameter.
- The :page_offset implicit parameter is deprecated, instead use the :row_offset implicit parameter.

About the :page_size Parameter

The :page_size implicit parameter is used to indicate the maximum number of rows to be retrieved on a page. :page_size parameter is provided for backward compatibility. This parameter is deprecated, instead use :fetch size implicit parameter.



About the :row offset Parameter

The <code>:row_offset</code> implicit parameter indicates the number of the first row to be displayed on a page. The <code>:row_offset</code> implicit parameter is used when you are using both a wrapper pagination query and <code>row_number()</code> (used in Oracle 11g and earlier releases). Starting Oracle 12c or later releases, Oracle recommends using the <code>:fetch_offset</code> implicit parameter and a row limiting clause instead of the <code>:row_offset</code> parameter.

About the :row_count Parameter

The :row_count implicit parameter is used to indicate the number of rows to be displayed on a page. The :row_count value is the value of the sum of :row_offset and the pagination size. The :row_count implicit parameter is useful when implementing pagination using a wrapper pagination query and row_number() method that was used in Oracle database 11g and earlier releases. Starting Oracle Database release 12c or later, Oracle recommends that you use :fetch_size parameter and a row limiting clause instead.

About the :fetch offset Parameter

The :fetch_offset implicit parameter is used to indicate the zero based offset of the first row to display in a given page. The :fetch_offset implicit parameter is used when you implement pagination using a row limiting clause, which is recommended for use with Oracle 12c and later releases.

About the :fetch size Parameter

The :fetch_size implicit parameter is used to indicate the maximum number of rows to retrieve on a page. ORDS always sets the value of :fetch_size to the pagination size plus one. The presence or absence of the extra row helps ORDS in determining if there is a subsequent page in the results or not.



The extra row that is queried is never displayed on the page.

About Automatic Pagination

This section describes the automatic pagination process.

If a GET resource handler source type, <code>source_type_collection_feed</code> or <code>source_type_query</code> has a non zero pagination size (<code>p_items_per_page</code>) and the source of the GET resource handler does not dereference any of the implicit pagination parameters discussed in the preceding sections, then ORDS automatically wraps the query in a pagination clause to constrain the query results to include only the values from the requested page. With automatic pagination, the resource handler



author needs to specify only the pagination size, and ORDS automatically handles the remaining effort in paginating the resource.



All resource modules have a default pagination size (p_items_per_page) of 25. So, by default automatic pagination is enabled.

About Manual Pagination

This section describes the manual pagination process.

In some scenarios, a GET resource handler needs to perform pagination on its own rather than delegating the pagination process to ORDS. In such cases, the source of the GET resource handler will dereference one or more implicit pagination parameters discussed in the preceding sections.



The GET resource handler must specify the desired pagination size so that ORDS can correctly calculate the required values for the implicit pagination parameters.

Examples

Manual pagination example using row limiting clause

The following example defines a REST service that uses a row limiting clause to paginate the query result set. This is the recommended way to implement manual pagination:

```
begin
  ords.define_service(
    p_module_name => 'example.paging',
    p_base_path => '/example/',
    p_pattern => '/paged',
    p_items_per_page => 7,
    p_source => 'select * from emp e order by empno desc
  offset :fetch_offset rows fetch next :fetch_size rows only'
    );
    commit;
end;
```

Manual pagination example using row_number() method

The following example defines a REST service that uses a wrapper query and row_number() method. This approach is not recommended.

```
begin
ords.define_service(
    p_module_name => 'example.paging',
```



```
p_base_path => '/example/',
    p_pattern => '/paged',
    p_items_per_page => 7,
    p_source => 'select * from (select q_.* , row_number() over (order by 1) rn__ from (select * from emp e order by empno desc) q_ )where rn__ between :row_offset and :row_count'
    );
    commit;
end;
```



OAUTH PL/SQL Package Reference

The OAUTH PL/SQL package contains procedures for implementing OAuth authentication using Oracle REST Data Services.

Related Topics

Using the Oracle REST Data Services PL/SQL API

OAUTH.CREATE_CLIENT

Format

```
OAUTH.CREATE_CLIENT(

p_name VARCHAR2 IN,
p_grant_type VARCHAR2 IN,
p_owner VARCHAR2 IN DEFAULT NULL,
p_description VARCHAR2 IN DEFAULT NULL,
p_allowed_origins VARCHAR2 IN DEFAULT NULL,
p_redirect_uri VARCHAR2 IN DEFAULT NULL,
p_support_email VARCHAR2 IN DEFAULT NULL,
p_support_uri VARCHAR2 IN DEFAULT NULL,
p_privilege_names VARCHAR2 IN)
```

Description

Creates an OAuth client registration.

Parameters

p_name

Name for the client, displayed to the end user during the approval phase of three-legged OAuth. Must be unique.

p_grant_type

Must be one of authorization_code, implicit, or client_credentials.

p owner

Name of the party that owns the client application.

p_description

Description of the purpose of the client, displayed to the end user during the approval phase of three-legged OAuth. May be null if p_grant_type is client_credentials; otherwise. must not be null.

p_allowed_origins

A comma-separated list of URL prefixes. If the list is empty, any existing origins are removed.



p_redirect_uri

Client-controlled URI to which redirect containing an OAuth access token or error will be sent. May be null if p_grant_type is client_credentials; otherwise, must not be null.

p_support_email

The email where end users can contact the client for support.

p_support_uri

The URI where end users can contact the client for support. Example: http://www.myclientdomain.com/support/

p_privilege_names

List of comma-separated privileges that the client wants to access.

Usage Notes

To have the operation take effect, use the COMMIT statement after calling this procedure.

Examples

The following example creates an OAuth client registration.

```
BEGIN
   OAUTH.create_client(
    'CLIENT_TEST',
    'authorization_code',
    'test_user',
    'This is a test description.',
    '',
    'https://example.org/my_redirect/#/',
    'test@example.org',
    'https://example.org/help/#/',
     'MyPrivilege'
   );
   COMMIT;
END;
//
```

OAUTH.DELETE_CLIENT

Format

```
OAUTH.DELETE_CLIENT(
    p_name VARCHAR2 IN);
```

Description

Deletes an OAuth client registration.

Parameters

p_name

Name of the client registration to be deleted.

Usage Notes

To have the operation take effect, use the COMMIT statement after calling this procedure.

Examples

The following example deletes an OAuth client registration.

```
BEGIN
   OAUTH.delete_client(
    'CLIENT_TEST'
   );
   COMMIT;
END;
//
```

OAUTH.GRANT_CLIENT_ROLE

Format

```
OAUTH.GRANT_CLIENT_ROLE(
   p_client_name VARCHAR2 IN,
   p_role_name VARCHAR2 IN);
```

Description

Grant an OAuth client the specified role, enabling clients performing two-legged OAuth to access privileges requiring the role.

Parameters

p_client_name

Name of the OAuth client.

p_role_name

Name of the role to be granted.

Usage Notes

To have the operation take effect, use the COMMIT statement after calling this procedure.

Examples

The following example creates a role and grants that role to an OAuth client.

```
BEGIN
   ORDS.create_role(p_role_name => 'CLIENT_TEST_ROLE');

OAUTH.grant_client_role(
   'CLIENT_TEST',
   'CLIENT_TEST_ROLE'
   );
COMMIT;
END;
//
```



OAUTH.RENAME_CLIENT

Format

Description

Renames a client.

Parameters

p_name

Current name for the client.

p_new_name

New name for the client.

Usage Notes

The client name is displayed to the end user during the approval phase of threelegged OAuth.

To have the operation take effect, use the COMMIT statement after calling this procedure.

Examples

The following example renames a client.

```
BEGIN
   OAUTH.rename_client(
    'CLIENT_TEST',
    'CLIENT_TEST_RENAMED'
   );
   COMMIT;
END;
//
```

OAUTH.REVOKE_CLIENT_ROLE

Format

Description

Revokes the specified role from an OAuth client, preventing the client from accessing privileges requiring the role through two-legged OAuth.



Parameters

p client name

Name of the OAuth client.

p_role_name

Name of the role to be revoked

Usage Notes

To have the operation take effect, use the COMMIT statement after calling this procedure.

Examples

The following example revokes a specified role from an OAuth client.

```
BEGIN
   OAUTH.revoke_client_role(
    'CLIENT_TEST_RENAMED',
    'CLIENT_TEST_ROLE'
    );
   COMMIT;
END;
//
```

OAUTH.UPDATE_CLIENT

Format

```
OAUTH.UPDATE_CLIENT(
p_name VARCHAR2 IN,
p_description VARCHAR2 IN,
p_origins_allowed VARCHAR2 IN,
p_redirect_uri VARCHAR2 IN,
p_support_email VARCHAR2 IN,
p_suppor_uri VARCHAR2 IN,
p_privilege_names t_ords_vchar_tab IN);
```

Description

Updates the client information (except name). Any null values will not alter the existing client property.

Parameters

p_name

Name of the client that requires the owner, description, origins allowed, support e-mail, support URI, and/or privilege modification.

p_description

Description of the purpose of the client, displayed to the end user during the approval phase of three-legged OAuth.

p_redirect_uri

Client-controlled URI to which a redirect containing the OAuth access token/error will be sent. If this parameter is null, the existing $p_{redirect_uri}$ value (if any) is not changed.

p_support_email

The email address where end users can contact the client for support.

p_support_uri

The URI where end users can contact the client for support. Example: http://www.myclientdomain.com/support/

p privilege names

List of names of the privileges that the client wishes to access.

Usage Notes

To have the operation take effect, use the COMMIT statement after calling this procedure.

If you want to rename the client, use the <code>OAUTH.RENAME_CLIENT</code> procedure.

Example to Updates the Description of the Specified Client

The following example updates the description of the client with the name matching the value for p name.

```
BEGIN
ORDS_METADATA.OAUTH.update_client(
    p_name => 'CLIENT_TEST_RENAMED',
    p_description => 'The description was altered',
    p_origins_allowed => null,
    p_redirect_uri => null,
    p_support_email => null,
    p_support_uri => null,
    p_privilege_names => null);
COMMIT;
END;
//
```

Example 11-1 Example to Add Multiple Privileges

The following example adds a second privilege:

```
declare
  my_privs t_ords_vchar_tab := t_ords_vchar_tab ();
begin
  my_privs.EXTEND (3);
  my_privs(1):='tst.privilege1';
  my_privs(2):='tst.privilege2';
.
  oauth.update_client(
    p_name => 'Test_Client',
    p_owner => 'scott',
    p_description => 'Description',
    p_grant_type => 'client_credentials',
    p_redirect_uri => '/abc/efg/',
    p_privilege_names => my_privs);
commit;
end;
```



Related Topics

OAUTH.RENAME_CLIENT



Enabling ORDS Database API

This section describes how to enable the Oracle REST Data Services (ORDS) Database API.

ORDS database API is a database management and monitoring REST API embedded into Oracle REST Data Services. Depending on the database version and configuration, ORDS database API provides services such as manage pluggable databases, export data and review database performance. By default, the ORDS database API feature is disabled when you install ORDS for the first time.

Basic Setup to Enable ORDS Database API

This section explains the basic setup to enable the ORDS database API.

To enable the ORDS database API, set the database.api.enabled property to true and then restart ORDS:

java -jar ords.war set-property database.api.enabled true

To access the ORDS database API, you can use one of the following available authentication methods available:

- Database authentication using database username and password
- Through a mid-tier user with the SQL Administrator, or System Administrator role



There are certain endpoints that are accessible only by certain roles. The REST APIs for Oracle Database documentation provides information on which roles can access each endpoint.

To enable database authentication, you must set the restEnabledSql.active property to true as shown in the following code snippet and then restart ORDS:

java -jar ords.war set-property restEnabledSql.active true

For the database authentication, ensure that the administrator schema is ORDS enabled and is granted with the DBA role in an 11gR2 environment or the PDB_DBA role for 12c and higher versions of the database before the schema is used to execute the database API queries in the database. This is done for each non-CDB or pluggable database in which you want to use the database. For more information, refer to "REST-Enabling the Oracle Database Schema" and "ORDS_ADMIN.ENABLE_SCHEMA" sections.



In the following example, sqlplus command-line utility is used to connect to the SALESPDB database as the system user to configure the PDBADMIN user in that database. The mechanism to connect to the database and performing the steps will differ depending on your environment settings.

For example, to use PDBADMIN schema, in the SALESPDB database for ORDS Database API services, use the following commands in the database.

```
sqlplus system@SALESPDB
GRANT PDB_DBA TO PDBADMIN;
BEGIN
ORDS_ADMIN.ENABLE_SCHEMA(p_schema => 'PDBADMIN');
END;
//
```

The PDBADMIN user is now ready to use the ORDS database API services.

To list the tables in the database, send a GET request to https://<server>/ords/salespdb/pdbadmin/_/db-api/stable/database/objects/tables/

On request, you must provide the username and password. If you are using a browser, ORDS provides a link to login and authenticate the request. Once you are authenticated, your browser will have an access cookie, and you do not have to specify the user credentials until that cookie expires.

The same service can be accessed through command line utilities such as curl:

```
curl --user pdbadmin:password https://<server>/ords/salespdb/
pdbadmin/_/db-api/stable/database/objects/tables/
```

An OpenAPI V3 document that describes the available ORDS database API services can be accessed at https://cserver>/ords/cmy database>/cmy admin schema>/_/db-api/stable/metadata-catalog/openapi.json. With the exception of https://cserver>/ords/cmy database>/cmy admin schema>/_/db-api/stable/databases/pdbs/, all other ORDS database API services are made available.

Related Topics

- REST-Enabling the Oracle Database Schema
- ORDS_ADMIN.ENABLE_SCHEMA

Advanced Setup to Enable the ORDS Database API

This section describes the configuration options for using ORDS database API with various database topologies.



Note:

Disabling management services: When the value of database.api.management.services.disabled property is set to true, the following ORDS Database API services are disabled:

DBCA Jobs: DELETE, GET and POST

DBCA Templates: GET

Oracle Home Environment: GET

PDB Lifecycle: DELETE, GET, POST

Open Service Broker- DELETE, GET and PUT

Pluggable Database Lifecycle Management

This section describes how to enable the Pluggable Database (PDB) lifecycle management operations. Pluggable Database management is performed in the Container Database (CDB) and includes create, clone, plug, unplug and delete operations.

You cannot have an ORDS enabled schema in the container database. To perform the PDB lifecycle management operations, the default CDB administrator credentials, db.cdb.adminUser and db.cdb.adminUser.password must be defined in the connection pool. In this case, specifying an user schema in the URI is not required.

To define the default CDB administrator credentials, perform the following steps:

1. Create the CDB administrator user and grant the SYSDBA privilege. In this example, the user is called C##DBAPI_CDB_ADMIN. However, any suitable common user name can be used.

```
CREATE USER C##DBAPI_CDB_ADMIN IDENTIFIED BY <PASSWORD>;
GRANT SYSDBA TO C##DBAPI CDB ADMIN CONTAINER = ALL;
```

Set the db.cdb.adminUser and db.cdb.adminUser.password properties for the connection pool.

```
echo db.cdb.adminUser=C##DBAPI_CDB_ADMIN as SYSDBA > cdbAdmin.properties echo db.cdb.adminUser.password=<PASSWORD> >> cdbAdmin.properties java -jar ords.war set-properties --conf apex_pu cdbAdmin.properties rm cdbAdmin.properties
```

The ORDS role, SQL Administrator must be used to access the https://<server>/ords/_/db-api/stable/database/pdbs/ Services.

Disabling PDB Lifecycle Management

This section describes how to disable the PDB lifecycle management services.

You can enable ORDS database API and disable the PDB related services at https://server>/ords/_/db-api/stable/databases/pdbs/.



When the optional CDB administrator credentials are not set, a HTTP 503 Service Unavailable response is produced if a user attempts to access https://<server>/ords/_/db-api/stable/databases/pdbs/.

To clearly indicate that the PDB operations are disabled for the ORDS installation, set the database.api.management.services.disabled property to true as shown in the following code snippet and then restart ORDS:

```
java -jar ords.war set-property
database.api.management.services.disabled true
```

This will produce a response, HTTP 503 Service Unavailable with an explanatory reason.

Creating a Default Administrator

This section describes how to create and use the default administrator user for the non-CDB or PDB connections.

The ORDS database API service operations are not schema specific. By configuring the default administrator credentials, db.adminUser and db.adminUser.password in the connection pool, you can execute the corresponding SQL statements as the default administrator user. The ORDS database API endpoints can be executed using a specified ORDS enabled schema if the schema has the DBA role. However, it is not necessary to do so when the default administrator credentials are configured.



The user credentials must be the same across all the pluggable databases and therefore it is recommended to create the common user in the CDB.

To create the default administrator and grant the DBA role, perform the following steps:

 Create the default administrator user and grant the DBA role. In this example, the user is called C##_DBAPI_DEFAULT_ADMIN. However, any suitable common user name can be used as shown in the following code snippet:

```
CREATE USER C##_DBAPI_DEFAULT_ADMIN IDENTIFIED BY <PASSWORD> CONTAINER = ALL;

GRANT DBA TO C## DBAPI DEFAULT ADMIN CONTAINER = ALL;
```

2. Set the db.adminUser and db.adminUser.password properties for the connection pool as shown in the following code snipet:

```
echo db.adminUser=C##_DBAPI_PDB_ADMIN > pdbAdmin.properties
echo db.adminUser.password=<PASSWORD> >> pdbAdmin.properties
java -jar ords.war set-properties --conf apex_pu pdbAdmin.properties
rm pdbAdmin.properties
```

A schema is not required to be provided in the URI request.

For example, https://<server>/ords/salespdb/_/db-api/stable/database/datapump/jobs/ lists all the data pump jobs in the salespdb, and queries in that database are executed as the db.adminUser user.



The ORDS role SQL Administrator, is required to use the database API services.

Configuration of Database API Environment Services

This section describes how to configure ORDS Database API environment services.

Starting with ORDS 19.2 release, on a system with ORDS installed, you can perform the set of environment services operations.

For example, the following endpoint lists all the databases discovered in the Oracle Home:

https://<server>/ords/_/db-api/stable/environment/databases/

You must have the ORDS System Administrator role to use the ORDS database API environment services. The environment services provide information about the database Oracle Home on the host machine and a RESTful interface to the Oracle Database Configuration Assistant to create or delete the databases.

Similar to pluggable database lifecycle management, the environment services can be disabled.

To disable the environment services, set the

database.api.management.services.disabled property to true as follows and then restart ORDS:

java -jar ords.war set-property database.api.management.services.disabled true

Configuration of Database API with Open Service Broker API Compatible Platforms

This section describes how to configure and use the ORDS database API with Open Service Broker API compatible platforms.

The ORDS database API provides a service broker for each registered connection pool. Service brokers compliant with the Open Service Broker API specification, allow platforms to provision a new instance of a service. With ORDS as an Open Service Broker to an Oracle database, customers can provision pluggable databases and database users. The nature of the database dictates the service offering that the ORDS database API provides.



Table 12-1 Open Service Broker Service Catalog

Database Type	Service	Plans	Prerequisites
Container Database	create-pluggable-database. Create a new pluggable database in the Oracle multitenant container database.	clone-database Create a new pluggable database in the container database by cloning another local pluggable database. Any ORDS REST enabled schemas in the source database is REST enabled in the new database.	Pluggable database lifecycle management must be configured.
		create-database	
		Create a new pluggable database from PDB\$SEED. The pluggable database administrator account is automatically rest enabled.	
Non-Container or Pluggable Database	create-oracle-database-user Create and configure an Oracle database user with an account through which the user can log in to the database.	create-standard-database-user Create an Oracle database user with the specified roles and privileges. The objects of the user are stored in the default database tablespace. The temporary segments of the user are stored in the default temporary database tablespace. create-ords- enabled-database-	None
		enabled-database- user	
		Create an Oracle database user with an ORDS enabled schema. The objects of the user are stored in the default database tablespace. The temporary segments of the user are stored in the default temporary database tablespace.	

To register the service broker URL with your Open Service Broker compliant platform, it depends on how the pool is registered with ORDS and the database type. Oracle



recommends that you use HTTPS with Open Service Broker endpoints. The process of registering a service broker differs depending on the platform.

The Service Broker URL for ORDS follows the following pattern:

create-oracle-database-user

To register the non-CDB or PDB service catalog, you must use the service broker URL for the non-CDB or PDB pool. The format is as follows:

https://<server>/ords/<my database>/<my admin schema>/_/db-api/stable/openservicebroker/

Using the SALESPDB example with PDBADMIN as an ORDS enabled schema, the URL is as follows:

https://<server>/ords/salespdb/pdbadmin/_/db-api/stable/openservicebroker/



<my database > can be the default database connection.

This configuration is common when customers are using ORDS directly with a single database. With this configuration, the example URL is https://<server>/ords/pdbadmin_/db-api/stable/openservicebroker/.

Supported Open Service Broker Operations

ORDS database API supports the synchronous provisioning operation. Other Open Service Broker operations such as deprovisioning and service binding are not supported.

Disabling the Service Broker for a Specific Pool

To disable the Open Service Broker services available for a specific pool, set the feature. openservicebroker.exclude property to true by specifying the pool name as follows:

java -jar ords.war set-property --conf <pool name>
feature.openservicebroker.exclude true
And then restart ORDS.

When you use ORDS directly with a container database and pluggable database mapping at runtime, disabling the Open Service Broker for the container disables the broker for all pluggable databases in the container. In such case, the configuration is defined in the container database pool configuration file.



A

Oracle REST Data Services Database Type Mappings

This appendix describes the REST Data Services database type mappings along with the structural database types.

Oracle Built-in Types

Data Type	JSON Data Type	REST Versi on	Value Example	Description
NUMBER	number	v1	"big": 1234567890 "bigger": 1.2345678901e1	Represented with all significant digits. An exponent is used when the number exceeds 10 digits.
RAW	string	Custo m	"code" : "SEVMTE8gV09ST EQh"	Base64 bit encoding is used
DATE	string	v1.2	"start" : "1995-06-02T04 :29:11Z"	Represented using ISO 8601 format in UTC time zone
TIMESTAMP	string	v1.2	when: "1995-06-02T04:29:11.002Z"	Represented using ISO 8601 format in UTC time zone
TIMESTAMP WITH LOCAL TIME ZONE	string	v1.2	"at" : "1995-06-02T04:2 9:11.002Z"	Represented using ISO 8601 format. The local time zone is converted to UTC time zone as the local time zone specification does not apply for a transfer encoding.
CHAR	string	v1	"message" : "Hello World! "	Represented with trailing spaces. This may be required as padding for PUT or POST methods. For example, "abc ".
ROWID	string	Custo m	"id" : "AAAGq9AAEAAAA 0bAAA"	Output as the native Oracle textual representation. For example, equivalent to the following conversion: SELECT ROWIDTOCHAR(id) id FROM DUAL.
UROWID	string	Custo m	"uid" : "AAAGq9AAEAAAA 0bAAA"	Output as the native Oracle textual representation. For example, equivalent to the following conversion: SELECT CAST(uid as VARCHAR(4000)) id FROM DUAL.



Data Type	JSON Data Type	REST Versi on	Value Example	Description
FLOAT	number	v1	*as NUMBER	
NCHAR	string	v1	"message" : "Hello World!	Represented using unicode character where the character is not supported by the body character set.
NVARCHAR2	string	v1	"message" : "Hello World!"	Represented using unicode character where the character is not supported by the body character set.
VARCHAR2	string	v1	"message" : "Hello World!"	
BINARY_FLOAT	number	v1	*as NUMBER	
BINARY_DOUBLE	number	v1	*as NUMBER	
TIMESTAMP WITH TIME ZONE	object	v1.2	"event": "1995-06-02T 04:29:11.002 Z" "when": "1995-06-02T 04:29:11.002 Z"	Represented using ISO 8601 format in UTC time zone. The value represents the same point in time but the original time zone is lost.
INTERVAL YEAR TO MONTH	object	Custo m	"until" : "P-123Y3M" "until" : "P3M"	Represented using ISO 8601 "Duration" format. Zero duration components are considered optional.
INTERVAL DAY TO SECOND	object	Custo m	"until" : "P-5DT3H55M" "until" : "PT3H55M"	Represented using ISO 8601 "Duration" format. Zero duration components are considered optional
LONG	string	v1	*as VARCHAR	
LONG RAW	string	Custo m	"long_code" : {	



Data Type	JSON Data Type	REST Versi on	Value Example	Description
BLOB	string	Custo m	"bin" : { "base64_valu e" : "bGVhc3VyZS4 =" }	
CLOB	string	Custo m	"text" : { "value" : "Hello World! " }	
BFILE	Object	Custo m	<pre>"file" : { "locator" : "TARGET_DIR" , "filename" : "myfile" }</pre>	
BOOLEAN	true false	v1	"right" : true "wrong" : false	

Handling Structural Database Types

This section explains how structural database types are handled.

Object Types

An exception to this is where ORDS has adopted an accepted encoding for an Industry Standard type such as GeoJSON.

Following is a sample code snippet:

```
"address" : {
"number" : 42,
```



```
"street" : "Wallaby Way",
"city" : "Sydney"
}
```

Inheritance

Object type inheritance is not supported. For marshalling purposes, all object types are treated as if they are left concrete types.

PL/SQL Records

PL/SQL Records are not supported.

VARRAYS

VARRAYS are mapped directly to the JSON array type.

Following is a sample code snippet:

```
"addresses" : [
{

"__db_type" : "MY_SCHEMA.AUS_ADDRESS",
"number" : 42,

"street" : "Wallaby Way",
"city" : "Sydney"
},
{

"__db_type" : "MY_SCHEMA.UK_ADDRESS"
"number : 1,
"street" : "Oracle Parkway"
"city" : "Reading"
"postcode" : "RG6 1RA"
}
]
```



Element Inheritance

If the type of a VARRAY element instance is a sub-type of the defined type, then it becomes mandatory to add the __db_type named value, as explained in the object types section.

Associative Arrays

Associative arrays (formally known as PL/SQL table or index-by table) fall into following two categories:

Indexed by an integer value: A sparsely populated indexed array. This type of
array may not yield a value for a given index. When this type of array is converted
to and from JSON, the index is ignored, removing the indexable value gaps. This
will have the side-effect that a sparsely populated indexed array that is passed as
an IN/OUT parameter through a PL/SQL procedure without any changes, could
still appear to have been changed, as the indexable value gaps would have been
removed.

Following is a sample code snippet:

```
"avg_values" : [
34,
57,
86,
3235
]
```

• **Not indexed by an integer value**: For example, VARCHAR. This category is rarely used and not supported by the Oracle JDBC API.

Oracle Geospacial Encoding

Oracle Geospacial types comprises of more than the predefined Oracle Object types. However, recognized JSON encoding call, GeoJSON is used to encode the instance data.

Related Topics

GeoJSON standard documentation

Enabling Database Mapping Support

This section shows how to enable the extended database mapping support.



To enable the extended database mapping support, the following code snippet must be added to the Oracle REST Data Services defaults.xml file, which is located in the Oracle REST Data Services configuration ords directory:

<entry key="misc.datatypes.enable">true</entry>



B

About the Oracle REST Data Services Configuration Files

The section describes the Oracle REST Data Services configuration files.

Topics:

- Locating Configuration Files
- Setting the Location of the Configuration Files
- Understanding the Configuration Folder Structure
- Understanding the Configuration File Format
- · Understanding Configurable Parameters

Locating Configuration Files

Use the configdir command to display the current location of the configuration files:

```
java -jar ords.war configdir
```

If the configuration folder has not yet been configured, the message: The <code>config.dir</code> setting is not set, is displayed. If it has been configured, the current value of the setting is displayed.

Setting the Location of the Configuration Files

To change the location of the configuration folder use the configdir command:

```
java -jar ords.war configdir </path/to/config>
```

Where:

</path/to/config> is the location where the configuration files are stored.

Understanding the Configuration Folder Structure

The configuration folder has the following structure:



```
+-apex_rt.xml
+-apex_pu.xml
|
...
+-(db-name).xml
+-(db-name)_al.xml
+-(db-name)_rt.xml
+-(db-name)_pu.xml
```

Global settings that apply to all database connections are stored in defaults.xml.

Settings specific to a particular database connection (for example, the default apex connection) are stored in conf/<db-name>.xml, where <db-name> is the name of the database connection.

If the database connection uses Oracle Application Express RESTful Services, the files with names including $_{al.xml}$, $_{rt.xml}$, and $_{pu.xml}$ store the configuration for the APEX_LISTENER, APEX_REST_PUBLIC_USER, and ORDS_PUBLIC_USER database users, respectively.

If the database connection uses Oracle REST Data Services RESTful Services, the file $\del{db-name}_{pu.xml}$ stores the configuration for the <code>ORDS_PUBLIC_USER</code> database user.

Understanding the Configuration File Format

Configuration files use the standard Java XML properties file format, where each configuration setting contains a key and a corresponding value. The following is an example of a defaults.xml file:

```
<?xml version="1.0" encoding="UTF-8"?>
<!DOCTYPE properties SYSTEM "http://java.sun.com/dtd/properties.dtd">
properties>
<entry key="db.connectionType">basic</entry>
<entry key="db.hostname">localhost</entry>
<entry key="db.port">1521</entry>
<entry key="db.sid">orcl</entry>
<entry key="jdbc.DriverType">thin</entry>
<entry key="jdbc.InitialLimit">3</entry>
<entry key="jdbc.MinLimit">1</entry>
<entry key="jdbc.MaxLimit">10</entry>
<entry key="jdbc.MaxStatementsLimit">10</entry>
<entry key="jdbc.InactivityTimeout">1800</entry>
<entry key="jdbc.statementTimeout">900</entry>
<entry key="jdbc.MaxConnectionReuseCount">1000</entry>
</properties>
```

Understanding the url-mapping.xml File Format

The url-mapping.xml file stores the rules that route requests to the appropriate database when more than one database is configured. The following is an example of a url-mapping.xml file:

```
<pool-config xmlns="http://xmlns.oracle.com/apex/pool-config">
  <pool name="sales_db"</pre>
```



```
base-path="/sales"
workspace-id="sales_rest"/>
</pool-config>
```

Understanding Configurable Parameters

Table B-1 lists editable parameters for the defaults.xml and (db-name).xml configuration files.



Oracle recommends users to use the Oracle REST Data Services commandline interface and Oracle SQL Developer Oracle REST Data Services Administration to edit the configuration files.

Table B-1 Oracle REST Data Services Configuration Files Parameters

Key	Туре	Description	Example	Setting Type
apex.docTable	string	This parameter is deprecated, instead use owa.docTable parameter.	MYDOCTABLE	Pool specific
database.api.enabled	string	Specifies whether the Database API is enabled. Supported values: true false (default)		
db.connectionType	string	The type of connection. Supported values: basic tns customurl	basic	Pool specific
db.customURL	string	Specifies the JDBC URL connection to connect to the database.	<pre>jdbc:oracle:t hin:@(DESCRIP TION=(ADDRESS =(PROTOCOL=TC P) (HOST=myhost) (PORT=1521)) (CONNECT_DATA =(SERVICE_NAM E=orall1.exam ple.com)))</pre>	Pool specific
db.hostname	string	Specifies the host system for the Oracle database.	myhostname	Pool specific
db.password	string	Specifies the password of the specified database user. Include an exclamation at the beginning of the password so that it can be stored encrypted.	! password4user	Pool specific



Table B-1 (Cont.) Oracle REST Data Services Configuration Files Parameters

Key	Туре	Description	Example	Setting Type
db.port	numeric	Specifies the database listener port.	1521	Pool specific
db.servicename	string	Specifies the network service name of the database.	orall1.exampl e.com	Pool specific
db.serviceNameSuffix	string	Specifies that the pool points to a CDB, and that the PDBs connected to that CDB should be made addressable by Oracle REST Data Services (see Making All PDBs Addressable by Oracle REST Data Services (Pluggable Mapping)).	apex_pu	Pool specific
db.sid	string	Specifies the name of the database.	orall1	Pool specific
db.tnsAliasName	string	Specifies the TNS alias name that matches the name in the tnsnames.ora file.	MY_TNSALIAS	Pool specific
db.tnsDirectory	string	The directory location of your tnsnames.ora file.	C:\ORACLE\NET WORK\ADMIN	Pool specific
db.username	string	Specifies the name of the database user for the connection.	APEX_PUBLIC_U SER	Pool specific
debug.printDebugToScreen	boolean	Specifies whether to display error messages on the browser. Supported values: true false (default)	false	Global
error.keepErrorMessages	boolean	Specifies whether to retain the error messages. Supported values: true false (default)	true	Global
error.responseFormat	string	Specifies how the HTTP error responses must be formatted. Supported values:	json	Global
		 html - Force all responses to be in HTML format json - Force all responses to be in JSON format auto - Automatically determines most appropriate format for the request (default). 		
error.maxEntries	numeric	Specifies the total number of error messages to retain.	50	Global
		Defaults to 50.		-
error.externalPath	string	Specifies the path to a folder that contains the custom error page.	/path/to/ error/pages/ folder/	Global



Table B-1 (Cont.) Oracle REST Data Services Configuration Files Parameters

Key	Туре	Description	Example	Setting Type
icap.port	numeric	Specifies the Internet Content Adaptation Protocol (ICAP) Port to virus scan files.	5555	Global
		The icap.port is required to have a value.		
icap.server	string	Specifies the Internet Content Adaptation Protocol (ICAP) Server name to virus scan files.	servername	Global
		The icap.server is required to have a value.		
jdbc.DriverType	string	Specifies the JDBC driver type. Supported values:	thin	Pool specific
		thinoci8		
jdbc.InactivityTimeout	numeric	Specifies how long an available connection can remain idle before it is closed. The inactivity connection timeout is in seconds.	1800	Pool specific
		Defaults to 1800.		
jdbc.InitialLimit	numeric	Specifies the initial size for the number of connections that will be created.	10	Pool specific
		Defaults to 3. (The default is low, and should probably be set higher in most production environments.)		
jdbc.MaxConnectionReuseCo unt	numeric	Specifies the maximum number of times to reuse a connection before it is discarded and replaced with a new connection.	1000	Pool specific
		Defaults to 1000.		
jdbc.MaxLimit	numeric	Specifies the maximum number of connections.	20	Pool specific
		Defaults to 10. (Might be too low for some production environments.)		
jdbc.auth.enabled	boolean	Specifies if the PL/SQL Gateway calls can be authenticated using database users. If the value is true then this feature is enabled. If the value is false, then this feature is disabled. The default value is false. Oracle recommends not to use this feature. This feature used only to facilitate customers migrating from mod_plsql.	false	Pool specific



 Table B-1
 (Cont.) Oracle REST Data Services Configuration Files Parameters

Key	Туре	Description	Example	Setting Type
jdbc.MaxStatementsLimit	numeric	Specifies the maximum number of statements to cache for each connection. Defaults to 10.	10	Pool specific
jdbc.MinLimit	numeric	Specifies the minimum number of connections. Defaults to 1.	1	Pool specific
jdbc.statementTimeout	numeric	Specifies a timeout period on a statement.	900	Pool specific
		An abnormally long running query or script, executed by a request, may leave it in a hanging state unless a timeout is set on the statement. Setting a timeout on the statement ensures that all the queries automatically timeout if they are not completed within the specified time period.		
log.logging	boolean	Defaults to 900. Specifies whether to retain the log messages. Supported values:	true	Global
		truefalse (default)		
log.maxEntries	numeric	Specifies the total number of log messages to retain. Defaults to 50.	50	Global
log.procedure	boolean	Specifies whether procedures are to be logged. Supported values:	false	Global
		truefalse (default)		
misc.defaultPage	string	Specifies the default page to display. The Oracle REST Data Services home page, apex , is commonly used.	apex	Pool specific
misc.pagination.maxRows	numeric	Specifies the maximum number of rows that will be returned from a query when processing a RESTful service and that will be returned from a nested cursor in a result set. Affects all RESTful services generated through a SQL query, regardless of whether the resource is paginated. Defaults to 10000.	300	Pool specific



Table B-1 (Cont.) Oracle REST Data Services Configuration Files Parameters

Key	Type	Description	Example	Setting Type
owa.docTable	string	Specifies the name of the document table used by the file upload. Defaults to FLOWS_FILES.WWV_FLOW_FILE_OBJECTS\$ value.	MYDOCTABLE	Pool specific
		For AP EX 4.x and abo ve this par am eter sho uld not be use d.		
procedure.postProcess	string	Specifies the procedure name(s) to execute after executing the procedure specified on the URL. Multiple procedure names must be separated by commas.	SCHEMA1.SUBMI T.REQUEST,FIN ISHTASK	Pool specific
procedure.preProcess	string	Specifies the procedure name(s) to execute prior to executing the procedure specified on the URL. Multiple procedure names must	SCOTT.PREPROC 1, INITIALIZE, PKG1.PROC	Pool specific

be separated by commas.



 Table B-1
 (Cont.) Oracle REST Data Services Configuration Files Parameters

Key	Туре	Description	Example	Setting Type
procedure.rest.preHook	string	Specifies the function to be invoked prior to dispatching each Oracle REST Data Services based REST Service. The function can perform configuration of the database session, perform additional validation or authorization of the request. If the function returns true, then processing of the request continues. If the function returns false, then processing of the request is aborted and an HTTP 403 Forbidden status is returned.	MYAPP.VALIDAT E_REST_CALL	Pool specific
security.disableDefaultEx book	boolean	If this value is set to true, then the Oracle REST Data Services internal exclusion list is not enforced.	false	Global
		Note: The Oracle REST Data Services internal exclusion list blocks the users from accessing the following: • sys.* • dbms_* • utl_* • owa_* • htp.* • htf.* • wpg_docload.*		
		Supported values: true false (default) Oracle recommends that you do not set this value to true. That is, do not disable the default internal exclusion list. The only possible exception is temporarily disabling the internal exclusion list for debugging purposes.		



Table B-1 (Cont.) Oracle REST Data Services Configuration Files Parameters

Key	Туре	Description	Example	Setting Type
security.exclusionList	string	Specifies a pattern for procedures, packages, or schema names which are forbidden to be directly executed from a browser.	<pre>customer_acco unt,bank*, employe?</pre>	Global
		Procedure names can contain the wildcard characters asterisk (*) or question mark (?). Use an asterisk (*) to substitute zero or more characters and a question mark (?) to substitute for any one character.		
		Note : Separate multiple patterns using commas.		
security.inclusionList	string	Specifies a pattern for procedures, packages, or schema names which are allowed to be directly executed from a browser.	apex, p, v, f, wwv_*, y*, c*	Global
		Procedure names can contain the wildcard characters asterisk (*) or question mark (?). Use an asterisk (*) to substitute zero or more characters and a question mark (?) to substitute for any one character.		
		Note : Separate multiple patterns using commas.		
security.maxEntries	numeric	Specifies the maximum number of cached procedure validations. Defaults to 2000. Set this value to 0 to force the validation procedure to be invoked on each request.	2000	Global
security.requestAuthentic ationFunction	string	Specifies an authentication function to determine if the requested procedure in the URL should be allowed or disallowed for processing. The function should return true if the procedure is allowed; otherwise, it should return false. If it returns false, Oracle REST Data Services will return WWW-Authenticate in the response header.	owa_custom.au thorize	Pool specific



Table B-1 (Cont.) Oracle REST Data Services Configuration Files Parameters

Key	Туре	Description	Example	Setting Type
security.requestValidatio nFunction	string	Specifies a validation function to determine if the requested procedure in the URL should be allowed or disallowed for processing. The function should return true if the procedure is allowed; otherwise, return false.	CHECK_VALID_P ROCEDURE	Pool specific
security.verifySSL	boolean	Specifies whether HTTPS is available in your environment.	true	Global
		Supported values: true (default) false If you change the value to false, see Using OAuth2 in Non-HTTPS Environments.		
soda.defaultLimit	string	When using the SODA REST API, specifies the default number of documents returned for a GET request on a collection when a limit is not specified in the URL. Must be a positive integer, or "unlimited" for no limit. Defaults to 100.	75	Pool specific
soda.maxLimit	string	When using the SODA REST API, specifies the maximum number of documents that will be returned for a GET request on a collection URL, regardless of any limit specified in the URL. Must be a positive integer, or "unlimited" for no limit. Defaults to 1000.	700	Pool specific
restEnabledSql.active	boolean	Specifies whether the REST- Enabled SQL service is active. Supported values: true false (default)	true	Pool specific



For more information, see Configuring and Installing Oracle REST Data Services and "Oracle REST Data Services Administration" in *Oracle SQL Developer User's Guide*.



C

Troubleshooting Oracle REST Data Services

This appendix contains information on troubleshooting Oracle REST Data Services.

Topics:

- Enabling Detailed Request Error Messages
- Configuring Application Express Static Resources with Oracle REST Data Services

Enabling Detailed Request Error Messages

To enable detailed request error messages, add the following setting to the Oracle REST Data Services configuration file named: defaults.xml:

<entry key="debug.printDebugToScreen">true</entry>

When this setting is present in defaults.xml, any request that produces an error response includes a detailed message, including a stack trace. This setting must not be enabled on productions systems due to the risk of sensitive information being revealed to an attacker.

ORDS User Defined Service

The following table lists the ORDS user defined services:

Table C-1 List of ORDS user defined service

Service	Response
HTTP	>curl -
200	i -X
BEGIN	GET
	user
ORDS.def	DEMO:dem
ine_serv	o -k
ice(http://
	localhos
p_module	t:8082/
_name	ords/
=>	demo/
'test1',	test1/ok
	/
p_base_p	HTTP/1.1
ath	200 OK
=>	Date:
'test1/'	Thu, 19
,	Mar
	2020
p_patter	17:18:05
n	GMT
=>	Content-
'ok/',	Type:
	applicat
p_method	ion/json
	ETag:
=>	"BLNTmyd
'GET',	/ FM00000
	ZM889Q0G
p_source	lgJ1t7lk
_type ->	SYo2kpAV Iv4CY5dv
=> ORDS.sou	tp9NI/
	Em1DJRzp
rce_type _collect	mE5Bg/
ion_feed	шьзьд/ 4GiKifew
	tzuJA6i+
1	YCgdxETW
p_source	WQ=="
F_SOULCE	Transfer
=>	_
SELECT	Encoding
* FROM	:
	chunked
dual',	
p_items_	



Table C-1 (Cont.) List of ORDS user defined service

Service	Response
COMMITTER	
COMMIT; END;	
/	



Table C-1 (Cont.) List of ORDS user defined service

HTTP 200 , p_source _type => ORDS.sou rce_type _collect ion_feed , BEGIN	head -i -X GET user DEMO:dem
<pre>200 , p_source _type => ORDS.sou rce_type _collect ion_feed ,</pre>	head -i -X GET user DEMO:dem
<pre>p_source _type => ORDS.sou rce_type _collect ion_feed ,</pre>	-i -X GET user DEMO:dem
_type => ORDS.sou rce_type _collect ion_feed	GET user DEMO:dem
<pre>=> ORDS.sou rce_type _collect ion_feed ,</pre>	user DEMO:dem
ORDS.sou rce_type _collect ion_feed	DEMO:dem
<pre>rce_type _collect ion_feed ,</pre>	
_collect ion_feed ,	
ion_feed ,	
,	
	t:8082/
DEGIN	ords/
	demo/
ORDS.def	
ine_serv	
ice(HTTP/1.1
	200 OK
p_module	
_name	Thu, 19
=>	Mar
'test2',	2020
	17:18:28
	GMT
p_base_p	Content-
ath =>	Type:
'test2/'	applicat
,	ion/json
	ETag:
p_patter	"aZVsHTw
n =>	ewrbbk16
'norows/	wHNcTa3R
1,	FFdEsbdt
	DRBTS1R9
p_method	3r/
=>	vBmDvVsg
'GET',	ud2rFqLD
	I65UKxzS
p_source	ElnAAMQd
_type	lBj/
=>	sB9ywWqQ
ORDS.sou	=="
rce_type	Transfer
_collect	- 1'
ion_feed	Encoding .
,	: chunked
	Ciluliked
n dollado	
p_source	
<pre>p_source => 'SELECT</pre>	



Table C-1 (Cont.) List of ORDS user defined service

Service	Response
* FROM	
dual	
where 1	
= 2',	
p_items_	
per_page	
=> 0);	
G010/75	
COMMIT;	
END;	
/	



Table C-1 (Cont.) List of ORDS user defined service

create table no_rows	>curl
table no_rows	\aurl
table no_rows	Saurl
no_rows	
	head
	-i -X
(col1	GET
int);	user
HTTP	DEMO:dem
200 ,	o -k
p_source	http://
_type	localhos
=>	t:8082/
ORDS.sou	ords/
rce_type	demo/ test2b/
_collect ion_feed	rest2b/ norows/
	HTTP/1.1
, BEGIN	200 OK
DEGIN	Date:
ORDS.def	Thu, 19
ine_serv	Mar
ice(2020
	17:18:34
p_module	GMT
_name	Content-
=>	Type:
'test2b'	applicat
,	ion/json
	ETag:
p_base_p	"Ns/g/
ath =>	hFxVWYPH
'test2b/	UyZT53HN
1,	16EMV1QU
	XD5wmz3e
p_patter	oO15dlY6
n =>	nSVkk2FX
'norows/	3sNw3Yvq
1,	87SdLYA1
	CLeuqb4N
<pre>p_method =></pre>	4DQrcy+0 Q=="
=> 'GET',	Q==¨ Transfer
GEI,	-
p_source	Encoding
_type	:
=>	chunked
	0114111104
ORDS.Sou	
ORDS.sou rce_type	



Table C-1 (Cont.) List of ORDS user defined service

Service	Response
ion_feed	
,	
p_source	
=> 'SELECT	
* FROM	
no_rows'	
p_items_	
<pre>per_page => 0);</pre>	
COMMIT;	
END;	
/	
-	



Table C-1 (Cont.) List of ORDS user defined service

Service	Response
	•
HTTP	>curl
404 ,	head
p_source	−i −X
_type	GET
=>	user
ORDS.sou	DEMO:dem
	o -k
	http://
ion_item	localhos
/ DEGIN	t:8082/
BEGIN	ords/
ORDS.def	demo/ test2c/
ine_serv	norows/
ice(HTTP/1.1
	404
p_module	Not
_name	Found
=>	Content-
'test2c'	Type:
1	text/
_	html
p_base_p	Content-
ath =>	
'test2c/	16127
' ,	
p_patter	
n =>	
'norows/	
1,	
p_method	
=>	
'GET',	
n	
p_source _type	
=> _c\be	
ORDS.sou	
rce_type	
_collect	
ion_item	
1	
p_source	
=>	
'SELECT	



Table C-1 (Cont.) List of ORDS user defined service

Service	Response
* FROM	
dual	
where 1 = 2',	
p_items_	
per_page	
=> 0);	
COMMIT;	
END;	
/	
,	



Table C-1 (Cont.) List of ORDS user defined service

Service	Response
HTTP	>curl
404	head
404 BEGIN	-i -X
אדטייט	GET
ORDS.def	user
ine_serv	DEMO:dem
ice(o -k
100 (http://
p_module	localhos
_name	t:8082/
=>	ords/
'test3',	demo/
7	test3/
	doesnote
p_base_p	xist/
ath =>	HTTP/1.1
'test3/'	403
,	Forbidde
,	n
p_patter	Content-
n =>	Type:
'doesnot	text/
exist/',	html
,	Error-
	Reason:
p_method	error="m
=>	issing.o
'GET',	bject";
•	error_de
p_source	scriptio
_type	n*=UTF-8
=>	1
ORDS.sou	'The
rce_type	request
_collect	could
ion_feed	not be
,	processe
	d
p_source	because
=>	a table
'SELECT	or view
10 as A	referenc
FROM	ed
daaanata	0by the
doesnote	
xist',	SQL
	statemen
	statemen



Table C-1 (Cont.) List of ORDS user defined service

Service	Response
=> 0);	d is
COMMIT;	not accessib
END;	le or
/	does
	not exist
	Content-
	Length:
	16327



Table C-1 (Cont.) List of ORDS user defined service

Service	Response
HTTP 555	>curl head
BEGIN	-i -X
ORDS.def	GET
ine_serv	user DEMO:dem
	o -k
ice(o -k http://
p_module	localhos
_name	t:8082/
	ords/
'test4',	demo/
CCDCT ,	test4/
	badsynta
p_base_p	x/
ath =>	HTTP/1.1
'test4/'	500
,	Server
•	Error
p_patter	Content-
n =>	Type:
'badsynt	text/
ax/',	html
	Error-
p_method	Reason:
=>	error="r
'GET',	esource.
	generato
p_source	r.evalua
_type	tion";
=>	error_de
ORDS.sou	scriptio
rce_type	n*=UTF-8
_collect	ī
ion_feed	'The
,	request
	could
p_source	not be
=>	processe
'SELECT	d
10',	because
24	an
p_items_	error
per_page	occurred
=> 0);	whilst
COMMIT;	attempti
COMMITTI	ng to
	LU



Table C-1 (Cont.) List of ORDS user defined service

Service	Response
END:	1±
END;	evaluate the
/	
	SQL statemen
	t statemen
	u associat
	ed with
	this
	resource
	· Dloago
	Please check
	the
	SQL
	statemen
	t is
	correctl
	У
	formed
	and
	executes
	without
	error.
	SQL
	Error
	Code
	ORA-0092
	3 FROM
	keyword
	not
	found
	where
	expected
	Error
	Message.
	Content-
	Length:
	16514

Configuring Application Express Static Resources with Oracle REST Data Services

When using Oracle REST Data Services, a blank page might be displayed when attempting to access an Oracle Application Express page, for example, when attempting to display https://example/ords/. This problem is caused by an improper



configuration of Application Express static resources, which causes the JavaScript and CSS resources required by Application Express not to be found and the Application Express page not to render correctly.

The specific cause can be any of the following:

- Forgetting to ensure that the Application Express static images are located on the same server as the Oracle REST Data Services instance
- Forgetting to deploy i.war on WebLogic Server
- Specifying an incorrect path when using the java -jar ords.war static command to generate i.war
- Configuring Application Express to use a nondefault context path for static resources (/i) and not specifying the same context path (using the --contextpath option) when using java -jar ords.war static
- Moving, renaming, or deleting the folder pointed to by i.war after deploying i.war
- When running in Standalone mode, entering an incorrect path (or not specifying a path) when prompted on the first run of Standalone mode
- When running in Standalone mode, entering an incorrect path with the --staticimages option
- Upgrading to a new version of Application Express and forgetting to reconfigure and redeploy i.war to point to the static resources for the new Application Express version, or in Standalone mode forgetting to update the location by using the --apex-images option

To help in diagnosing the problem, you can try to access the apex_version.txt file. For example, if your Application Express deployment is located at https://example.com/ords/ and your static resources have been deployed at https://example.com/i/, use a browser to access the following URL:

```
https://example.com/i/apex_version.txt
```

If you get a 404 Not Found error, then check the preceding list of possible specific causes, including i.war not being deployed or not pointing to a folder containing Application Express static resources.

If a plain text file is displayed, it should contain text like the following:

```
Application Express Version: 4.2.1
```

Check that the version number matches the version of Application Express that is deployed on the database. If the numbers do not match, check if you have made an error mentioned in the last item in the preceding list of possible specific causes, because Oracle REST Data Services is not configured to use the correct version of the Application Express static resources to match the Application Express version in the database.

If you need help in solving the problem, check the information in this book about creating and deploying i.war for your environment, such as WebLogic Server.

You can also get detailed help on the static listener command by entering the following at a command prompt:

```
java -jar ords.war help static
```



D

Creating an Image Gallery

This tutorial explains an extended example that builds an image gallery service for storing and retrieving images. This tutorial uses Oracle Application Express.

Topics:

- · Before You Begin
- Creating the Gallery Database Table
- Creating the Gallery RESTful Service Module
- Trying Out the Gallery RESTful Service
- Creating the Gallery Application
- · Trying Out the Gallery Application
- Securing the Gallery RESTful Services
- Accessing the RESTful Services from a Third Party Application



To do this tutorial, you must be familiar with the concepts and techniques covered in Developing Oracle REST Data Services Applications.

Before You Begin

This section describes some common conventions used in this example as well as best practices regarding API entry points.

Topics:

- About URIs
- About Browser Support
- Creating an Application Express Workspace

About URIs

Throughout this example, URIs and URI Templates are referenced using an abbreviated form that omits the host name, context root and workspace path prefix. Consider the following example:

gallery/images/

To access this URI in your Web browser, you would use a URI in the following format:

https://<host>:<port>/ords/<workspace>/gallery/images/



where

- <host> is the host on which Oracle REST Data Services is running.
- <port> is the port on which Oracle REST Data Services is listening.
- /ords is the context root where Oracle REST Data Services is deployed.
- /<workspace>/ is the workspace path prefix of the Oracle Application Express workspace where the RESTful Service is defined.

About Browser Support

This example uses many modern features defined in HTML5 and related specifications. It has only been tested in Mozilla Firefox and Google Chrome. It has not been tested in Microsoft Internet Explorer or on smart-phone/tablet web browsers. Please use recent versions of either Mozilla Firefox or Google Chrome for this example.

Creating an Application Express Workspace

To follow the instructions for creation the Gallery example application and related objects, first, create a new Oracle Application Express Workspace (in Full Development mode). See the Oracle Application Express Documentation for details on how to do this.

Call the workspace resteasy and call the administrator user of the workspace resteasy_admin. Ensure the resteasy_admin user is a a member of the RESTful Services user group.

Creating the Gallery Database Table

To create the Gallery database table, follow these steps:

- 1. Log into the resteasy workspace.
- 2. Navigate to SQL Workshop and then SQL Commands.
- 3. Enter or copy and paste in the following SQL:

```
CREATE SEQUENCE GALLERY_SEQ

/

CREATE TABLE GALLERY (
   ID NUMBER NOT NULL ENABLE,
   TITLE VARCHAR2(1000) NOT NULL ENABLE,
   CONTENT_TYPE VARCHAR2(1000) NOT NULL ENABLE,
   IMAGE BLOB NOT NULL ENABLE,
   CONSTRAINT GALLERY_PK PRIMARY KEY (ID) ENABLE
)

/

CREATE OR REPLACE TRIGGER BI_GALLERY
before insert on GALLERY for each row
begin
   if :NEW.ID is null then
   select GALLERY_SEQ.nextval into :NEW.ID from sys.dual;
   end if;
end;
/
```



```
ALTER TRIGGER BI_GALLERY ENABLE
```

Creating the Gallery RESTful Service Module

To create the Gallery RESTful services module, follow these steps:

- Navigate to SQL Workshop and then RESTful Services.
- 2. Click **Create** on the right side, and enter the following information:
 - Name: gallery.example
 - URI Prefix: gallery/
 - URI Template: images/
 - Method: POST
 - Source: Enter or copy and paste in the following:

- Click Create Module.
- 4. Click the POST handler under images/
- 5. For Requires Secure Access, select No.
- 6. Click Create Parameter, and enter the following:
 - Name: Slug
 - Bind Variable Name: title
- 7. Click Create.
- 8. Click Create Parameter on the bottom right, and enter the following information:
 - Name: X-APEX-FORWARD
 - Bind Variable Name: location
 - Access Method: OUT
- Click Create.
- 10. Click Create Parameter on the bottom right, and enter the following information:
 - Name: X-APEX-STATUS-CODE
 - Bind Variable Name: status
 - Access Method: OUT
 - Parameter Type: Integer
- 11. Click Create.



At this point you have created the module with a single service that can store new images. Next, add a service to display the list of stored images:

- 1. Navigate to SQL Workshop and then RESTful Services.
- 2. Click the module named gallery.example.
- 3. Click Create Handler under images/, and enter the following information:
 - Method: GET
 - Source Type: Feed
 - Requires Secure Access: No
 - Source: Enter or copy and paste in the following:

```
select id, title, content_type from gallery order by id desc
```

4. Click Create.

At this point you have created the service to store and list images. Next, add a service to display individual images:

- 1. Navigate to SQL Workshop and then RESTful Services.
- 2. Click the module named gallery.example.
- 3. Click Create Template under gallery.example, and enter the following information:
 - URI Template: images/{id}
- 4. Click Create.
- 5. Click Create Handler under images/{id}, and enter the following information:
 - Method: GET
 - Source Type: Media Resource
 - Requires Secure Access: No
 - **Source**: Enter or copy and paste in the following:

```
select content_type, image from gallery where id = :id
```

6. Click Create.

Trying Out the Gallery RESTful Service

To try out the Gallery RESTful Service, follow these steps:

- 1. Navigate to **SQL Workshop** and then **RESTful Services**.
- 2. Click the module named gallery.example.
- 3. Click the GET handler located under images/.
- 4. Click Test.

The following URI should be displayed in the browser:

```
https://<host>:<port>/ords/resteasy/gallery/images/
```

Content similar to the following should be displayed:

```
{"next":
{"$ref":
```



```
"http://localhost:8080/ords/resteasy/gallery/images/?page=1"
},
"items":[]
```

- The content is a JSON document that lists the location of each image in the gallery, but since you have not yet added any images, the list (the items[] element) is empty.
- The JSON has no extra white space to minimize its size, this can make it difficult to decipher, it is recommended to add a JSON viewing plugin to your browser to make viewing the JSON easier.

To create an Oracle Application Express application to enable users to add and view images in the gallery, see Creating the Gallery Application.

Creating the Gallery Application

To create an Oracle Application Express application that uses the gallery RESTful Services, follow these steps:

- 1. Navigate to Application Builder.
- 2. Click Create.
- 3. Choose Database, then click Next.
- 4. Enter Image Gallery in the Name field, then click Next.
- Click Create Application, and then Create Application again to confirm creation of the application.
- 6. Click page 1, Home.
- 7. Under **Regions** click the + (plus sign) icon to create a new region.
- 8. For Region Type, choose HTML and click Next, then click Next on the next page.
- 9. For Region Template, choose No Template.
- 10. For Title, enter Tasks, and click Next.
- 11. For Enter HTML Text Region Source, specify:

```
<a class="button" id="upload-btn">Upload Image</a>
```

- 12. Click Create Region.
- **13**. Under **Regions**, click the + (plus sign) icon to create a new region.
- 14. For Region Type, choose HTML, and click Next, then Next again.
- 15. For Region Template, choose DIV Region with ID.
- 16. For Title, enter Images.
- 17. Click Create Region.
- 18. Click the Images region and click the Attributes tab.
- 19. For Static ID, enter images, and click Apply Changes.
- 20. Under Page, click the Edit icon, then click the JavaScript tab.
- 21. For Function and Global Variable Declaration, enter or copy and paste in the following:



```
var workspace_path_prefix = 'resteasy';
var gallery_url = './' + workspace_path_prefix + '/gallery/images/';
function uploadFiles(url, fileOrBlob, onload) {
 var name = 'unspecified';
 if ( fileOrBlob['name'] ) {
  name = fileOrBlob.name;
 var xhr = new XMLHttpRequest();
 xhr.open('POST', url, true);
 xhr.setRequestHeader('Slug',name);
 xhr.onload = onload;
 xhr.send(fileOrBlob);
 function createUploader() {
 var $upload = $('<div id="uploader" title="Image Upload"\</pre>
  style="display:none">\
   <form>\
   <fieldset>\
    <label for="file">File</label>\
    <input type="file" name="file" id="file"\</pre>
     class="text ui-widget-content ui-corner-all"/>\
    </fieldset>\
   </form>\
  </div>');
  $(document.body).append($upload);
  $upload.dialog({
  autoOpen:false,
  modal: true,
  buttons: {
    "Upload": function() {
    var file = document.querySelector('input[type="file"]');
    uploadFiles(gallery_url,file.files[0],function() {
     $('#uploader').dialog("close");
     getImages();
    });
    },
    "Cancel": function() {
    $('#uploader').dialog("close");
 });
  $('#upload-btn').click(function() {
  $('#uploader').dialog("open");
 });
 }
 function getImages() {
 var xhr = new XMLHttpRequest();
 xhr.open('GET', gallery_url);
 xhr.onload = function(e) {
  var data = JSON.parse(this.response);
   $('#image-list').remove();
   var $images = $('');
   for ( i in data.items ) {
   var item = data.items[i];
   var uri = item.uri['$ref'];
    var $image = $('')
                 .append('<a href="' + uri + '" + title="' +
                         item.title + '"><img src="graphics/'+ uri +</pre>
                         '"></a>');
```

```
$images.append($image);
}
$('#images').append($images);
}
xhr.send();
}
```

22. For Execute when Page Loads, enter or copy and paste in the following:

```
createUploader();
getImages();
```

- 23. Click Apply Changes.
- 24. Under Page, click the Edit icon, then click the CSS tab.
- 25. For Inline, enter or copy and paste in the following:

```
a img { border:none; }
#images ol { margin: 1em auto; width: 100%; }
#images li { display: inline; }
#images a { background: #fff; display: inline; float: left;
           margin: 0 0 27px 30px; width: auto; padding: 10px 10px 15px;
            textalign: center; text-decoration: none; color: #333;
            font-size: 18px; -webkit-box-shadow: 0 3px 6px rgba(0,0,0,.25);
            -moz-boxshadow: 0 3px 6px rgba(0,0,0,.25); }
#images img { display: block; width: 190px; margin-bottom: 12px; }
label {font-weight: bold; text-align: right;float: left;
       width: 120px; margin-right: 0.625em; }
label :after {content(":")}
input, textarea { width: 250px; margin-bottom: 5px;textalign: left}
textarea {height: 150px;}
br { clear: left; }
#images a:after { content: attr(title); }
.button {
 border-top: 1px solid #96d1f8;
 background: #65a9d7;
 background:
   -webkit-gradient(linear,left top,left bottom,
                    from(#3e779d),to(#65a9d7));
 background:
   -webkit-linear-gradient(top, #3e779d, #65a9d7);
 background:
  -moz-linear-gradient(top, #3e779d, #65a9d7);
 background: -ms-linear-gradient(top, #3e779d, #65a9d7);
 background: -o-linear-gradient(top, #3e779d, #65a9d7);
 padding: 5px 10px;
  -webkit-border-radius: 8px;
  -moz-border-radius: 8px;
 border-radius: 8px;
  -webkit-box-shadow: rgba(0,0,0,1) 0 1px 0;
  -moz-box-shadow: rgba(0,0,0,1) 0 1px 0;
 box-shadow: rgba(0,0,0,1) 0 1px 0;
  text-shadow: rgba(0,0,0,.4) 0 1px 0;
  color: white;
  font-size: 14px;
  text-decoration: none;
  vertical-align: middle;
 .button:hover {
 border-top-color: #28597a;
```



```
background: #28597a;
color: #ccc;
cursor: pointer;
}
.button:active {
  border-top-color: #1b435e;
  background: #1b435e;
}
```

26. Click Apply Changes.

Trying Out the Gallery Application

To try out the Gallery application, follow these steps:

- Navigate to Application Builder.
- 2. Click Run beside the Image Gallery application.
- 3. Log in as the resteasy_admin user.
- Click Upload Image.
- 5. Choose an image file (a JPEG or PNG file) and click Upload.

The application displays the uploaded image.

Securing the Gallery RESTful Services

It is not wise to allow public access to the image uploading service, and it is probably not ideal to allow public access to the images in the gallery either. Therefore, you should protect access to the RESTful services.

RESTful Services support two kinds of authentication:

- First Party Authentication. This is authentication intended to be used by the party
 who created the RESTful service, enabling an Application Express application to
 easily consume a protected RESTful service. The application must be located with
 the RESTful service, that is, it must be located in the same Oracle Application
 Express workspace. The application must use the standard Oracle Application
 Express authentication.
- Third Party Authentication. This is authentication intended to be used by third party applications not related to the party who created the RESTful service. Third party authentication relies on the OAuth 2.0 protocol.

Topics:

- Protecting the RESTful Services
- Modifying the Application to Use First Party Authentication

Protecting the RESTful Services

To protect the RESTful services, follow these steps:

Navigate to SQL Workshop and then RESTful Services.

- 2. Click **RESTful Service Privileges** in the section labeled **Tasks**.
- Click Create, and enter the following:

Name: example.gallery

Label: Gallery Access

Assigned Groups: RESTful Services

Description: View and Post images in the Gallery

Protected Modules: gallery.example

4. Click Create.

To check that access to the RESTful Service is now restricted, follow these steps:

- 1. Navigate to SQL Workshop and then RESTful Services.
- 2. Click the module named gallery.example.
- 3. Click the GET handler located under images/.
- Click Test.

The URI in the following format should be displayed in the browser:

https://<host>:<port>/ords/resteasy/gallery/images

An error page should be displayed with the error message:

401 Unauthorized.

See Also:

This is the expected result, because a protected RESTful Service cannot be accessed unless proper credentials are provided. To add the required credentials to the request, see Modifying the Application to Use First Party Authentication

Modifying the Application to Use First Party Authentication

First Party Authentication relies on the cookie and user session established by the Application Express application, but Oracle REST Data Services needs additional information to enable it to verify the cookie. It needs to know the application ID and the current session ID. This information is always known to the Application Express application, and must be included with the request made to the RESTful service by adding the custom Apex-Session HTTP header to each request sent to a RESTful Service. The application ID and session ID are sent as the value of the header, separated from each other by a comma delimiter. For example:

GET /ords/resteasy/gallery/images/
Host: server.example.com
Apex-Session: 102,6028968452563

Sometimes it is not possible to include a custom header in the HTTP request. For example, when displaying an image in an HTML page using the tag, an alternative mechanism is used for these scenarios. The application ID and session ID are included in a query parameter named _apex_session, which is added to

the Request URI, which contains the application ID and session ID separated by a comma. For example:

```
<img src="graphics/101?_apex_session=102,6028968452563">
```

Note that this approach must only be used when it is not possible to use a custom header. Otherwise, this approach is discouraged because of the increased risk of the session ID being inadvertently stored or disclosed due to its inclusion in the URI.

To modify the application to add the first party authentication information to each request, follow these steps:

- 1. Navigate to Application Builder.
- 2. Click the Edit button beside the Image Gallery application.
- 3. Click the first page, named Home.
- 4. Under Page click the Edit icon, and click the JavaScript tab.
- Add the following at the start of the Function and Global Variable Declaration field:

```
function setApexSession(pathOrXhr) {
  var appId = $v('pFlowId');
  var sessionId = $v('pInstance');
  var apexSession = appId + ',' + sessionId;
  if ( typeof pathOrXhr === 'string' ) {
    var path = pathOrXhr;
    if ( path.indexOf('?') == -1 ) {
      path = path + '?_apex_session=' + apexSession;
    } else {
      path = path + '&_apex_session=' + apexSession;
    }
    return path;
} else {
    var xhr = pathOrXhr;
    xhr.setRequestHeader('Apex-Session',apexSession);
    return xhr;
}
```

6. This defines a JavaScript function named setApexSession() which will add the first party authentication information to an XMLHttpRequest object or a string containing a path.

Now you must modify the existing JavaScript code to add call this function when appropriate.

7. After the line reading xhr.open('POST', url, true);, add the following line:

```
setApexSession(xhr);
```

8. After the line reading xhr.open('GET', gallery_url);, add the following line:

```
setApexSession(xhr);
```

9. Change the line reading var uri = item.uri['\$ref']; to:

```
var uri = setApexSession(item.uri['$ref']);
```

- 10. Click Apply Changes.
- 11. Try running the application as before. It should work, because it is now providing the RESTful Services with the required authentication information.



Accessing the RESTful Services from a Third Party Application

If third parties want to consume and use the Gallery RESTful services, they must register the third party application in order to gain OAuth 2.0 credentials, which can then be used to initiate an interactive process by which users can authorize the third party application to access the RESTful Services on their behalf.

Once an application is registered, it can then acquire an access token. The access token must be provided with each request to a protected RESTful Service. Oracle REST Data Services verifies the access token before allowing access to the RESTful service.

OAuth 2.0 defines a number of different protocol flows that can be used by applications to acquire an access token. Oracle REST Data Services supports two of these protocol flows:

- Authorization Code. This flow is used when the third party application is able to keep its client credentials secure, for example, a third party website that is properly secured.
- Implicit Grant. This flow is used when the third party application cannot assure
 that its credentials would remain secret, for example, a JavaScript-based browser
 application or a native smartphone application.

The first step is to register the third party application. To demonstrate this, you will create a user representing the third party developer, and then use that user to register an application.

The steps in the related topics create a user in the RESTEASY workspace user repository and perform related actions.



In addition to authenticating users defined in workspace user repositories, Oracle REST Data Services can also authenticate against any user repository accessible from WebLogic Server. For information, see Authenticating Against WebLogic Server.

Topics:

- Creating the Third Party Developer User
- Registering the Third Party Application
- Acquiring an Access Token
- · Using an Access Token
- About Browser Origins
- Configuring a RESTful Service for Cross Origin Resource Sharing
- Acquiring a Token Using the Authorization Code Protocol Flow
- About Securing the Access Token



Creating the Third Party Developer User

To create the third party developer user (the user account for the third party developer who wants to register an application to access the RESTful services), follow these steps:

- 1. Navigate to Administration.
- 2. Click Manage Users and Groups.
- 3. Click **Create User**, and enter the following information:
 - Username: 3rdparty_dev
 - Email Address: Email address for this developer user
 - Password: Password for this user
 - User Groups: OAuth 2.0 Client Developer
- 4. Click Create User.

Registering the Third Party Application

To register the third party application to use the Implicit Grant OAuth 2.0 protocol flow, follow these steps:

Go to the following URI in your browser:

```
https://server:port/ords/resteasy/ui/oauth2/clients/
```

- 2. Enter the credentials of the 3rdparty_dev user created above, and click Sign In.
- 3. Click Register Client, and enter the following information:
 - Name: 3rd Party Gallery
 - Description: Demonstrates consuming the Gallery RESTful Service
 - Response Type: Token
 - Redirect URI: https://example.org/
 - Support Email: Desired email address
 - Required Scopes: Gallery Access
- Click Register.
- 5. Click **3rd Party Gallery** in the list that appears on the next page.
- Note the values of the Client Identifier and the Authorization URI fields.

Acquiring an Access Token

To acquire an access token, a user must be prompted to approve access. To initiate the approval process, direct the user to the approval page using the following URI:

where:



- CLIENT_IDENTIFIER is the Client Identifier assigned to the application when it was registered.
- STATE is a unique value generated by the application used to prevent Cross Site Request Forgery (CSRF) attacks.

Note the following about the Oracle REST Data Services OAuth 2.0 implementation:

- The OAuth 2.0 specification allows two optional parameters to be supplied in the above request:
 - redirect_uri: Identifies the location where the authorization server will redirect back to after the user has approved/denied access.
 - scope: Identifies the RESTful Service Privileges that the client wishes to access.

Oracle REST Data Services does not support either of these parameters: both of these values are specified when the client is registered, so it would be redundant to repeat them here. Any values supplied for these parameters will be ignored.

- The OAuth 2.0 specification recommends the use of the state parameter, but Oracle REST Data Services requires the use of the parameter because of its importance in helping to prevent CSRF attacks.
- The response type is also specified when the application is registered, and
 thus the response_type parameter is also redundant; however, the OAuth 2.0
 specification states the parameter is always required, so it must be included. It is
 an error if the response_type value differs from the registered response type.

When the preceding URI is accessed in a browser, the user is prompted to sign on, and then prompted to review the application's request for access and choose whether to approve or deny access.

If the user approves the request, then the browser will be redirected back to the registered redirect URI, and the access token will be encoded in the fragment portion of the URI:

where:

- example.org is used for illustrative purposes only. In a real application
 example.org will be replaced with the URL of the third party application that is
 requesting access.
- ACCESS_TOKEN is the unique, unguessable access token assigned to the current user session, and which must be provided with subsequent requests to the RESTful service.
- TOKEN LIFETIME is the number of seconds for which the access token is valid.
- STATE is the unique value supplied by the application at the start of the
 authorization flow. If the returned state value does not match the initial state
 value, then there is an error condition, and the access token must not be used,
 because it is possible an attacker is attempting to subvert the authorization
 process through a CSRF attack.



Note:

You can modify the default OAuth access token duration (or lifetime) for all the generated access tokens. To achieve this, add the security.oauth.tokenLifetime entry to the defaults.xml configuration file in the following way, with the OAuth access token duration specified in seconds:

<entry key="security.oauth.tokenLifetime">600</entry>

If the user denies the request, or the user is not authorized to access the RESTful Service, the browser will be redirected back to the registered redirect URI, and an error message will be encoded in the fragment portion of the URI:

https://example.org/#error=access_denied&state=STATE

where:

- error=access_denied informs the client that the user is not authorized to access the RESTful Service, or chose not to approve access to the application.
- STATE is the unique value supplied by the application at the start of the
 authorization flow. If the returned state value does not match the initial state
 value, then there is an error condition, the client should ignore this response. It is
 possible an attacker is attempting to subvert the authorization process via a CSRF
 attack.

Using an Access Token

After the application has acquired an access token, the access token must be included with each request made to the protected RESTful service. To do this, an Authorization header is added to the HTTP request, with the following syntax:

Authorization: Bearer ACCESS_TOKEN

where:

ACCESS_TOKEN is the access token value.

For example, a JavaScript-based browser application might invoke the Gallery service as follows:

```
var accessToken = ... /* initialize with the value of the access token */
var xhr = new XMLHttpRequest();
xhr.open('GET', 'https://server:port/ords/resteasy/gallery/images/',true);
/* Add the Access Token to the request */
xhr.setRequestHeader('Authorization', 'Bearer ' + accessToken);
xhr.onload = function(e) {
   /* logic to process the returned JSON document */
   ...
};
xhr.send();
```

The preceding example uses the XMLHttpRequest.setRequestHeader(name,value) function to add the Authorization header to the HTTP request. If the access token



is valid, then the server will respond with a JSON document listing the images in the gallery.

About Browser Origins

One of the key security concepts of web browsers is the **Same Origin Policy**, which permits scripts running on pages originating from the same web site (an Origin) to access each other's data with no restrictions, but prevents access to data originating from other web sites.

An origin is defined by the protocol, host name and port of a web-site. For example https://example.com is one origin and https://another.example.com is a different origin, because the host name differs. Similarly, http://example.com is a different origin than https://example.com because the protocol differs. Finally, http://example.com is a different origin from http://example.com:8080 because the port differs.

For example, if a third party client of the Gallery RESTful service is located at:

https://thirdparty.com/gallery.html

and the Gallery RESTful service is located at:

https://example.com/ords/resteasy/gallery/images/

then the Same Origin Policy will prevent <code>gallery.html</code> making an <code>XMLHttpRequest</code> to <code>https://example.com/ords/resteasy/gallery/images/</code>, because scripts in the <code>https://thirdparty.com</code> origin can only access data from that same origin, and <code>https://example.com</code> is clearly a different origin.

This is proper if the authors of https://example.com do not trust the authors of https://thirdparty.com. However, if the authors do have reason to trust each other, then the Same Origin Policy is too restrictive. Fortunately, a protocol called **Cross Origin Resource Sharing (CORS)**, provides a means for https://example.com to inform the web browser that it trusts https://thirdparty.com and thus to instruct the browser to permit gallery.html to make an XMLHttpRequest to https://example.com/ords/resteasy/gallery/images/.

Configuring a RESTful Service for Cross Origin Resource Sharing

To configure a RESTful service for Cross Origin Resource Sharing, follow these steps:

- Navigate to SQL Workshop and then RESTful Services.
- **2.** Click the module named gallery.example.
- 3. For **Origins Allowed**, enter the origins that are permitted to access the RESTful service (origins are separated by a comma).
- 4. Press Apply Changes

Acquiring a Token Using the Authorization Code Protocol Flow

Other sections have explained acquiring an access token using the OAuth 2.0 Implicit protocol flow. This section explains how to do the same using the Authorization Code protocol flow. The process is slightly more involved than for the Implicit protocol flow, because it requires exchanging an authorization code for an access token.



This section will mimic this exchange process using cURL.

Topics:

- Registering the Client Application
- Acquiring an Authorization Code
- Exchanging an Authorization Code for an Access Token
- Extending OAuth 2.0 Session Duration

Registering the Client Application

[To register the client, follow these steps:

1. Go to the following URI in your browser:

```
https://server:port/ords/resteasy/ui/oauth2/clients/
```

- 2. Enter the credentials of the 3rdparty_dev user, and click Sign In.
- 3. Click Register Client, and enter the following information:
 - Name: Another Gallery
 - Description: Demonstrates using the Authorization Code OAuth 2.0 Protocol Flow
 - Response Type: Code
 - Redirect URI: https://gallery.example.demo
 - Support EMail: any desired email address
 - Required Scopes: Gallery Access
- 4. Click Register.
- 5. Click **3rd Party Gallery** in the list that appears on the next page.
- Note the values of the Client Identifier, Client Secret, and the Authorization URI fields.

Acquiring an Authorization Code

The first step in the Authorization Code protocol flow is to acquire an authorization code. An authorization code is a short lived token that when presented along with the application's client identifier and secret can be exchanged for an access token.

To acquire an access token, the user must be prompted to approve access. To initiate the approval process, direct the user to the approval page using a URI in the following format:

where:

 CLIENT_IDENTIFIER is the Client Identifier assigned to the application when it was registered.



 STATE is a unique value generated by the application used to prevent Cross Site Request Forgery (CSRF) attacks.

If the user approves the request, then the browser will be redirected back to the registered redirect URI, and the access token will be encoded in the query string portion of the URI:

https://gallery.example.demo?code=AUTHORIZATION_CODE&state=STATE

where:

- AUTHORIZATION_CODE is the authorization code value.
- STATE is the unique value supplied by the application at the start of the
 authorization flow. If the returned state value does not match the initial state
 value, then there is an error condition, the authorization code must not be used.
 It is possible an attacker is attempting to subvert the authorization process via a
 CSRF attack.

Because the registered https://gallery.example.demo redirect URI does not exist, the browser will report a server not found error, but for the purposes of this example, this does not matter, because you can still see the authorization code value encoded in the URI. Note the value of the code parameter, because it will be used while Exchanging an Authorization Code for an Access Token.

Exchanging an Authorization Code for an Access Token

In this section you will use cURL to exchange the authorization code for an access token. To exchange an authorization code the application must make an HTTP request to the Oracle REST Data Services OAuth 2.0 token endpoint, providing the authorization code and its client identifier and secret. If the credentials are correct, Oracle REST Data Services responds with a JSON document containing the access token. Note that the application makes the HTTP request from its server side (where the client identifier and secret are securely stored) directly to Oracle REST Data Services; the web-browser is not involved at all in this step of the protocol flow.

Use a cURL command in the following format to exchange the authorization code for an access token:

```
curl -i -d "grant_type=authorization_code&code=AUTHORIZATION_CODE" \
    --user CLIENT_IDENTIFER:CLIENT_SECRET \
    https://server:port/ords/resteasy/oauth2/token
```

where:

- AUTHORIZATION_CODE is the authorization code value (which was encoded in the code parameter of the query string in the redirect URI in the previous section).
- CLIENT IDENTIFER is the client identifier value.
- CLIENT SECRET is the client secret value.

cURL translates the above commands into an HTTP request like the following:

```
POST /ords/resteasy/oauth2/token HTTP/1.1
Authorization: Basic Q0xJRU5UX01ERU5USUZJRVI6Q0xJRU5UX1NFQ1JFVA==
Host: server:port
Accept: */*
Content-Length: 59
Content-Type: application/x-www-form-urlencoded
```



grant_type=authorization_code&code=AUTHORIZATION_CODE

where:

- The request is an HTTP POST to the oauth2/token OAuth 2.0 token endpoint.
- The Authorization header uses the HTTP BASIC authentication protocol to encode the client identifier and secret to assert the application's identity.
- The Content-Type of the request is form data (application/x-www-form-urlencoded) and the content of the request is the form data asserting the OAuth 2.0 token grant type and the OAuth 2.0 authorization code value.

The preceding HTTP request will produce a response like the following:

```
HTTP/1.1 200 OK
ETag: "..."
Content-Type: application/json

{
    "access_token":"04tss-gM35u0eQzR_2ve4Q..",
    "token_type":"bearer",
    "expires_in":3600,
    "refresh_token":"UX4FVHhPFJ16GokvTXYw0A.."
}
```

The response is a JSON document containing the access token along with a refresh token. After the application has acquired an access token, the access token must be included with each request made to the protected RESTful Service. To do this an Authorization header is added to the HTTP request, with the following syntax:

```
Authorization: Bearer ACCESS_TOKEN
```

Related Topics

Extending OAuth 2.0 Session Duration

Extending OAuth 2.0 Session Duration

To extend the lifetime of an OAuth 2.0 session, a refresh token can be exchanged for a new access token with a new expiration time. Note that refresh tokens are only issued for the Authorization Code protocol flow.

The application makes a similar request to that used to exchange an authorization code for an access token. Use a cURL command in the following format to exchange the refresh token for an access token:

```
curl -i -d "grant_type=refresh_token&refresh_token=REFRESH_TOKEN" \
    --user CLIENT_IDENTIFER:CLIENT_SECRET \
    https://server:port/ords/resteasy/oauth2/token
```

where:

- REFRESH_TOKEN is the refresh token value returned when the access token was initially issued.
- CLIENT_IDENTIFER is the client identifier value.
- CLIENT_SECRET is the client secret value.

cURL translates the above commands into an HTTP request like the following:



```
POST /ords/resteasy/oauth2/token HTTP/1.1
Authorization: Basic Q0xJRU5UX01ERU5USUZJRVI6Q0xJRU5UX1NFQ1JFVA==
Host: server:port
Accept: */*
Content-Length: 53
Content-Type: application/x-www-form-urlencoded
grant_type=refresh_token&refresh_token=REFRESH_TOKEN
```

where:

- The request is an HTTP POST to the oauth2/token OAuth 2.0 token endpoint.
- The Authorization header uses the HTTP BASIC authentication protocol to encode the client identifier and secret to assert the application's identity.
- The Content-Type of the request is form data (application/x-www-form-urlencoded) and the content of the request is the form data asserting the OAuth 2.0 token grant type and the refresh token value.

The preceding HTTP request will produce a response like the following:

```
HTTP/1.1 200 OK
ETag: "..."
Content-Type: application/json

{
    "access_token":"hECH_Fc7os2KtXT4pDfkzw..",
    "token_type":"bearer",
    "expires_in":3600,
    "refresh_token":"-7OBQKc_gUQG93ZHCi08Hg.."
}
```

The response is a JSON document containing the new access token along with a new refresh token. The existing access token and refresh token are invalidated, and any attempt to access a service using the old access token will fail.

About Securing the Access Token

In OAuth 2.0 the access token is the sole credential required to provide access to a protected service. It is, therefore, essential to keep the access token secure. Follow these guidelines to help keep the token secure:

- It is strongly recommended to use HTTPS for all protected RESTful Services. This
 prevents snooping attacks where an attacker may be able to steal access tokens
 by eavesdropping on insecure channels. It also prevents attackers from viewing
 the sensitive data that may be present in the payload of the requests.
- Ensure that the client application is not located in a browser origin with other applications or scripts that cannot be trusted. For example assume that user Alice has a client application hosted at the following location:

```
https://sharedhosting.com/alice/application
```

If another user (such as Fred) is also able to host his application in the same origin, for example, at:

```
https://sharedhosting.com/fred/trouble
```

then it will be easy for /fred/trouble to steal any access token acquired by /alice/application, because they share the same origin https://



 ${\tt sharedhost.com},$ and thus the browser will not prevent either application from accessing the other's data.

To protect against this scenario, Alice's application must be deployed in its own origin, for example:

https://alice.sharedhosting.com/application

or:

https://application.alice.sharedhosting.com

or:

https://aliceapp.com



Е

Third-Party License Information

Oracle REST Data Services contains third-party code. See the Oracle Database Licensing Information for notices Oracle is required to provide.

Note, however, that the Oracle program license that accompanied this product determines your right to use the Oracle program, including the third-party software, and the terms contained in the following notices do not change those rights.

jackson-annotations 2.10.3

Jackson Annotations Copyright (c) 2019 Tatu Saloranta

LICENSE: Apache 2.0

Apache License
Version 2.0, January 2004
http://www.apache.org/licenses/

TERMS AND CONDITIONS FOR USE, REPRODUCTION, AND DISTRIBUTION

1. Definitions.

"License" shall mean the terms and conditions for use, reproduction, $\$

and distribution as defined by Sections 1 through 9 of this document.

"Licensor" shall mean the copyright owner or entity authorized by the copyright owner that is granting the License.

"Legal Entity" shall mean the union of the acting entity and all other entities that control, are controlled by, or are under common

control with that entity. For the purposes of this definition, "control" means (i) the power, direct or indirect, to cause the direction or management of such entity, whether by contract or otherwise, or (ii) ownership of fifty percent (50%) or more of the outstanding shares, or (iii) beneficial ownership of such entity.

"You" (or "Your") shall mean an individual or Legal Entity exercising permissions granted by this License.

"Source" form shall mean the preferred form for making modifications, $% \left(\frac{1}{2}\right) =\frac{1}{2}\left(\frac{1}{2}\right) =\frac{1}{$

including but not limited to software source code, documentation source, and configuration files.

"Object" form shall mean any form resulting from mechanical transformation or translation of a Source form, including but not limited to compiled object code, generated documentation, and conversions to other media types.

"Work" shall mean the work of authorship, whether in Source or Object form, made available under the License, as indicated by a copyright notice that is included in or attached to the work (an example is provided in the Appendix below).

"Derivative Works" shall mean any work, whether in Source or Object $% \left(1\right) =\left(1\right) \left(1\right) +\left(1\right) \left(1\right) \left(1\right) +\left(1\right) \left(1$

form, that is based on (or derived from) the Work and for which the $\,$

editorial revisions, annotations, elaborations, or other modifications $% \left(1\right) =\left(1\right) \left(1\right) \left($

represent, as a whole, an original work of authorship. For the purposes

of this License, Derivative Works shall not include works that remain

separable from, or merely link (or bind by name) to the interfaces of,

the Work and Derivative Works thereof.

"Contribution" shall mean any work of authorship, including the original version of the Work and any modifications or additions

to that Work or Derivative Works thereof, that is intentionally submitted to Licensor for inclusion in the Work by the copyright owner

or by an individual or Legal Entity authorized to submit on behalf of

the copyright owner. For the purposes of this definition, "submitted" $% \left(\frac{1}{2}\right) =\frac{1}{2}\left(\frac{1}{2}\right) ^{2}$

 $\ensuremath{\mathsf{means}}$ any form of electronic, verbal, or written communication sent

to the Licensor or its representatives, including but not limited to $% \left(1\right) =\left(1\right) \left(1\right) +\left(1\right) \left(1\right) \left(1\right) +\left(1\right) \left(1\right) \left($

communication on electronic mailing lists, source code control systems,

and issue tracking systems that are managed by, or on behalf of, the $% \left(1\right) =\left(1\right) +\left(1\right$

Licensor for the purpose of discussing and improving the Work, but excluding communication that is conspicuously marked or otherwise designated in writing by the copyright owner as "Not a Contribution."

"Contributor" shall mean Licensor and any individual or Legal $\mathop{\hbox{\rm Entity}}\nolimits$

on behalf of whom a Contribution has been received by Licensor and subsequently incorporated within the Work.

2. Grant of Copyright License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual,



worldwide, non-exclusive, no-charge, royalty-free, irrevocable copyright license to reproduce, prepare Derivative Works of, publicly display, publicly perform, sublicense, and distribute the Work and such Derivative Works in Source or Object form.

3. Grant of Patent License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable (except as stated in this section) patent license to make, have

made,

use, offer to sell, sell, import, and otherwise transfer the Work, where such license applies only to those patent claims licensable by such Contributor that are necessarily infringed by their Contribution(s) alone or by combination of their Contribution(s) with the Work to which such Contribution(s) was submitted. If You institute patent litigation against any entity (including a cross-claim or counterclaim in a lawsuit) alleging that the Work or a Contribution incorporated within the Work constitutes direct or contributory patent infringement, then any patent licenses granted to You under this License for that Work shall terminate as of the date such litigation is filed.

- 4. Redistribution. You may reproduce and distribute copies of the Work or Derivative Works thereof in any medium, with or without modifications, and in Source or Object form, provided that You meet the following conditions:
 - (a) You must give any other recipients of the Work or Derivative Works a copy of this License; and
 - (b) You must cause any modified files to carry prominent notices stating that You changed the files; and
 - (c) You must retain, in the Source form of any Derivative Works that You distribute, all copyright, patent, trademark, and attribution notices from the Source form of the Work, excluding those notices that do not pertain to any part of the Derivative Works; and
 - (d) If the Work includes a "NOTICE" text file as part of its distribution, then any Derivative Works that You distribute

must

include a readable copy of the attribution notices contained within such NOTICE file, excluding those notices that do not pertain to any part of the Derivative Works, in at least one of the following places: within a NOTICE text file distributed as part of the Derivative Works; within the Source form or documentation, if provided along with the Derivative Works;

or,

within a display generated by the Derivative Works, if and wherever such third-party notices normally appear. The

contents

of the NOTICE file are for informational purposes only and do not modify the License. You may add Your own attribution notices within Derivative Works that You distribute, alongside or as an addendum to the NOTICE text from the Work, provided that such additional attribution notices cannot be construed as modifying the License.

You may add Your own copyright statement to Your modifications and may provide additional or different license terms and conditions for use, reproduction, or distribution of Your modifications, or for any such Derivative Works as a whole, provided Your use, reproduction, and distribution of the Work otherwise complies with the conditions stated in this License.

5. Submission of Contributions. Unless You explicitly state otherwise,

any Contribution intentionally submitted for inclusion in the Work by You to the Licensor shall be under the terms and conditions of this License, without any additional terms or conditions.

Notwithstanding the above, nothing herein shall supersede or $\ensuremath{\mathsf{modify}}$

the terms of any separate license agreement you may have executed with Licensor regarding such Contributions.

 $\ensuremath{\mathsf{6}}\xspace$. Trademarks. This License does not grant permission to use the trade

names, trademarks, service marks, or product names of the Licensor, $% \left(1\right) =\left(1\right) \left(1\right)$

except as required for reasonable and customary use in describing the $% \left(1\right) =\left(1\right) \left(1\right) +\left(1\right) \left(1\right) \left(1\right) +\left(1\right) \left(1\right) \left($

origin of the Work and reproducing the content of the NOTICE file.

7. Disclaimer of Warranty. Unless required by applicable law or agreed to in writing, Licensor provides the Work (and each Contributor provides its Contributions) on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied, including, without limitation, any warranties or conditions

of TITLE, NON-INFRINGEMENT, MERCHANTABILITY, or FITNESS FOR A PARTICULAR PURPOSE. You are solely responsible for determining the appropriateness of using or redistributing the Work and assume any risks associated with Your exercise of permissions under this License.

8. Limitation of Liability. In no event and under no legal theory, whether in tort (including negligence), contract, or otherwise, unless required by applicable law (such as deliberate and grossly negligent acts) or agreed to in writing, shall any Contributor be liable to You for damages, including any direct, indirect, special,

incidental, or consequential damages of any character arising as a result of this License or out of the use or inability to use the Work (including but not limited to damages for loss of goodwill, work stoppage, computer failure or malfunction, or any and all other commercial damages or losses), even if such Contributor has been advised of the possibility of such damages.

9. Accepting Warranty or Additional Liability. While redistributing



the Work or Derivative Works thereof, You may choose to offer, and charge a fee for, acceptance of support, warranty, indemnity, or other liability obligations and/or rights consistent with this License. However, in accepting such obligations, You may act only on Your own behalf and on Your sole responsibility, not on behalf of any other Contributor, and only if You agree to indemnify, defend, and hold each Contributor harmless for any liability incurred by, or claims asserted against, such Contributor by reason

of your accepting any such warranty or additional liability.

END OF TERMS AND CONDITIONS

APPENDIX: How to apply the Apache License to your work.

To apply the Apache License to your work, attach the following boilerplate notice, with the fields enclosed by brackets "[]" replaced with your own identifying information. (Don't include the brackets!) The text should be enclosed in the appropriate comment syntax for the file format. We also recommend that a file or class name and description of purpose be included on the same "printed page" as the copyright notice for easier identification within third-party archives.

Copyright [yyyy] [name of copyright owner]

Licensed under the Apache License, Version 2.0 (the "License"); you may not use this file except in compliance with the License. You may obtain a copy of the License at

http://www.apache.org/licenses/LICENSE-2.0

Unless required by applicable law or agreed to in writing, software distributed under the License is distributed on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.

See the License for the specific language governing permissions and limitations under the License.

jackson-databind 2.10.3

Jackson Databind Copyright (c) 2019 Tatu Saloranta

LICENSE: Apache 2.0

Apache License
Version 2.0, January 2004
http://www.apache.org/licenses/

TERMS AND CONDITIONS FOR USE, REPRODUCTION, AND DISTRIBUTION

1. Definitions.



"License" shall mean the terms and conditions for use, reproduction,

and distribution as defined by Sections 1 through 9 of this document.

"Licensor" shall mean the copyright owner or entity authorized by the copyright owner that is granting the License.

"Legal Entity" shall mean the union of the acting entity and all other entities that control, are controlled by, or are under common

control with that entity. For the purposes of this definition, "control" means (i) the power, direct or indirect, to cause the direction or management of such entity, whether by contract or otherwise, or (ii) ownership of fifty percent (50%) or more of the outstanding shares, or (iii) beneficial ownership of such entity.

"You" (or "Your") shall mean an individual or Legal Entity exercising permissions granted by this License.

"Source" form shall mean the preferred form for making modifications,

including but not limited to software source code, documentation source, and configuration files.

"Object" form shall mean any form resulting from mechanical transformation or translation of a Source form, including but not limited to compiled object code, generated documentation, and conversions to other media types.

"Work" shall mean the work of authorship, whether in Source or Object form, made available under the License, as indicated by a copyright notice that is included in or attached to the work (an example is provided in the Appendix below).

"Derivative Works" shall mean any work, whether in Source or Object $% \left(1\right) =\left(1\right) \left(1\right) +\left(1\right) \left(1\right) \left(1\right) +\left(1\right) \left(1$

form, that is based on (or derived from) the Work and for which the $\ensuremath{\mbox{\sc that}}$

editorial revisions, annotations, elaborations, or other modifications $% \left(1\right) =\left(1\right) \left(1\right) \left($

represent, as a whole, an original work of authorship. For the purposes

of this License, Derivative Works shall not include works that $\ensuremath{\operatorname{remain}}$

separable from, or merely link (or bind by name) to the interfaces of, $% \left(1\right) =\left(1\right) \left(1\right) \left($

the Work and Derivative Works thereof.

"Contribution" shall mean any work of authorship, including the original version of the Work and any modifications or additions

to that Work or Derivative Works thereof, that is intentionally submitted to Licensor for inclusion in the Work by the copyright



owner

or by an individual or Legal Entity authorized to submit on behalf of

the copyright owner. For the purposes of this definition, "submitted" $% \left(\frac{1}{2}\right) =\frac{1}{2}\left(\frac{1}{2}\right) ^{2}$

 $\ensuremath{\mathsf{means}}$ any form of electronic, verbal, or written communication sent

to the Licensor or its representatives, including but not limited to

communication on electronic mailing lists, source code control systems,

and issue tracking systems that are managed by, or on behalf of, the $\,$

Licensor for the purpose of discussing and improving the Work, but excluding communication that is conspicuously marked or otherwise designated in writing by the copyright owner as "Not a Contribution."

"Contributor" shall mean Licensor and any individual or Legal Entity

on behalf of whom a Contribution has been received by Licensor and subsequently incorporated within the Work.

- 2. Grant of Copyright License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable copyright license to reproduce, prepare Derivative Works of, publicly display, publicly perform, sublicense, and distribute the Work and such Derivative Works in Source or Object form.
- 3. Grant of Patent License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable (except as stated in this section) patent license to make, have made,

use, offer to sell, sell, import, and otherwise transfer the Work, where such license applies only to those patent claims licensable by such Contributor that are necessarily infringed by their Contribution(s) alone or by combination of their Contribution(s) with the Work to which such Contribution(s) was submitted. If You institute patent litigation against any entity (including a cross-claim or counterclaim in a lawsuit) alleging that the Work or a Contribution incorporated within the Work constitutes direct or contributory patent infringement, then any patent licenses granted to You under this License for that Work shall terminate as of the date such litigation is filed.

- 4. Redistribution. You may reproduce and distribute copies of the Work or Derivative Works thereof in any medium, with or without modifications, and in Source or Object form, provided that You meet the following conditions:
 - (a) You must give any other recipients of the Work or Derivative Works a copy of this License; and



- (b) You must cause any modified files to carry prominent notices stating that You changed the files; and
- (c) You must retain, in the Source form of any Derivative Works that You distribute, all copyright, patent, trademark, and attribution notices from the Source form of the Work, excluding those notices that do not pertain to any part of the Derivative Works; and
- (d) If the Work includes a "NOTICE" text file as part of its distribution, then any Derivative Works that You distribute

must

include a readable copy of the attribution notices contained within such NOTICE file, excluding those notices that do not pertain to any part of the Derivative Works, in at least one of the following places: within a NOTICE text file distributed as part of the Derivative Works; within the Source form or documentation, if provided along with the Derivative Works;

or,

within a display generated by the Derivative Works, if and wherever such third-party notices normally appear. The $\,$

contents

of the NOTICE file are for informational purposes only and do not modify the License. You may add Your own attribution notices within Derivative Works that You distribute, alongside or as an addendum to the NOTICE text from the Work, provided that such additional attribution notices cannot be construed as modifying the License.

You may add Your own copyright statement to Your modifications and may provide additional or different license terms and conditions for use, reproduction, or distribution of Your modifications, or for any such Derivative Works as a whole, provided Your use, reproduction, and distribution of the Work otherwise complies with the conditions stated in this License.

5. Submission of Contributions. Unless You explicitly state otherwise,

any Contribution intentionally submitted for inclusion in the Work by You to the Licensor shall be under the terms and conditions of this License, without any additional terms or conditions.

Notwithstanding the above, nothing herein shall supersede or \mbox{modify}

the terms of any separate license agreement you may have executed with Licensor regarding such Contributions.

 $\ensuremath{\mathsf{6}}.$ Trademarks. This License does not grant permission to use the trade

names, trademarks, service marks, or product names of the Licensor, $\$

except as required for reasonable and customary use in describing the $\ensuremath{\mathsf{E}}$

origin of the Work and reproducing the content of the NOTICE file.

7. Disclaimer of Warranty. Unless required by applicable law or



agreed to in writing, Licensor provides the Work (and each Contributor provides its Contributions) on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied, including, without limitation, any warranties or conditions

of TITLE, NON-INFRINGEMENT, MERCHANTABILITY, or FITNESS FOR A PARTICULAR PURPOSE. You are solely responsible for determining the appropriateness of using or redistributing the Work and assume any risks associated with Your exercise of permissions under this License.

8. Limitation of Liability. In no event and under no legal theory, whether in tort (including negligence), contract, or otherwise, unless required by applicable law (such as deliberate and grossly negligent acts) or agreed to in writing, shall any Contributor be liable to You for damages, including any direct, indirect, special,

incidental, or consequential damages of any character arising as a result of this License or out of the use or inability to use the Work (including but not limited to damages for loss of goodwill, work stoppage, computer failure or malfunction, or any and all other commercial damages or losses), even if such Contributor has been advised of the possibility of such damages.

9. Accepting Warranty or Additional Liability. While redistributing the Work or Derivative Works thereof, You may choose to offer, and charge a fee for, acceptance of support, warranty, indemnity, or other liability obligations and/or rights consistent with this License. However, in accepting such obligations, You may act only on Your own behalf and on Your sole responsibility, not on behalf of any other Contributor, and only if You agree to indemnify, defend, and hold each Contributor harmless for any liability incurred by, or claims asserted against, such Contributor by reason

of your accepting any such warranty or additional liability.

END OF TERMS AND CONDITIONS

APPENDIX: How to apply the Apache License to your work.

To apply the Apache License to your work, attach the following boilerplate notice, with the fields enclosed by brackets "[]" replaced with your own identifying information. (Don't include the brackets!) The text should be enclosed in the appropriate comment syntax for the file format. We also recommend that a file or class name and description of purpose be included on the same "printed page" as the copyright notice for easier identification within third-party archives.

Copyright [yyyy] [name of copyright owner]

Licensed under the Apache License, Version 2.0 (the "License"); you may not use this file except in compliance with the License. You may obtain a copy of the License at



http://www.apache.org/licenses/LICENSE-2.0

Unless required by applicable law or agreed to in writing, software distributed under the License is distributed on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.

See the License for the specific language governing permissions and limitations under the License.

COPYRIGHT NOTICE

Jackson JSON processor

Jackson is a high-performance, Free/Open Source JSON processing library. It was originally written by Tatu Saloranta (tatu.saloranta@iki.fi), and has

been in development since 2007.

It is currently developed by a community of developers, as well as $\ensuremath{\mathsf{supported}}$

commercially by FasterXML.com.

```
------COPYRIGHT: Copyright (c) 2007- Tatu Saloranta, tatu.saloranta@iki.fi LICENSE: Apache 2.0
```

Credits

A list of contributors may be found from CREDITS file, which is included in some artifacts (usually source distributions); but is always available

from the source code management (SCM) system project uses.
----jackson-annotations 2.10.2 -----

COPYRIGHT: Copyright (c) 2007- Tatu Saloranta, tatu.saloranta@iki.fi LICENSE: Apache 2.0

jackson-dataformat-xml 2.10.3

Top Level Component Name: Jackson Data Format XML Top Level Component License:

Apache License
Version 2.0, January 2004
http://www.apache.org/licenses/

TERMS AND CONDITIONS FOR USE, REPRODUCTION, AND DISTRIBUTION

1. Definitions.

and distribution as defined by Sections 1 through 9 of this document.

"Licensor" shall mean the copyright owner or entity authorized by

the copyright owner that is granting the License.

"Legal Entity" shall mean the union of the acting entity and all other entities that control, are controlled by, or are under common

control with that entity. For the purposes of this definition, "control" means (i) the power, direct or indirect, to cause the direction or management of such entity, whether by contract or otherwise, or (ii) ownership of fifty percent (50%) or more of the outstanding shares, or (iii) beneficial ownership of such entity.

"You" (or "Your") shall mean an individual or Legal Entity exercising permissions granted by this License.

"Source" form shall mean the preferred form for making modifications, $% \left(\frac{1}{2}\right) =\frac{1}{2}\left(\frac{1}{2}\right) ^{2}$

including but not limited to software source code, documentation source, and configuration files.

"Object" form shall mean any form resulting from mechanical transformation or translation of a Source form, including but not limited to compiled object code, generated documentation, and conversions to other media types.

"Work" shall mean the work of authorship, whether in Source or Object form, made available under the License, as indicated by a copyright notice that is included in or attached to the work (an example is provided in the Appendix below).

"Derivative Works" shall mean any work, whether in Source or Object

form, that is based on (or derived from) the Work and for which the $\ensuremath{\mbox{\sc derived}}$

editorial revisions, annotations, elaborations, or other ${\tt modifications}$

represent, as a whole, an original work of authorship. For the purposes

of this License, Derivative Works shall not include works that remain

separable from, or merely link (or bind by name) to the interfaces of,

the Work and Derivative Works thereof.

"Contribution" shall mean any work of authorship, including the original version of the Work and any modifications or additions

to that Work or Derivative Works thereof, that is intentionally submitted to Licensor for inclusion in the Work by the copyright owner

or by an individual or Legal Entity authorized to submit on behalf of

the copyright owner. For the purposes of this definition, "submitted"

 $\ensuremath{\mathsf{means}}$ any form of electronic, verbal, or written communication sent



to the Licensor or its representatives, including but not limited to

communication on electronic mailing lists, source code control systems,

and issue tracking systems that are managed by, or on behalf of, the $% \left(1\right) =\left(1\right) \left(1\right) +\left(1\right) \left(1\right) \left(1\right) +\left(1\right) \left(1\right) \left($

Licensor for the purpose of discussing and improving the Work, but excluding communication that is conspicuously marked or otherwise designated in writing by the copyright owner as "Not a Contribution."

"Contributor" shall mean Licensor and any individual or Legal Entity

on behalf of whom a Contribution has been received by Licensor and subsequently incorporated within the Work.

- 2. Grant of Copyright License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable copyright license to reproduce, prepare Derivative Works of, publicly display, publicly perform, sublicense, and distribute the Work and such Derivative Works in Source or Object form.
- 3. Grant of Patent License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable (except as stated in this section) patent license to make, have made,

use, offer to sell, sell, import, and otherwise transfer the Work, where such license applies only to those patent claims licensable by such Contributor that are necessarily infringed by their Contribution(s) alone or by combination of their Contribution(s) with the Work to which such Contribution(s) was submitted. If You institute patent litigation against any entity (including a cross-claim or counterclaim in a lawsuit) alleging that the Work or a Contribution incorporated within the Work constitutes direct or contributory patent infringement, then any patent licenses granted to You under this License for that Work shall terminate as of the date such litigation is filed.

- 4. Redistribution. You may reproduce and distribute copies of the Work or Derivative Works thereof in any medium, with or without modifications, and in Source or Object form, provided that You meet the following conditions:
 - (a) You must give any other recipients of the Work or Derivative Works a copy of this License; and
 - (b) You must cause any modified files to carry prominent notices stating that You changed the files; and
 - (c) You must retain, in the Source form of any Derivative Works that You distribute, all copyright, patent, trademark, and attribution notices from the Source form of the Work, excluding those notices that do not pertain to any part of



the Derivative Works; and

(d) If the Work includes a "NOTICE" text file as part of its distribution, then any Derivative Works that You distribute

must

include a readable copy of the attribution notices contained within such NOTICE file, excluding those notices that do not pertain to any part of the Derivative Works, in at least one of the following places: within a NOTICE text file distributed as part of the Derivative Works; within the Source form or documentation, if provided along with the Derivative Works;

or,

within a display generated by the Derivative Works, if and wherever such third-party notices normally appear. The

contents

of the NOTICE file are for informational purposes only and do not modify the License. You may add Your own attribution notices within Derivative Works that You distribute, alongside or as an addendum to the NOTICE text from the Work, provided that such additional attribution notices cannot be construed as modifying the License.

You may add Your own copyright statement to Your modifications and may provide additional or different license terms and conditions for use, reproduction, or distribution of Your modifications, or for any such Derivative Works as a whole, provided Your use, reproduction, and distribution of the Work otherwise complies with the conditions stated in this License.

5. Submission of Contributions. Unless You explicitly state otherwise,

any Contribution intentionally submitted for inclusion in the Work by You to the Licensor shall be under the terms and conditions of this License, without any additional terms or conditions. Notwithstanding the above, nothing herein shall supersede or

Notwithstanding the above, nothing herein shall supersede or modify

the terms of any separate license agreement you may have executed with Licensor regarding such Contributions.

6. Trademarks. This License does not grant permission to use the trade

names, trademarks, service marks, or product names of the Licensor, $\$

except as required for reasonable and customary use in describing the $% \left(1\right) =\left(1\right) \left(1\right) +\left(1\right) \left(1\right)$

origin of the Work and reproducing the content of the NOTICE file.

7. Disclaimer of Warranty. Unless required by applicable law or agreed to in writing, Licensor provides the Work (and each Contributor provides its Contributions) on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied, including, without limitation, any warranties or conditions

of TITLE, NON-INFRINGEMENT, MERCHANTABILITY, or FITNESS FOR A PARTICULAR PURPOSE. You are solely responsible for determining the



appropriateness of using or redistributing the Work and assume any risks associated with Your exercise of permissions under this License.

8. Limitation of Liability. In no event and under no legal theory, whether in tort (including negligence), contract, or otherwise, unless required by applicable law (such as deliberate and grossly negligent acts) or agreed to in writing, shall any Contributor be liable to You for damages, including any direct, indirect, special,

incidental, or consequential damages of any character arising as a result of this License or out of the use or inability to use the Work (including but not limited to damages for loss of goodwill, work stoppage, computer failure or malfunction, or any and all other commercial damages or losses), even if such Contributor has been advised of the possibility of such damages.

9. Accepting Warranty or Additional Liability. While redistributing the Work or Derivative Works thereof, You may choose to offer, and charge a fee for, acceptance of support, warranty, indemnity, or other liability obligations and/or rights consistent with this License. However, in accepting such obligations, You may act only on Your own behalf and on Your sole responsibility, not on behalf of any other Contributor, and only if You agree to indemnify, defend, and hold each Contributor harmless for any liability incurred by, or claims asserted against, such Contributor by reason

of your accepting any such warranty or additional liability.

END OF TERMS AND CONDITIONS

Top Level Component Copyright:

Jackson JSON processor

Jackson is a high-performance, Free/Open Source JSON processing library. It was originally written by Tatu Saloranta (tatu.saloranta@iki.fi), and has

been in development since 2007.

It is currently developed by a community of developers, as well as $\ensuremath{\operatorname{supported}}$

commercially by FasterXML.com.

Licensing

Jackson core and extension components may be licensed under different licenses.

To find the details that apply to this artifact see the accompanying LICENSE file.

For more information, including possible other licensing options, contact

FasterXML.com (http://fasterxml.com).

Credits



A list of contributors may be found from CREDITS file, which is included in some artifacts (usually source distributions); but is always available

from the source code management (SCM) system project uses.

jackson-dataformat-xml has these fourth-party dependencies that are also licensed under the Apache 2.0 license:

- * jackson-core
- * jackson-annotations
- * jackson-databind
- * jackson-module-jaxb-annotations
- * com.fasterxml.woodstox/woodstox-core
- * stax2-api

woodstox-core depends on org.codehous.woodstox/stax2-api 3.1.4, which is licensed under the BSD 2-clause license.

Contents of stax2-api/src/main/resources/META-INF/LICENSE:

This copy of Stax2 API is licensed under the Simplified BSF License (also known as "2-clause BSD", or "FreeBSD License")

See the License for details about distribution rights, and the specific rights regarding derivate works.

You may obtain a copy of the License at:

http://www.opensource.org/licenses/bsd-license.php

with details of:

- = FasterXML.com
- = 2010-

Contents of https://opensource.org/licenses/bsd-license.php:

Copyright

Redistribution and use in source and binary forms, with or without modification, are

permitted provided that the following conditions are met:

1. Redistributions of source code must retain the above copyright notice, this list of $\ensuremath{\mathsf{I}}$

conditions and the following disclaimer.

2. Redistributions in binary form must reproduce the above



copyright notice, this list

of conditions and the following disclaimer in the documentation and/or other materials

provided with the distribution.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS" AND ANY EXPRESS

OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY

AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT HOLDER OR

CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL

DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF

USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY,

WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN

ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Stax2 API License:

Note: This license has also been called the "Simplified BSD License" and the "FreeBSD License". See also the 3-clause BSD License.

Copyright

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

- 1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
- 2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS
"AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT
LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS
FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE
COPYRIGHT HOLDER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT,
INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING,
BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS
OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND
ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR
TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE
USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Stax2 API Copyright:



```
This copy of Stax2 API is licensed under the
Simplified BSD License (also known as "2-clause BSD", or "FreeBSD
License")
See the License for details about distribution rights, and the
specific rights regarding derivate works.
You may obtain a copy of the License at:
http://www.opensource.org/licenses/bsd-license.php
with details of:
= FasterXML.com
= 2010 -
______
Jackson Annotations
Copyright (c) 2019 Tatu Saloranta
LICENSE: Apache 2.0
______
Jackson Core
Copyright © 2008-2019 FasterXML. All rights reserved.
This copy of Jackson JSON processor streaming parser/generator is
licensed under the
Apache (Software) License, version 2.0 ("the License").
See the License for details about distribution rights, and the
specific rights regarding derivate works.
You may obtain a copy of the License at:
http://www.apache.org/licenses/LICENSE-2.0
NOTICE FILE:
==========
# Jackson JSON processor
Jackson is a high-performance, Free/Open Source JSON processing library.
It was originally written by Tatu Saloranta (tatu.saloranta@iki.fi),
and has
been in development since 2007.
It is currently developed by a community of developers, as well as
supported
commercially by FasterXML.com.
## Licensing
Jackson core and extension components may licensed under different
To find the details that apply to this artifact see the accompanying
```



LICENSE file.

For more information, including possible other licensing options, contact

FasterXML.com (http://fasterxml.com).

Credits

A list of contributors may be found from CREDITS file, which is included in some artifacts (usually source distributions); but is always available

from the source code management (SCM) system project uses.

Jackson Databind

Copyright (c) 2019 Tatu Saloranta

License: Apache 2.0

=========

Jackson Databind

Copyright (c) 2019 Tatu Saloranta

License: Apache 2.0

jackson-core 2.10.3

Apache License

Version 2.0, January 2004
http://www.apache.org/licenses/

TERMS AND CONDITIONS FOR USE, REPRODUCTION, AND DISTRIBUTION

1. Definitions.

"License" shall mean the terms and conditions for use, reproduction, $\ensuremath{\text{c}}$

and distribution as defined by Sections 1 through 9 of this document.

"Licensor" shall mean the copyright owner or entity authorized by the copyright owner that is granting the License.

"Legal Entity" shall mean the union of the acting entity and all other entities that control, are controlled by, or are under common

control with that entity. For the purposes of this definition, "control" means (i) the power, direct or indirect, to cause the direction or management of such entity, whether by contract or otherwise, or (ii) ownership of fifty percent (50%) or more of the outstanding shares, or (iii) beneficial ownership of such entity.

"You" (or "Your") shall mean an individual or Legal Entity



exercising permissions granted by this License.

"Source" form shall mean the preferred form for making modifications, $% \left(\frac{1}{2}\right) =\frac{1}{2}\left(\frac{1}{2}\right) ^{2}$

including but not limited to software source code, documentation source, and configuration files.

"Object" form shall mean any form resulting from mechanical transformation or translation of a Source form, including but not limited to compiled object code, generated documentation, and conversions to other media types.

"Work" shall mean the work of authorship, whether in Source or Object form, made available under the License, as indicated by a copyright notice that is included in or attached to the work (an example is provided in the Appendix below).

"Derivative Works" shall mean any work, whether in Source or Object

form, that is based on (or derived from) the Work and for which the $\,$

editorial revisions, annotations, elaborations, or other modifications

represent, as a whole, an original work of authorship. For the purposes

of this License, Derivative Works shall not include works that remain

separable from, or merely link (or bind by name) to the interfaces of, $\$

the Work and Derivative Works thereof.

"Contribution" shall mean any work of authorship, including the original version of the Work and any modifications or additions

to that Work or Derivative Works thereof, that is intentionally submitted to Licensor for inclusion in the Work by the copyright owner

or by an individual or Legal Entity authorized to submit on behalf of

the copyright owner. For the purposes of this definition, "submitted"

 $% \left(1\right) =\left(1\right) \left(1\right) +\left(1\right) +\left(1\right) \left(1\right) +\left(1\right) +\left(1\right) \left(1\right) +\left(1\right) +\left($

to the Licensor or its representatives, including but not limited to

communication on electronic mailing lists, source code control systems,

and issue tracking systems that are managed by, or on behalf of, the $% \left(1\right) =\left(1\right) \left(1\right) +\left(1\right) \left(1\right) \left(1\right) +\left(1\right) \left(1\right) \left($

Licensor for the purpose of discussing and improving the Work, but excluding communication that is conspicuously marked or otherwise designated in writing by the copyright owner as "Not a Contribution."

"Contributor" shall mean Licensor and any individual or Legal



Entity

made,

on behalf of whom a Contribution has been received by Licensor and subsequently incorporated within the Work.

- 2. Grant of Copyright License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable copyright license to reproduce, prepare Derivative Works of, publicly display, publicly perform, sublicense, and distribute the Work and such Derivative Works in Source or Object form.
- 3. Grant of Patent License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable (except as stated in this section) patent license to make, have

use, offer to sell, sell, import, and otherwise transfer the Work, where such license applies only to those patent claims licensable by such Contributor that are necessarily infringed by their Contribution(s) alone or by combination of their Contribution(s) with the Work to which such Contribution(s) was submitted. If You institute patent litigation against any entity (including a cross-claim or counterclaim in a lawsuit) alleging that the Work or a Contribution incorporated within the Work constitutes direct or contributory patent infringement, then any patent licenses granted to You under this License for that Work shall terminate as of the date such litigation is filed.

- 4. Redistribution. You may reproduce and distribute copies of the Work or Derivative Works thereof in any medium, with or without modifications, and in Source or Object form, provided that You meet the following conditions:
 - (a) You must give any other recipients of the Work or Derivative Works a copy of this License; and
 - (b) You must cause any modified files to carry prominent notices stating that You changed the files; and
 - (c) You must retain, in the Source form of any Derivative Works that You distribute, all copyright, patent, trademark, and attribution notices from the Source form of the Work, excluding those notices that do not pertain to any part of the Derivative Works; and
 - (d) If the Work includes a "NOTICE" text file as part of its distribution, then any Derivative Works that You distribute

must

include a readable copy of the attribution notices contained within such NOTICE file, excluding those notices that do not pertain to any part of the Derivative Works, in at least one of the following places: within a NOTICE text file distributed as part of the Derivative Works; within the Source form or documentation, if provided along with the Derivative Works;

or,



within a display generated by the Derivative Works, if and wherever such third-party notices normally appear. The

contents

of the NOTICE file are for informational purposes only and do not modify the License. You may add Your own attribution notices within Derivative Works that You distribute, alongside or as an addendum to the NOTICE text from the Work, provided that such additional attribution notices cannot be construed as modifying the License.

You may add Your own copyright statement to Your modifications and may provide additional or different license terms and conditions for use, reproduction, or distribution of Your modifications, or for any such Derivative Works as a whole, provided Your use, reproduction, and distribution of the Work otherwise complies with the conditions stated in this License.

5. Submission of Contributions. Unless You explicitly state otherwise,

any Contribution intentionally submitted for inclusion in the Work by You to the Licensor shall be under the terms and conditions of this License, without any additional terms or conditions.

Notwithstanding the above, nothing herein shall supersede or \mbox{modify}

the terms of any separate license agreement you may have executed with Licensor regarding such Contributions.

 $\ensuremath{\mathsf{6}}\xspace$. Trademarks. This License does not grant permission to use the trade

names, trademarks, service marks, or product names of the Licensor,

except as required for reasonable and customary use in describing the $% \left(1\right) =\left(1\right) \left(1\right)$

origin of the Work and reproducing the content of the NOTICE file.

7. Disclaimer of Warranty. Unless required by applicable law or agreed to in writing, Licensor provides the Work (and each Contributor provides its Contributions) on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied, including, without limitation, any warranties or conditions

of TITLE, NON-INFRINGEMENT, MERCHANTABILITY, or FITNESS FOR A PARTICULAR PURPOSE. You are solely responsible for determining the appropriateness of using or redistributing the Work and assume any risks associated with Your exercise of permissions under this License.

8. Limitation of Liability. In no event and under no legal theory, whether in tort (including negligence), contract, or otherwise, unless required by applicable law (such as deliberate and grossly negligent acts) or agreed to in writing, shall any Contributor be liable to You for damages, including any direct, indirect, special,

incidental, or consequential damages of any character arising as a result of this License or out of the use or inability to use the



Work (including but not limited to damages for loss of goodwill, work stoppage, computer failure or malfunction, or any and all other commercial damages or losses), even if such Contributor has been advised of the possibility of such damages.

9. Accepting Warranty or Additional Liability. While redistributing the Work or Derivative Works thereof, You may choose to offer, and charge a fee for, acceptance of support, warranty, indemnity, or other liability obligations and/or rights consistent with this License. However, in accepting such obligations, You may act only on Your own behalf and on Your sole responsibility, not on behalf of any other Contributor, and only if You agree to indemnify, defend, and hold each Contributor harmless for any liability incurred by, or claims asserted against, such Contributor by reason

of your accepting any such warranty or additional liability.

END OF TERMS AND CONDITIONS

APPENDIX: How to apply the Apache License to your work.

To apply the Apache License to your work, attach the following boilerplate notice, with the fields enclosed by brackets "[]" replaced with your own identifying information. (Don't include the brackets!) The text should be enclosed in the appropriate comment syntax for the file format. We also recommend that a file or class name and description of purpose be included on the same "printed page" as the copyright notice for easier identification within third-party archives.

Copyright [yyyy] [name of copyright owner]

Licensed under the Apache License, Version 2.0 (the "License"); you may not use this file except in compliance with the License. You may obtain a copy of the License at

http://www.apache.org/licenses/LICENSE-2.0

Unless required by applicable law or agreed to in writing, software distributed under the License is distributed on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.

See the License for the specific language governing permissions and limitations under the License.

Google Guava 29.0

COPYRIGHT: Copyright (C) 2008 The Guava Authors

LICENSE: Apache 2.0

Apache License



Version 2.0, January 2004 http://www.apache.org/licenses/

TERMS AND CONDITIONS FOR USE, REPRODUCTION, AND DISTRIBUTION

1. Definitions.

"License" shall mean the terms and conditions for use, reproduction, $% \left(1\right) =\left(1\right) \left(1\right$

and distribution as defined by Sections 1 through 9 of this document.

"Licensor" shall mean the copyright owner or entity authorized by the copyright owner that is granting the License.

"Legal Entity" shall mean the union of the acting entity and all other entities that control, are controlled by, or are under common

control with that entity. For the purposes of this definition, "control" means (i) the power, direct or indirect, to cause the direction or management of such entity, whether by contract or otherwise, or (ii) ownership of fifty percent (50%) or more of the outstanding shares, or (iii) beneficial ownership of such entity.

"You" (or "Your") shall mean an individual or Legal Entity exercising permissions granted by this License.

"Source" form shall mean the preferred form for making modifications,

including but not limited to software source code, documentation source, and configuration files.

"Object" form shall mean any form resulting from mechanical transformation or translation of a Source form, including but not limited to compiled object code, generated documentation, and conversions to other media types.

"Work" shall mean the work of authorship, whether in Source or Object form, made available under the License, as indicated by a copyright notice that is included in or attached to the work (an example is provided in the Appendix below).

"Derivative Works" shall mean any work, whether in Source or Object

form, that is based on (or derived from) the Work and for which the $\,$

editorial revisions, annotations, elaborations, or other ${\tt modifications}$

represent, as a whole, an original work of authorship. For the purposes

of this License, Derivative Works shall not include works that remain

separable from, or merely link (or bind by name) to the interfaces of,

the Work and Derivative Works thereof.



"Contribution" shall mean any work of authorship, including the original version of the Work and any modifications or additions

to that Work or Derivative Works thereof, that is intentionally submitted to Licensor for inclusion in the Work by the copyright owner

or by an individual or Legal Entity authorized to submit on behalf of

the copyright owner. For the purposes of this definition, "submitted" $% \left(\frac{1}{2}\right) =\frac{1}{2}\left(\frac{1}{2}\right) +\frac{1}{2}\left(\frac{1}{2}\right) +\frac{1}{$

 $\ensuremath{\mathsf{means}}$ any form of electronic, verbal, or written communication sent

to the Licensor or its representatives, including but not limited to

communication on electronic mailing lists, source code control systems,

and issue tracking systems that are managed by, or on behalf of, the $% \left(1\right) =\left(1\right) +\left(1\right$

Licensor for the purpose of discussing and improving the Work, but excluding communication that is conspicuously marked or otherwise designated in writing by the copyright owner as "Not a Contribution."

"Contributor" shall mean Licensor and any individual or Legal $\mathop{\hbox{\rm Entity}}\nolimits$

on behalf of whom a Contribution has been received by Licensor and subsequently incorporated within the Work.

- 2. Grant of Copyright License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable copyright license to reproduce, prepare Derivative Works of, publicly display, publicly perform, sublicense, and distribute the Work and such Derivative Works in Source or Object form.
- 3. Grant of Patent License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable (except as stated in this section) patent license to make, have made,

use, offer to sell, sell, import, and otherwise transfer the Work, where such license applies only to those patent claims licensable by such Contributor that are necessarily infringed by their Contribution(s) alone or by combination of their Contribution(s) with the Work to which such Contribution(s) was submitted. If You institute patent litigation against any entity (including a cross-claim or counterclaim in a lawsuit) alleging that the Work or a Contribution incorporated within the Work constitutes direct or contributory patent infringement, then any patent licenses granted to You under this License for that Work shall terminate as of the date such litigation is filed.

4. Redistribution. You may reproduce and distribute copies of the Work or Derivative Works thereof in any medium, with or without



modifications, and in Source or Object form, provided that You meet the following conditions:

- (a) You must give any other recipients of the Work or Derivative Works a copy of this License; and
- (b) You must cause any modified files to carry prominent notices stating that You changed the files; and
- (c) You must retain, in the Source form of any Derivative Works that You distribute, all copyright, patent, trademark, and attribution notices from the Source form of the Work, excluding those notices that do not pertain to any part of the Derivative Works; and
- (d) If the Work includes a "NOTICE" text file as part of its distribution, then any Derivative Works that You distribute

must

include a readable copy of the attribution notices contained within such NOTICE file, excluding those notices that do not pertain to any part of the Derivative Works, in at least one of the following places: within a NOTICE text file distributed as part of the Derivative Works; within the Source form or documentation, if provided along with the Derivative Works;

or,

within a display generated by the Derivative Works, if and wherever such third-party notices normally appear. The $\,$

contents

of the NOTICE file are for informational purposes only and do not modify the License. You may add Your own attribution notices within Derivative Works that You distribute, alongside or as an addendum to the NOTICE text from the Work, provided that such additional attribution notices cannot be construed as modifying the License.

You may add Your own copyright statement to Your modifications and may provide additional or different license terms and conditions for use, reproduction, or distribution of Your modifications, or for any such Derivative Works as a whole, provided Your use, reproduction, and distribution of the Work otherwise complies with the conditions stated in this License.

5. Submission of Contributions. Unless You explicitly state otherwise,

any Contribution intentionally submitted for inclusion in the Work by You to the Licensor shall be under the terms and conditions of this License, without any additional terms or conditions.

Notwithstanding the above nothing herein shall supersede or

Notwithstanding the above, nothing herein shall supersede or \mbox{modify}

the terms of any separate license agreement you may have executed with Licensor regarding such Contributions.

6. Trademarks. This License does not grant permission to use the trade

names, trademarks, service marks, or product names of the



Licensor,

except as required for reasonable and customary use in describing the $\,$

origin of the Work and reproducing the content of the NOTICE file.

7. Disclaimer of Warranty. Unless required by applicable law or agreed to in writing, Licensor provides the Work (and each Contributor provides its Contributions) on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied, including, without limitation, any warranties or conditions

of TITLE, NON-INFRINGEMENT, MERCHANTABILITY, or FITNESS FOR A PARTICULAR PURPOSE. You are solely responsible for determining the appropriateness of using or redistributing the Work and assume any risks associated with Your exercise of permissions under this License.

8. Limitation of Liability. In no event and under no legal theory, whether in tort (including negligence), contract, or otherwise, unless required by applicable law (such as deliberate and grossly negligent acts) or agreed to in writing, shall any Contributor be liable to You for damages, including any direct, indirect, special,

incidental, or consequential damages of any character arising as a result of this License or out of the use or inability to use the Work (including but not limited to damages for loss of goodwill, work stoppage, computer failure or malfunction, or any and all other commercial damages or losses), even if such Contributor has been advised of the possibility of such damages.

9. Accepting Warranty or Additional Liability. While redistributing the Work or Derivative Works thereof, You may choose to offer, and charge a fee for, acceptance of support, warranty, indemnity, or other liability obligations and/or rights consistent with this License. However, in accepting such obligations, You may act only on Your own behalf and on Your sole responsibility, not on behalf of any other Contributor, and only if You agree to indemnify, defend, and hold each Contributor harmless for any liability incurred by, or claims asserted against, such Contributor by reason

of your accepting any such warranty or additional liability.

END OF TERMS AND CONDITIONS

Modules which can optionally be built:
guava-bom
guava-gwt
guava-testlib
guava-tests
guava
refactorings



util

Compile time Dependencies:

com.google.code.findbugs » jsr305 3.0.2
COPYRIGHT: (C) University of Maryland

LICENSE:

The JSR-305 reference implementation (lib/jsr305.jar) is distributed under the terms of the New BSD license:

http://www.opensource.org/licenses/bsd-license.php

See the JSR-305 home page for more information:

http://code.google.com/p/jsr-305/

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

- 1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
- 2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
- 3. Neither the name of the copyright holder nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT HOLDER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

com.google.errorprone » error_prone_annotations 2.3.4
COPYRIGHT: Copyright 2017 The Error Prone Authors.
LICENSE: Apache 2.0 https://github.com/google/error-prone/blob/v2.2.0/
COPYING

com.google.guava » failureaccess 1.0.1 (part of google guava 28.1-jre. same license and copyright)



```
com.google.guava » listenablefuture 9999.0-empty-...
(part of google guava 28.1-jre. same license and copyright)

---
com.google.j2objc » j2objc-annotations 1.3
COPYRIGHT: (C) Daniel Connelly and Google, Inc.
LICENSE: Apache 2.0 https://github.com/google/j2objc/blob/1.1/LICENSE

---
org.checkerframework » checker-qual 2.10 MIT license
COPYRIGHT: Copyright 2004-present by the Checker Framework developers
```

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

===

Jetty 9.4.28

This program and the accompanying materials are made available under the terms of the Eclipse Public License 1.0 which is available at https://www.eclipse.org/org/documents/epl-1.0/EPL-1.0.txt or the Apache Software License 2.0 which is available at https://www.apache.org/licenses/LICENSE-2.0

Eclipse Public License - v 1.0

THE ACCOMPANYING PROGRAM IS PROVIDED UNDER THE TERMS OF THIS ECLIPSE PUBLIC

LICENSE ("AGREEMENT"). ANY USE, REPRODUCTION OR DISTRIBUTION OF THE PROGRAM

CONSTITUTES RECIPIENT'S ACCEPTANCE OF THIS AGREEMENT.

1. DEFINITIONS



"Contribution" means:

 $\ensuremath{\mathrm{a}}\xspace)$ in the case of the initial Contributor, the initial code and documentation

distributed under this Agreement, and

- b) in the case of each subsequent Contributor:
 - i) changes to the Program, and
 - ii) additions to the Program;

where such changes and/or additions to the Program originate from and are

distributed by that particular Contributor. A Contribution 'originates'

from a Contributor if it was added to the Program by such Contributor itself or anyone acting on such Contributor's behalf. Contributions do not

include additions to the Program which: (i) are separate modules of software distributed in conjunction with the Program under their own license agreement, and (ii) are not derivative works of the Program.

"Contributor" means any person or entity that distributes the Program.

"Licensed Patents" mean patent claims licensable by a Contributor which are

necessarily infringed by the use or sale of its Contribution alone or when

combined with the Program.

"Program" means the Contributions distributed in accordance with this $\mbox{\sc Agreement.}$

"Recipient" means anyone who receives the Program under this Agreement, including all Contributors.

2. GRANT OF RIGHTS

a) Subject to the terms of this Agreement, each Contributor hereby grants

Recipient a non-exclusive, worldwide, royalty-free copyright license to $% \left\{ 1,2,\ldots ,2,\ldots \right\}$

reproduce, prepare derivative works of, publicly display, publicly perform, distribute and sublicense the Contribution of such Contributor,

if any, and such derivative works, in source code and object code form.

b) Subject to the terms of this Agreement, each Contributor hereby grants

Recipient a non-exclusive, worldwide, royalty-free patent license under $% \left(1\right) =\left(1\right) +\left(1\right) +\left($

Licensed Patents to make, use, sell, offer to sell, import and otherwise

transfer the Contribution of such Contributor, if any, in source code and

object code form. This patent license shall apply to the combination of

the Contribution and the Program if, at the time the Contribution



is

added by the Contributor, such addition of the Contribution causes such

combination to be covered by the Licensed Patents. The patent license

shall not apply to any other combinations which include the Contribution.

No hardware per se is licensed hereunder.

c) Recipient understands that although each Contributor grants the licenses

to its Contributions set forth herein, no assurances are provided by any

Contributor that the Program does not infringe the patent or other intellectual property rights of any other entity. Each Contributor disclaims any liability to Recipient for claims brought by any other

entity based on infringement of intellectual property rights or otherwise. As a condition to exercising the rights and licenses granted

hereunder, each Recipient hereby assumes sole responsibility to secure

any other intellectual property rights needed, if any. For example, if a $% \left(1\right) =\left(1\right)$

third party patent license is required to allow Recipient to distribute

the Program, it is Recipient's responsibility to acquire that license $% \left(1\right) =\left(1\right) \left(1$

before distributing the Program.

d) Each Contributor represents that to its knowledge it has sufficient copyright rights in its Contribution, if any, to grant the copyright

license set forth in this Agreement.

3. REQUIREMENTS

A Contributor may choose to distribute the Program in object code form under

its own license agreement, provided that:

- a) it complies with the terms and conditions of this Agreement; and
- b) its license agreement:
- i) effectively disclaims on behalf of all Contributors all warranties

and conditions, express and implied, including warranties or conditions of title and non-infringement, and implied warranties or

conditions of merchantability and fitness for a particular purpose;

 $\hspace{1cm}$ ii) effectively excludes on behalf of all Contributors all liability for

damages, including direct, indirect, special, incidental and consequential damages, such as lost profits;

iii) states that any provisions which differ from this Agreement are offered by that Contributor alone and not by any other party; and



manner on or through a medium customarily used for software exchange.

When the Program is made available in source code form:

- a) it must be made available under this Agreement; and
- b) a copy of this Agreement must be included with each copy of the Program.

Contributors may not remove or alter any copyright notices contained

within the Program.

Each Contributor must identify itself as the originator of its Contribution,

if

any, in a manner that reasonably allows subsequent Recipients to identify the $% \left(1\right) =\left(1\right) \left(1\right) +\left(1\right) \left(1\right) \left(1\right) +\left(1\right) \left(1\right) \left$

originator of the Contribution.

4. COMMERCIAL DISTRIBUTION

Commercial distributors of software may accept certain responsibilities with

respect to end users, business partners and the like. While this license is

intended to facilitate the commercial use of the Program, the ${\tt Contributor}$ who

includes the Program in a commercial product offering should do so in a manner

which does not create potential liability for other Contributors. Therefore,

if a Contributor includes the Program in a commercial product offering, such

Contributor ("Commercial Contributor") hereby agrees to defend and indemnify

every other Contributor ("Indemnified Contributor") against any losses, damages and costs (collectively "Losses") arising from claims, lawsuits and

other legal actions brought by a third party against the Indemnified Contributor to the extent caused by the acts or omissions of such Commercial

Contributor in connection with its distribution of the Program in a $\operatorname{\mathsf{commercial}}$

product offering. The obligations in this section do not apply to any claims

or Losses relating to any actual or alleged intellectual property infringement. In order to qualify, an Indemnified Contributor must:

a) promptly notify the Commercial Contributor in writing of such claim,

b) allow the Commercial Contributor to control, and cooperate with the Commercial Contributor in, the defense and any related settlement negotiations. The Indemnified Contributor may participate in any such



claim at

its own expense.

For example, a Contributor might include the Program in a commercial product

offering, Product X. That Contributor is then a Commercial Contributor. If

that Commercial Contributor then makes performance claims, or offers warranties related to Product X, those performance claims and warranties are

such Commercial Contributor's responsibility alone. Under this section, the

Commercial Contributor would have to defend claims against the other Contributors related to those performance claims and warranties, and if a $\,$

court requires any other Contributor to pay any damages as a result, the Commercial Contributor must pay those damages.

5. NO WARRANTY

EXCEPT AS EXPRESSLY SET FORTH IN THIS AGREEMENT, THE PROGRAM IS PROVIDED ON AN

"AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, EITHER EXPRESS OR

IMPLIED INCLUDING, WITHOUT LIMITATION, ANY WARRANTIES OR CONDITIONS OF TITLE,

NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Each

Recipient is solely responsible for determining the appropriateness of using

and distributing the Program and assumes all risks associated with its exercise of rights under this Agreement , including but not limited to the

risks and costs of program errors, compliance with applicable laws, damage to

or loss of data, programs or equipment, and unavailability or interruption of operations.

6. DISCLAIMER OF LIABILITY

EXCEPT AS EXPRESSLY SET FORTH IN THIS AGREEMENT, NEITHER RECIPIENT NOR ANY

CONTRIBUTORS SHALL HAVE ANY LIABILITY FOR ANY DIRECT, INDIRECT, INCIDENTAL.

SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING WITHOUT LIMITATION

LOST PROFITS), HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OR DISTRIBUTION OF THE PROGRAM OR THE EXERCISE OF ANY RIGHTS GRANTED HEREUNDER, EVEN IF ADVISED OF THE POSSIBILITY

OF SUCH DAMAGES.

7. GENERAL



If any provision of this Agreement is invalid or unenforceable under applicable law, it shall not affect the validity or enforceability of the

remainder of the terms of this Agreement, and without further action by the

parties hereto, such provision shall be reformed to the minimum extent necessary to make such provision valid and enforceable.

If Recipient institutes patent litigation against any entity (including a

cross-claim or counterclaim in a lawsuit) alleging that the Program itself

(excluding combinations of the Program with other software or hardware) infringes such Recipient's patent(s), then such Recipient's rights granted

under Section 2(b) shall terminate as of the date such litigation is filed.

All Recipient's rights under this Agreement shall terminate if it fails to

comply with any of the material terms or conditions of this Agreement and does

not cure such failure in a reasonable period of time after becoming aware of

such noncompliance. If all Recipient's rights under this Agreement terminate,

Recipient agrees to cease use and distribution of the Program as soon as reasonably practicable. However, Recipient's obligations under this Agreement

and any licenses granted by Recipient relating to the Program shall continue $% \left(1\right) =\left(1\right) +\left(1\right$

and survive.

Everyone is permitted to copy and distribute copies of this Agreement, but in

order to avoid inconsistency the Agreement is copyrighted and may only be

modified in the following manner. The Agreement Steward reserves the right to $% \left(1\right) =\left(1\right) \left(1\right) +\left(1\right) \left(1\right) \left(1\right) +\left(1\right) \left(1\right) \left$

publish new versions (including revisions) of this Agreement from time to

time. No one other than the Agreement Steward has the right to modify this

Agreement. The Eclipse Foundation is the initial Agreement Steward. The Eclipse Foundation may assign the responsibility to serve as the Agreement

Steward to a suitable separate entity. Each new version of the Agreement will

be given a distinguishing version number. The Program (including Contributions) may always be distributed subject to the version of the Agreement under which it was received. In addition, after a new version of the

Agreement is published, Contributor may elect to distribute the Program (including its Contributions) under the new version. Except as expressly



stated in Sections 2(a) and 2(b) above, Recipient receives no rights or licenses to the intellectual property of any Contributor under this Agreement,

whether expressly, by implication, estoppel or otherwise. All rights in the

Program not expressly granted under this Agreement are reserved.

This Agreement is governed by the laws of the State of New York and the intellectual property laws of the United States of America. No party to this

Agreement will bring a legal action under this Agreement more than one year

after the cause of action arose. Each party waives its rights to a jury trial in

any resulting litigation.

Apache License
Version 2.0, January 2004
http://www.apache.org/licenses/

TERMS AND CONDITIONS FOR USE, REPRODUCTION, AND DISTRIBUTION

1. Definitions.

"License" shall mean the terms and conditions for use, reproduction,

and distribution as defined by Sections 1 through 9 of this document.

"Licensor" shall mean the copyright owner or entity authorized by the copyright owner that is granting the License.

"Legal Entity" shall mean the union of the acting entity and all other entities that control, are controlled by, or are under common

control with that entity. For the purposes of this definition, "control" means (i) the power, direct or indirect, to cause the direction or management of such entity, whether by contract or otherwise, or (ii) ownership of fifty percent (50%) or more of the outstanding shares, or (iii) beneficial ownership of such entity.

"You" (or "Your") shall mean an individual or Legal Entity exercising permissions granted by this License.

"Source" form shall mean the preferred form for making modifications, $% \left(1\right) =\left(1\right) \left(1\right) +\left(1\right) \left(1\right) \left(1\right) +\left(1\right) \left(1\right) \left($

including but not limited to software source code, documentation source, and configuration files.

"Object" form shall mean any form resulting from mechanical transformation or translation of a Source form, including but not limited to compiled object code, generated documentation, and conversions to other media types.



"Work" shall mean the work of authorship, whether in Source or Object form, made available under the License, as indicated by a copyright notice that is included in or attached to the work (an example is provided in the Appendix below).

"Derivative Works" shall mean any work, whether in Source or Object

form, that is based on (or derived from) the Work and for which the $\ensuremath{\mbox{\sc that}}$

editorial revisions, annotations, elaborations, or other ${\tt modifications}$

represent, as a whole, an original work of authorship. For the purposes

of this License, Derivative Works shall not include works that remain

separable from, or merely link (or bind by name) to the interfaces of, $\$

the Work and Derivative Works thereof.

"Contribution" shall mean any work of authorship, including the original version of the Work and any modifications or additions

to that Work or Derivative Works thereof, that is intentionally submitted to Licensor for inclusion in the Work by the copyright owner

or by an individual or Legal Entity authorized to submit on behalf of

the copyright owner. For the purposes of this definition, "submitted"

 $\ensuremath{\mathsf{means}}$ any form of electronic, verbal, or written communication sent

to the Licensor or its representatives, including but not limited to

communication on electronic mailing lists, source code control systems,

and issue tracking systems that are managed by, or on behalf of, the $% \left(1\right) =\left(1\right) \left(1\right) +\left(1\right) \left(1\right) \left(1\right) +\left(1\right) \left(1\right) \left($

Licensor for the purpose of discussing and improving the Work, but excluding communication that is conspicuously marked or otherwise designated in writing by the copyright owner as "Not a Contribution."

"Contributor" shall mean Licensor and any individual or Legal Entity

on behalf of whom a Contribution has been received by Licensor and subsequently incorporated within the Work.

2. Grant of Copyright License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable copyright license to reproduce, prepare Derivative Works of, publicly display, publicly perform, sublicense, and distribute the Work and such Derivative Works in Source or Object form.



3. Grant of Patent License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable (except as stated in this section) patent license to make, have made,

use, offer to sell, sell, import, and otherwise transfer the Work, where such license applies only to those patent claims licensable by such Contributor that are necessarily infringed by their Contribution(s) alone or by combination of their Contribution(s) with the Work to which such Contribution(s) was submitted. If You institute patent litigation against any entity (including a cross-claim or counterclaim in a lawsuit) alleging that the Work or a Contribution incorporated within the Work constitutes direct or contributory patent infringement, then any patent licenses granted to You under this License for that Work shall terminate as of the date such litigation is filed.

- 4. Redistribution. You may reproduce and distribute copies of the Work or Derivative Works thereof in any medium, with or without modifications, and in Source or Object form, provided that You meet the following conditions:
 - (a) You must give any other recipients of the Work or Derivative Works a copy of this License; and
 - (b) You must cause any modified files to carry prominent notices stating that You changed the files; and
 - (c) You must retain, in the Source form of any Derivative Works that You distribute, all copyright, patent, trademark, and attribution notices from the Source form of the Work, excluding those notices that do not pertain to any part of the Derivative Works; and
 - (d) If the Work includes a "NOTICE" text file as part of its distribution, then any Derivative Works that You distribute

must

include a readable copy of the attribution notices contained within such NOTICE file, excluding those notices that do not pertain to any part of the Derivative Works, in at least one of the following places: within a NOTICE text file distributed as part of the Derivative Works; within the Source form or documentation, if provided along with the Derivative Works;

or,

within a display generated by the Derivative Works, if and wherever such third-party notices normally appear. The

contents

of the NOTICE file are for informational purposes only and do not modify the License. You may add Your own attribution notices within Derivative Works that You distribute, alongside or as an addendum to the NOTICE text from the Work, provided that such additional attribution notices cannot be construed as modifying the License.

You may add Your own copyright statement to Your modifications and

may provide additional or different license terms and conditions for use, reproduction, or distribution of Your modifications, or for any such Derivative Works as a whole, provided Your use, reproduction, and distribution of the Work otherwise complies with the conditions stated in this License.

5. Submission of Contributions. Unless You explicitly state otherwise,

any Contribution intentionally submitted for inclusion in the Work by You to the Licensor shall be under the terms and conditions of this License, without any additional terms or conditions.

Notwithstanding the above, nothing herein shall supersede or modify

the terms of any separate license agreement you may have executed with Licensor regarding such Contributions.

 $\ensuremath{\mathsf{6}}.$ Trademarks. This License does not grant permission to use the trade

names, trademarks, service marks, or product names of the Licensor, $% \left(1\right) =\left(1\right) \left(1\right)$

except as required for reasonable and customary use in describing the $% \left(1\right) =\left(1\right) \left(1\right)$

origin of the Work and reproducing the content of the NOTICE file.

7. Disclaimer of Warranty. Unless required by applicable law or agreed to in writing, Licensor provides the Work (and each Contributor provides its Contributions) on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied, including, without limitation, any warranties or conditions

of TITLE, NON-INFRINGEMENT, MERCHANTABILITY, or FITNESS FOR A PARTICULAR PURPOSE. You are solely responsible for determining the appropriateness of using or redistributing the Work and assume any risks associated with Your exercise of permissions under this License.

8. Limitation of Liability. In no event and under no legal theory, whether in tort (including negligence), contract, or otherwise, unless required by applicable law (such as deliberate and grossly negligent acts) or agreed to in writing, shall any Contributor be liable to You for damages, including any direct, indirect, special,

incidental, or consequential damages of any character arising as a result of this License or out of the use or inability to use the Work (including but not limited to damages for loss of goodwill, work stoppage, computer failure or malfunction, or any and all other commercial damages or losses), even if such Contributor has been advised of the possibility of such damages.

9. Accepting Warranty or Additional Liability. While redistributing the Work or Derivative Works thereof, You may choose to offer, and charge a fee for, acceptance of support, warranty, indemnity, or other liability obligations and/or rights consistent with this License. However, in accepting such obligations, You may act only on Your own behalf and on Your sole responsibility, not on behalf



of any other Contributor, and only if You agree to indemnify, defend, and hold each Contributor harmless for any liability incurred by, or claims asserted against, such Contributor by reason

of your accepting any such warranty or additional liability.

END OF TERMS AND CONDITIONS

APPENDIX: How to apply the Apache License to your work.

To apply the Apache License to your work, attach the following boilerplate notice, with the fields enclosed by brackets "[]" replaced with your own identifying information. (Don't include the brackets!) The text should be enclosed in the appropriate comment syntax for the file format. We also recommend that a file or class name and description of purpose be included on the same "printed page" as the copyright notice for easier identification within third-party archives.

Copyright [yyyy] [name of copyright owner]

Licensed under the Apache License, Version 2.0 (the "License"); you may not use this file except in compliance with the License. You may obtain a copy of the License at

http://www.apache.org/licenses/LICENSE-2.0

Unless required by applicable law or agreed to in writing, software distributed under the License is distributed on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.

See the License for the specific language governing permissions and limitations under the License.

Notice:

Jetty Web Container
Copyright 1995-2019 Mort Bay Consulting Pty Ltd.

The Jetty Web Container is Copyright Mort Bay Consulting Pty Ltd unless otherwise noted.

Jetty is dual licensed under both

* The Apache 2.0 License http://www.apache.org/licenses/LICENSE-2.0.html

and

* The Eclipse Public 1.0 License http://www.eclipse.org/legal/epl-v10.html

Jetty may be distributed under either license.



```
Eclipse
The following artifacts are EPL.
 * org.eclipse.jetty.orbit:org.eclipse.jdt.core
The following artifacts are EPL and ASL2.
 * org.eclipse.jetty.orbit:javax.security.auth.message
The following artifacts are EPL and CDDL 1.0.
 * org.eclipse.jetty.orbit:javax.mail.glassfish
_____
OW2
The following artifacts are licensed by the OW2 Foundation according to
terms of http://asm.ow2.org/license.html
org.ow2.asm:asm-commons
org.ow2.asm:asm
_____
Apache
The following artifacts are ASL2 licensed.
org.apache.taglibs:taglibs-standard-spec
org.apache.taglibs:taglibs-standard-impl
_____
MortBay
The following artifacts are ASL2 licensed. Based on selected classes
following Apache Tomcat jars, all ASL2 licensed.
org.mortbay.jasper:apache-jsp
 org.apache.tomcat:tomcat-jasper
 org.apache.tomcat:tomcat-juli
 org.apache.tomcat:tomcat-jsp-api
 org.apache.tomcat:tomcat-el-api
 org.apache.tomcat:tomcat-jasper-el
 org.apache.tomcat:tomcat-api
 org.apache.tomcat:tomcat-util-scan
 org.apache.tomcat:tomcat-util
org.mortbay.jasper:apache-el
 org.apache.tomcat:tomcat-jasper-el
 org.apache.tomcat:tomcat-el-api
```



Assorted

The UnixCrypt.java code implements the one way cryptography used by Unix systems for simple password protection. Copyright 1996 Aki Yoshida,

modified April 2001 by Iris Van den Broeke, Daniel Deville. Permission to use, copy, modify and distribute UnixCrypt for non-commercial or commercial purposes and without fee is granted provided that the copyright notice appears in all copies.

FROM POM FILE:

org.ow2.asm asm / asm-common / asm-tree / asm-analysis 7.0
COPYRIGHT and LICENSE:

ASM: a very small and fast Java bytecode manipulation framework Copyright (c) 2000-2011 INRIA, France Telecom All rights reserved.

Redistribution and use in source and binary forms, with or without modification, are permitted provided that the following conditions are met:

- 1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
- 2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
- 3. Neither the name of the copyright holders nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS"

AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE

IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE

ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT OWNER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

org.eclipse.jetty.toolchain jetty-schema 3.1.2

COPYRIGHT: Copyright 1995-2018 Mort Bay Consulting Pty Ltd.



```
LICENSE: Apache Software License - Version 2.0 + Eclipse Public License
- Version 1.0
org.eclipse.jetty.orbit javax.security.auth.message 1.0.0.v201108011116
org.eclipse.jetty.orbit javax.activation 1.1.0.v201105071233
COPYRIGHT: Mort Bay Consulting
LICENSE: Apache Software License - Version 2.0 + Eclipse Public License
- Version 1.0
org.mortbay.jasper apache-jsp 8.5.40
COPYRIGHT: Mort Bay Consulting
LICENSE: Apache 2.0 https://github.com/jetty-project/jasper-jsp/blob/
jasper-jsp-8.5.40/LICENSE
org.apache.taglibs taglibs-standard-imp 1.2.5
org.apache.taglibs taglibs-standard-spec 1.2.5
COPYRIGHT: Copyright © 2001-2015 The Apache Software Foundation. All
Rights Reserved.
LICENSE: Apache 2.0 https://www.apache.org/licenses/LICENSE-2.0
org.eclipse.jetty.toolchain jetty-perf-helper 1.0.5
COPYRIGHT and LICENSE:
// Copyright (c) 1995-2014 Mort Bay Consulting Pty. Ltd.
//
// All rights reserved. This program and the accompanying materials
// are made available under the terms of the Eclipse Public License
v1.0
// and Apache License v2.0 which accompanies this distribution.
//
//
        The Eclipse Public License is available at
//
        http://www.eclipse.org/legal/epl-v10.html
//
//
        The Apache License v2.0 is available at
//
        http://www.opensource.org/licenses/apache2.0.php
//
// You may elect to redistribute this code under either of these
licenses.
org.slf4j jcl104-over-slf4j 1.7.25
org.slf4j log4j-over-slf4j 1.7.25
org.slf4j slf4j-api 1.7.25
```

org.slf4j slf4j-simple 1.7.25 COPYRIGHT and LICENSE: Copyright (c) 2004-2017 QOS.ch All rights reserved.

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

org.jboss.logging 3.3.2.Final

COPYRIGHT: Copyright 2010 Red Hat, Inc.

LICENSE: Apache 2.0 https://github.com/jboss-logging/jboss-logging/blob/3.3.2.Final/src/main/resources/META-INF/LICENSE.txt

com.github.jnr jnr-unixsocket 0.22

COPYRIGHT:

Copyright (C) 2016 Fritz Elfert Copyright (C) 2009 Wayne Meissner Copyright (C) 2016 Marcus Linke

Copyright (C) 2014 Greg Vanore

LICENSE: Apache 2.0

Licensed under the Apache License, Version 2.0 (the "License"); you may not use this file except in compliance with the License. You may obtain a copy of the License at

http://www.apache.org/licenses/LICENSE-2.0

Unless required by applicable law or agreed to in writing, software distributed under the License is distributed on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.

See the License for the specific language governing permissions and



limitations under the License.

```
org.eclipse.jetty.alpn » alpn-api 1.1.3.v20160715
COPYRIGHT and LICENSE:
// Copyright (c) 1995-2015 Mort Bay Consulting Pty. Ltd.
// All rights reserved. This program and the accompanying materials
// are made available under the terms of the Eclipse Public License
v1.0
// and Apache License v2.0 which accompanies this distribution.
//
//
        The Eclipse Public License is available at
//
        http://www.eclipse.org/legal/epl-v10.html
//
//
        The Apache License v2.0 is available at
//
        http://www.opensource.org/licenses/apache2.0.php
// You may elect to redistribute this code under either of these
licenses.
org.infinispan » infinispan-core 9.4.8.Final
org.infinispan » infinispan-query 9.4.8.Final
org.infinispan » infinispan-client-hotrod 9.4.8.Final
org.infinispan » infinispan-remote-query-client 9.4.8.Final
Copyright The Infinispan Project Team
LICENSE: Apache 2.0 https://github.com/infinispan/infinispan/blob/
9.4.8.Final/LICENSE.md
org.conscrypt » conscrypt-openjdk-uber v2.1.0
COPYRIGHT and LICENSE:
Copyright 2016 The Android Open Source Project
Licensed under the Apache License, Version 2.0 (the "License");
you may not use this file except in compliance with the License.
You may obtain a copy of the License at
     http://www.apache.org/licenses/LICENSE-2.0
```

Unless required by applicable law or agreed to in writing, software distributed under the License is distributed on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied. See the License for the specific language governing permissions and limitations under the License.



org.mongodb » mongo-java-driver 2.13.2

COPYRIGHT: Copyright 2008-present MongoDB, Inc.

LICENSE: Apache 2.0 https://github.com/mongodb/mongo-java-driver/blob/r2.13.2/LICENSE.txt

NOTICE FILE:

The MongoDB Java Driver uses third-party libraries or other resources that may

be distributed under licenses different than the MongoDB Java Driver software.

In the event that we accidentally failed to list a required notice, please bring it to our attention through any of the ways detailed here:

mongodb-dev@googlegroups.com

The attached notices are provided for information only.

For any licenses that require disclosure of source, sources are available at

https://github.com/mongodb/mongo-java-driver.

1) The following files: Immutable.java, NotThreadSafe.java, ThreadSafe.java

Copyright (c) 2005 Brian Goetz and Tim Peierls
Released under the Creative Commons Attribution License (http://
creativecommons.org/licenses/by/2.5)
Official home: http://www.jcip.net

Any republication or derived work distributed in source code form must include this copyright and license notice.

2) The following files: Assertions.java, AbstractCopyOnWriteMap.java, CopyOnWriteMap.java

Copyright (c) 2008-2014 Atlassian Pty Ltd

Licensed under the Apache License, Version 2.0 (the "License"); you may not use this file except in compliance with the License. You may obtain a copy of the License at

http://www.apache.org/licenses/LICENSE-2.0

Unless required by applicable law or agreed to in writing, software distributed under the License is distributed on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.

See the License for the specific language governing permissions and limitations under the License.

3) The following files: Beta.java, UnsignedLongs.java, UnsignedLongsTest.java



Copyright 2010 The Guava Authors Copyright 2011 The Guava Authors

Licensed under the Apache License, Version 2.0 (the "License"); you may not use this file except in compliance with the License. You may obtain a copy of the License at

http://www.apache.org/licenses/LICENSE-2.0

Unless required by applicable law or agreed to in writing, software distributed under the License is distributed on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.

See the License for the specific language governing permissions and limitations under the License.

4) The following files: ReadTimeoutHandler.java

Copyright 2008-present MongoDB, Inc. Copyright 2012 The Netty Project

Licensed under the Apache License, Version 2.0 (the "License"); you may not use this file except in compliance with the License. You may obtain a copy of the License at

http://www.apache.org/licenses/LICENSE-2.0

Unless required by applicable law or agreed to in writing, software distributed under the License is distributed on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.

See the License for the specific language governing permissions and limitations under the License.

5) The following files: InstantCodec.java, Jsr310CodecProvider.java, LocalDateCodec.java, LocalDateTimeCodec.java, LocalTimeCodec.java

Copyright 2008-present MongoDB, Inc. Copyright 2018 Cezary Bartosiak

Licensed under the Apache License, Version 2.0 (the "License"); you may not use this file except in compliance with the License. You may obtain a copy of the License at

http://www.apache.org/licenses/LICENSE-2.0

Unless required by applicable law or agreed to in writing, software distributed under the License is distributed on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.

See the License for the specific language governing permissions and limitations under the License.

6) The following files: SaslPrep.java



Copyright 2008-present MongoDB, Inc. Copyright 2017 Tom Bentley Licensed under the Apache License, Version 2.0 (the "License"); you may not use this file except in compliance with the License. You may obtain a copy of the License at http://www.apache.org/licenses/LICENSE-2.0 Unless required by applicable law or agreed to in writing, software distributed under the License is distributed on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied. See the License for the specific language governing permissions and limitations under the License. 7) The following files (originally from https://github.com/ marianobarrios/tls-channel): AsynchronousTlsChannel.java AsynchronousTlsChannelGroup.java ${\tt ExtendedAsynchronousByteChannel.java}$ BufferHolder.java ByteBufferSet.java ByteBufferUtil.java TlsChannelImpl.java TlsChannelCallbackException.java Util.java BufferAllocator.java ClientTlsChannel.java NeedsReadException.java NeedsTaskException.java NeedsWriteException.java TlsChannel.java TlsChannelBuilder.java TlsChannelFlowControlException.java TrackingAllocator.java WouldBlockException.java Copyright (c) [2015-2018] all contributors MIT License Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, copies of the Software, and to permit persons to whom the Software

furnished to do so, subject to the following conditions:



is

included in all copies or substantial portions of the Software. THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE. org.springframework » spring-beans 3.2.8.RELEASE COPYRIGHT: Copyright (c) 2002-2014 Pivotal, Inc. LICENSE: Apache 2.0 The Spring Framework is released under version 2.0 of the Apache License. org.jboss.logging » jboss-logging 3.3.2.Final COPYRIGHT: Copyright 2010 Red Hat, Inc. LICENSE: Apache 2.0 https://github.com/jboss-logging/jboss-logging/blob/ 3.3.2.Final/src/main/resources/META-INF/LICENSE.txt com.hazelcast » hazelcast 3.9.4 com.hazelcast » hazelcast-client 3.9.4 LICENSE: Apache 2.0 https://github.com/hazelcast/hazelcast/blob/v3.9.4/ LICENSE NOTICE FILE: The packages: com.hazelcast.util.collection com.hazelcast.internal.util.concurrent and the classes: com.hazelcast.util.OuickMath com.hazelcast.client.impl.protocol.util.UnsafeBuffer com.hazelcast.client.impl.protocol.util.BufferBuilder contain code originating from the Agrona project (https://github.com/real-logic/Agrona). The class com.hazelcast.util.HashUtil contains code originating from the Koloboke project (https://github.com/OpenHFT/Koloboke).

The above copyright notice and this permission notice shall be



```
The class classloading. ThreadLocalLeakTestUtils contains code
originating
from the Tomcat project (https://github.com/apache/tomcat).
com.hazelcast.internal.cluster.fd.PhiAccrualFailureDetector contains
code originating
from the Akka project (https://github.com/akka/akka/).
ant » ant 1.6.5
ant » ant-launcher 1.6.5
COPYRIGHT: Copyright 1999-2012 The Apache Software Foundation
LICENSE: Aapche 2.0 https://github.com/apache/ant/blob/rel/1.6.5/LICENSE
NOTICE FILE:
   This product includes software developed by
   The Apache Software Foundation (http://www.apache.org/).
   This product includes also software developed by :
     - the W3C consortium (http://www.w3c.org) ,
     - the SAX project (http://www.saxproject.org)
   Please read the different LICENSE files present in the root
directory of
this distribution.
org.apache.ant » ant 1.8.4
COPYRIGHT: Copyright 1999-2012 The Apache Software Foundation
LICENSE: Apache 2.0 https://github.com/apache/ant/blob/rel/1.8.4/LICENSE
===
The task is based on code Copyright (c) 2002, Landmark
Graphics Corp that has been kindly donated to the Apache Software
Foundation.
W3C® SOFTWARE NOTICE AND LICENSE
http://www.w3.org/Consortium/Legal/2002/copyright-software-20021231
This work (and included software, documentation such as READMEs, or
other
related items) is being provided by the copyright holders under the
following
license. By obtaining, using and/or copying this work, you (the
licensee) agree
that you have read, understood, and will comply with the following
terms and
conditions.
```



Permission to copy, modify, and distribute this software and its documentation,

with or without modification, for any purpose and without fee or royalty is

hereby granted, provided that you include the following on ALL copies of the

software and documentation or portions thereof, including modifications:

- 1. The full text of this NOTICE in a location viewable to users of the redistributed or derivative work.
- 2. Any pre-existing intellectual property disclaimers, notices, or terms

and conditions. If none exist, the W3C Software Short Notice should be

included (hypertext is preferred, text is permitted) within the body

of any redistributed or derivative code.

3. Notice of any changes or modifications to the files, including the date

changes were made. (We recommend you provide URIs to the location from $% \left(1\right) =\left(1\right) +\left(1\right) +\left($

which the code is derived.)

THIS SOFTWARE AND DOCUMENTATION IS PROVIDED "AS IS," AND COPYRIGHT HOLDERS MAKE

NO REPRESENTATIONS OR WARRANTIES, EXPRESS OR IMPLIED, INCLUDING BUT NOT

TO, WARRANTIES OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE OR THAT

THE USE OF THE SOFTWARE OR DOCUMENTATION WILL NOT INFRINGE ANY THIRD PARTY

PATENTS, COPYRIGHTS, TRADEMARKS OR OTHER RIGHTS.

COPYRIGHT HOLDERS WILL NOT BE LIABLE FOR ANY DIRECT, INDIRECT, SPECIAL OR

CONSEQUENTIAL DAMAGES ARISING OUT OF ANY USE OF THE SOFTWARE OR DOCUMENTATION.

The name and trademarks of copyright holders may NOT be used in advertising or

publicity pertaining to the software without specific, written prior permission.

Title to copyright in this software and any associated documentation will at

all times remain with copyright holders.

This formulation of W3C's notice and license became active on December 31 2002.

This version removes the copyright ownership notice such that this license can

be used with materials other than those owned by the W3C, reflects that ${\tt ERCIM}$



```
is now a host of the W3C, includes references to this specific dated
version of
the license, and removes the ambiguous grant of "use". Otherwise, this
is the same as the previous version and is written so as to preserve
the Free
Software Foundation's assessment of GPL compatibility and OSI's
certification
under the Open Source Definition. Please see our Copyright FAQ for
questions about using materials from our site, including specific terms
conditions for packages like libwww, Amaya, and Jigsaw. Other questions
this notice can be directed to site-policy@w3.org.
Joseph Reagle
This license came from: http://www.megginson.com/SAX/copying.html
 However please note future versions of SAX may be covered
 under http://saxproject.org/?selected=pd
SAX2 is Free!
I hereby abandon any property rights to SAX 2.0 (the Simple API for
XML), and release all of the SAX 2.0 source code, compiled code, and
documentation contained in this distribution into the Public Domain.
SAX comes with NO WARRANTY or guarantee of fitness for any
purpose.
David Megginson, david@megginson.com
2000-05-05
LICENSES per Deps:
______
    BSD 3-Clause "New" or "Revised" License (BSD-3-Clause):
        * API Common (com.google.api:api-common:1.0.0 - https://
github.com/googleapis)
       * GAX (Google Api eXtensions) (com.google.api:gax:1.0.0 -
https://github.com/googleapis)
       * ParaNamer Core (com.thoughtworks.paranamer:paranamer:2.3 -
http://paranamer.codehaus.org/paranamer)
       * io.grpc:grpc-all (io.grpc:grpc-all:1.0.1 - https://github.com/
grpc/grpc-java)
       * io.grpc:grpc-auth (io.grpc:grpc-auth:1.0.1 - https://
github.com/grpc/grpc-java)
        * io.grpc:grpc-context (io.grpc:grpc-context:1.0.1 - https://
github.com/grpc/grpc-java)
       * io.grpc:grpc-core (io.grpc:grpc-core:1.0.1 - https://
github.com/grpc/grpc-java)
        * io.grpc:grpc-netty (io.grpc:grpc-netty:1.0.1 - https://
```

```
github.com/grpc/grpc-java)
        * io.grpc:grpc-okhttp (io.grpc:grpc-okhttp:1.0.1 - https://
github.com/grpc/grpc-java)
        * io.grpc:grpc-protobuf (io.grpc:grpc-protobuf:1.0.1 - https://
github.com/grpc/grpc-java)
        * io.grpc:grpc-protobuf-lite (io.grpc:grpc-protobuf-lite:1.0.1
- https://github.com/grpc/grpc-java)
        * io.grpc:grpc-protobuf-nano (io.grpc:grpc-protobuf-nano:1.0.1
- https://github.com/grpc/grpc-java)
        * io.grpc:grpc-stub (io.grpc:grpc-stub:1.0.1 - https://
github.com/grpc/grpc-java)
        * ANTLR 3 Runtime (org.antlr:antlr-runtime:3.5.2 - http://
www.antlr.org)
        * Hamcrest (org.hamcrest:hamcrest:2.1 - http://hamcrest.org/
JavaHamcrest/)
        * asm (org.ow2.asm:asm:7.1 - http://asm.ow2.org/)
        * asm-analysis (org.ow2.asm:asm-analysis:7.1 - http://
asm.ow2.org/)
        * asm-commons (org.ow2.asm:asm-commons:7.1 - http://
asm.ow2.org/)
        * asm-tree (org.ow2.asm:asm-tree:7.1 - http://asm.ow2.org/)
        * ASM Util (org.ow2.asm:asm-util:5.0.3 - http://
asm.objectweb.org/asm-util/)
        * ThreeTen backport (org.threeten:threetenbp:1.3.3 - https://
www.threeten.org/threetenbp)
        * Google Auth Library for Java - Credentials
(com.google.auth:google-auth-library-credentials:0.6.1 - https://
github.com/google/google-auth-library-java/google-auth-library-
credentials)
        * Google Auth Library for Java - OAuth2 HTTP
(com.google.auth:google-auth-library-oauth2-http:0.6.1 - https://
github.com/google/google-auth-library-java/google-auth-library-oauth2-
        * Protocol Buffers [Core] (com.google.protobuf:protobuf-
java:3.0.2 - https://developers.google.com/protocol-buffers/protobuf-
java/)
        * Protocol Buffers [Core] (com.google.protobuf:protobuf-
java:3.2.0 - https://developers.google.com/protocol-buffers/protobuf-
java/)
        * Protocol Buffers [Util] (com.google.protobuf:protobuf-java-
util:3.2.0 - https://developers.google.com/protocol-buffers/protobuf-
java-util/)
        * Protocol Buffers [Lite] (com.google.protobuf:protobuf-
lite:3.0.1 - https://developers.google.com/protocol-buffers/protobuf-
lite/)
        * Protocol Buffer JavaNano API
(com.google.protobuf.nano:protobuf-javanano:3.0.0-alpha-5 - https://
developers.google.com/protocol-buffers/)
Note: This license has also been called the "New BSD License" or
"Modified BSD License". See also the 2-clause BSD License.
Copyright
Redistribution and use in source and binary forms, with or without
```



modification, are permitted provided that the following conditions are met:

- 1. Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
- 2. Redistributions in binary form must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.
- 3. Neither the name of the copyright holder nor the names of its contributors may be used to endorse or promote products derived from this software without specific prior written permission.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL THE COPYRIGHT HOLDER OR CONTRIBUTORS BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Eclipse Public License - Version 1.0:

```
* Http Services Servlet (org.eclipse.equinox.http:servlet:1.0.0-v20070606 - no url defined)
```

- * Jetty :: ALPN :: Conscrypt Server Implementation (org.eclipse.jetty:jetty-alpn-conscrypt-server:9.4.21.v20190916 https://eclipse.org/jetty/jetty-alpn-parent/jetty-alpn-conscrypt-server)
- * Jetty :: ALPN :: OpenJDK8 Client Implementation (org.eclipse.jetty:jetty-alpn-openjdk8-client:9.4.21.v20190916 https://eclipse.org/jetty/jetty-alpn-parent/jetty-alpn-openjdk8-client)
- * Jetty :: ALPN :: OpenJDK8 Server Implementation (org.eclipse.jetty:jetty-alpn-openjdk8-server:9.4.21.v20190916 https://eclipse.org/jetty/jetty-alpn-parent/jetty-alpn-openjdk8-server)

^{*} Jetty :: Apache JSP Implementation (org.eclipse.jetty:apache-jsp:9.4.21.v20190916 - http://www.eclipse.org/jetty)

^{*} Apache :: JSTL module (org.eclipse.jetty:apache-jstl:9.4.21.v20190916 - http://tomcat.apache.org/taglibs/standard/)

^{*} Jetty :: Infinispan Session Manager Common (org.eclipse.jetty:infinispan-common:9.4.21.v20190916 - http://www.eclipse.org/jetty)

^{*} Jetty :: Infinispan Session Manager Remote (org.eclipse.jetty:infinispan-remote-query:9.4.21.v20190916 - http://www.eclipse.org/jetty)

^{*} Jetty :: ALPN :: Client (org.eclipse.jetty:jetty-alpnclient:9.4.21.v20190916 - https://eclipse.org/jetty/jetty-alpn-parent/
jetty-alpn-client)

```
* Jetty :: ALPN :: Server (org.eclipse.jetty:jetty-alpn-
server:9.4.21.v20190916 - https://eclipse.org/jetty/jetty-alpn-parent/
jetty-alpn-server)
        * Jetty :: Servlet Annotations (org.eclipse.jetty:jetty-
annotations:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Asynchronous HTTP Client (org.eclipse.jetty:jetty-
client:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Continuation (org.eclipse.jetty:jetty-
continuation:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Deployers (org.eclipse.jetty:jetty-
deploy:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Distribution Assemblies (org.eclipse.jetty:jetty-
distribution:9.4.21.v20190916 - https://eclipse.org/jetty/jetty-
distribution)
        * Jetty :: Hazelcast Session Manager (org.eclipse.jetty:jetty-
hazelcast:9.4.21.v20190916 - https://eclipse.org/jetty/jetty-hazelcast)
        * Jetty :: Http Utility (org.eclipse.jetty:jetty-
http:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: IO Utility (org.eclipse.jetty:jetty-
io:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: JAAS (org.eclipse.jetty:jetty-jaas:9.4.21.v20190916
- https://eclipse.org/jetty/jetty-jaas)
        * Jetty :: JMX Management (org.eclipse.jetty:jetty-
jmx:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: JNDI Naming (org.eclipse.jetty:jetty-
jndi:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: NoSQL Session Managers (org.eclipse.jetty:jetty-
nosql:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Plus (org.eclipse.jetty:jetty-plus:9.4.21.v20190916
- http://www.eclipse.org/jetty)
        * Jetty :: Proxy (org.eclipse.jetty:jetty-
proxy:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Quick Start (org.eclipse.jetty:jetty-
quickstart:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Rewrite Handler (org.eclipse.jetty:jetty-
rewrite:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Security (org.eclipse.jetty:jetty-
security:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Server Core (org.eclipse.jetty:jetty-
server:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Servlet Handling (org.eclipse.jetty:jetty-
servlet:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Utility Servlets and Filters
(org.eclipse.jetty:jetty-servlets:9.4.21.v20190916 - http://
www.eclipse.org/jetty)
        * Jetty :: Utilities (org.eclipse.jetty:jetty-util:9.3.0.RC0 -
http://www.eclipse.org/jetty)
        * Jetty :: Utilities (org.eclipse.jetty:jetty-
util:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Utilities :: Ajax(JSON) (org.eclipse.jetty:jetty-
util-ajax:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Webapp Application Support (org.eclipse.jetty:jetty-
webapp:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: XML utilities (org.eclipse.jetty:jetty-
xml:9.4.21.v20190916 - http://www.eclipse.org/jetty)
```

```
* Test :: Jetty Test Webapp (org.eclipse.jetty:test-jetty-
webapp:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: ALPN :: API (org.eclipse.jetty.alpn:alpn-
api:1.1.3.v20160715 - http://www.eclipse.org/jetty/alpn-api)
        * Example Async Rest :: Jar (org.eclipse.jetty.example-async-
rest:example-async-rest-jar:9.4.21.v20190916 - https://eclipse.org/
jetty/examples-parent/example-async-rest/example-async-rest-jar)
        * Jetty :: FastCGI :: Client (org.eclipse.jetty.fcqi:fcqi-
client:9.4.21.v20190916 - https://eclipse.org/jetty/fcgi-parent/fcgi-
client)
        * Jetty :: GCloud :: Session Manager
(org.eclipse.jetty.gcloud:jetty-gcloud-session-manager:9.4.21.v20190916
- https://eclipse.org/jetty/gcloud-parent/jetty-gcloud-session-manager)
        * Jetty :: HTTP2 :: Client (org.eclipse.jetty.http2:http2-
client:9.4.21.v20190916 - https://eclipse.org/jetty/http2-parent/http2-
client)
        * Jetty :: HTTP2 :: Common (org.eclipse.jetty.http2:http2-
common:9.4.21.v20190916 - https://eclipse.org/jetty/http2-parent/http2-
        * Jetty :: HTTP2 :: HPACK (org.eclipse.jetty.http2:http2-
hpack:9.4.21.v20190916 - https://eclipse.org/jetty/http2-parent/http2-
hpack)
        * Jetty :: HTTP2 :: Server (org.eclipse.jetty.http2:http2-
server:9.4.21.v20190916 - https://eclipse.org/jetty/http2-parent/http2-
server)
        * Jetty :: Memcached :: Sessions
(org.eclipse.jetty.memcached:jetty-memcached-sessions:9.4.21.v20190916
- https://eclipse.org/jetty/memcached-parent/jetty-memcached-sessions)
        * Jetty Orbit :: Activation
(org.eclipse.jetty.orbit:javax.activation:1.1.0.v201105071233 - http://
www.eclipse.org/jetty/jetty-orbit/javax.activation)
        * Jetty Orbit :: Glassfish Mail
(org.eclipse.jetty.orbit:javax.mail.glassfish:1.4.1.v201005082020 -
http://www.eclipse.org/jetty/jetty-orbit/javax.mail.glassfish)
        * Jetty Orbit :: JASPI API
(org.eclipse.jetty.orbit:javax.security.auth.message:1.0.0.v201108011116
 - http://www.eclipse.org/jetty/jetty-orbit/javax.security.auth.message)
        * Jetty Orbit :: JSP JSTL
(org.eclipse.jetty.orbit:javax.servlet.jsp.jstl:1.2.0.v201105211821 -
http://www.eclipse.org/jetty/jetty-orbit/javax.servlet.jsp.jstl)
        * Jetty :: OSGi :: Boot (org.eclipse.jetty.osgi:jetty-osgi-
boot:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty Tests :: JMX :: WebApp (org.eclipse.jetty.tests:jmx-
webapp:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Test :: CDI :: Common Demo Webapp
(org.eclipse.jetty.tests:test-cdi-common-webapp:9.4.21.v20190916 -
http://www.eclipse.org/jetty/test-cdi-common-webapp)
        * Jetty Tests :: WebApp :: Servlet Spec ::
ServletContainerInitializer Test Jar (org.eclipse.jetty.tests:test-
container-initializer:9.4.21.v20190916 - http://www.eclipse.org/jetty/
test-servlet-spec-parent/test-container-initializer)
        * Jetty Tests :: WebApp :: JNDI (org.eclipse.jetty.tests:test-
jndi-webapp:9.4.21.v20190916 - http://www.eclipse.org/jetty/test-jndi-
webapp)
        * Jetty Tests :: WebApp :: Mock Resources
```

```
(org.eclipse.jetty.tests:test-mock-resources:9.4.21.v20190916 - http://
www.eclipse.org/jetty/test-mock-resources)
        * Jetty Tests :: Sessions :: Common
(org.eclipse.jetty.tests:test-sessions-common:9.4.21.v20190916 - http://
www.eclipse.org/jetty)
        * Jetty Tests :: Webapps :: Spec Webapp
(org.eclipse.jetty.tests:test-spec-webapp:9.4.21.v20190916 - http://
www.eclipse.org/jetty/test-servlet-spec-parent/test-spec-webapp)
        * Jetty Tests :: WebApp :: Servlet Spec :: Fragment Jar
(org.eclipse.jetty.tests:test-web-fragment:9.4.21.v20190916 - http://
www.eclipse.org/jetty/test-servlet-spec-parent/test-web-fragment)
        * Jetty :: Servlet API and Schemas for OSGi
(org.eclipse.jetty.toolchain:jetty-osgi-servlet-api:3.1.0.M3 - http://
www.eclipse.org/jetty/jetty-toolchain/jetty-osgi-servlet-api)
        * Jetty :: Schemas (org.eclipse.jetty.toolchain:jetty-
schemas:3.1.2 - https://eclipse.org/jetty/jetty-schemas)
        * Jetty Toolchain :: Test Helper
(org.eclipse.jetty.toolchain:jetty-test-helper:5.3 - https://
eclipse.org/jetty/jetty-test-helper)
        * Jetty :: Websocket :: javax.websocket :: Client
Implementation (org.eclipse.jetty.websocket:javax-websocket-client-
impl:9.4.21.v20190916 - http://www.eclipse.org/jetty/javax-websocket-
client-impl)
        * Jetty :: Websocket :: javax.websocket.server :: Server
Implementation (org.eclipse.jetty.websocket:javax-websocket-server-
impl:9.4.21.v20190916 - http://www.eclipse.org/jetty/javax-websocket-
server-impl)
        * Jetty :: Websocket :: API
(org.eclipse.jetty.websocket:websocket-api:9.4.21.v20190916 - http://
www.eclipse.org/jetty/websocket-api)
        * Jetty :: Websocket :: Client
(org.eclipse.jetty.websocket:websocket-client:9.4.21.v20190916 - http://
www.eclipse.org/jetty/websocket-client)
        * Jetty :: Websocket :: Common
(org.eclipse.jetty.websocket:websocket-common:9.4.21.v20190916 - http://
www.eclipse.org/jetty/websocket-common)
        * Jetty :: Websocket :: Server
(org.eclipse.jetty.websocket:websocket-server:9.4.21.v20190916 - http://
www.eclipse.org/jetty/websocket-server)
        * Jetty :: Websocket :: Servlet Interface
(org.eclipse.jetty.websocket:websocket-servlet:9.4.21.v20190916 -
http://www.eclipse.org/jetty/websocket-servlet)
        * org.eclipse.osgi
(org.eclipse.osgi:org.eclipse.osgi:3.6.0.v20100517 - http://
www.eclipse.org/org.eclipse.osgi)
        * org.eclipse.osgi.services
(org.eclipse.osgi:org.eclipse.osgi.services:3.2.100.v20100503 - http://
www.eclipse.org/org.eclipse.osgi.services)
        * org.eclipse.sisu.inject
(org.eclipse.sisu:org.eclipse.sisu.inject:0.3.3 - http://
www.eclipse.org/sisu/org.eclipse.sisu.inject/)
        * org.eclipse.sisu.plexus
(org.eclipse.sisu:org.eclipse.sisu.plexus:0.3.3 - http://
www.eclipse.org/sisu/org.eclipse.sisu.plexus/)
```

See above for Eclipse Public License - v 1.0

=========

Eclipse Public License - v 2.0:

- * jnr-posix (com.github.jnr:jnr-posix:3.0.47 http://
 nexus.sonatype.org/oss-repository-hosting.html/jnr-posix)
- * Eclipse Compiler for Java(TM) (org.eclipse.jdt:ecj:3.17.0 http://www.eclipse.org/jdt)

Eclipse Public License - v 2.0

THE ACCOMPANYING PROGRAM IS PROVIDED UNDER THE TERMS OF THIS ECLIPSE PUBLIC LICENSE ("AGREEMENT"). ANY USE, REPRODUCTION OR DISTRIBUTION OF THE PROGRAM CONSTITUTES RECIPIENT'S ACCEPTANCE OF THIS AGREEMENT.

1. DEFINITIONS

"Contribution" means:

- a) in the case of the initial Contributor, the initial content Distributed under this Agreement, and
 - b) in the case of each subsequent Contributor:
 - i) changes to the Program, and
 - ii) additions to the Program;

where such changes and/or additions to the Program originate from and are Distributed by that particular Contributor. A Contribution "originates" from a Contributor if it was added to the Program by such Contributor itself or anyone acting on such Contributor's behalf. Contributions do not include changes or additions to the Program that are not Modified Works.

"Contributor" means any person or entity that Distributes the Program.

"Licensed Patents" mean patent claims licensable by a Contributor which are necessarily infringed by the use or sale of its Contribution alone or when combined with the Program.

"Program" means the Contributions Distributed in accordance with this Agreement.

"Recipient" means anyone who receives the Program under this Agreement or any Secondary License (as applicable), including Contributors.

"Derivative Works" shall mean any work, whether in Source Code or other form, that is based on (or derived from) the Program and for which the editorial revisions, annotations, elaborations, or other modifications represent, as a whole, an original work of authorship.

"Modified Works" shall mean any work in Source Code or other form that results from an addition to, deletion from, or modification of the



contents of the Program, including, for purposes of clarity any new file in Source Code form that contains any contents of the Program. Modified Works shall not include works that contain only declarations, interfaces, types, classes, structures, or files of the Program solely in each case in order to link to, bind by name, or subclass the Program or Modified Works thereof.

"Distribute" means the acts of a) distributing or b) making available in any manner that enables the transfer of a copy.

"Source Code" means the form of a Program preferred for making modifications, including but not limited to software source code, documentation source, and configuration files.

"Secondary License" means either the GNU General Public License, Version 2.0, or any later versions of that license, including any exceptions or additional permissions as identified by the initial Contributor.

2. GRANT OF RIGHTS

- a) Subject to the terms of this Agreement, each Contributor hereby grants Recipient a non-exclusive, worldwide, royalty-free copyright license to reproduce, prepare Derivative Works of, publicly display, publicly perform, Distribute and sublicense the Contribution of such Contributor, if any, and such Derivative Works.
- b) Subject to the terms of this Agreement, each Contributor hereby grants Recipient a non-exclusive, worldwide, royalty-free patent license under Licensed Patents to make, use, sell, offer to sell, import and otherwise transfer the Contribution of such Contributor, if any, in Source Code or other form. This patent license shall apply to the combination of the Contribution and the Program if, at the time the Contribution is added by the Contributor, such addition of the Contribution causes such combination to be covered by the Licensed Patents. The patent license shall not apply to any other combinations which include the Contribution. No hardware per se is licensed hereunder.
- c) Recipient understands that although each Contributor grants the licenses to its Contributions set forth herein, no assurances are provided by any Contributor that the Program does not infringe the patent or other intellectual property rights of any other entity. Each Contributor disclaims any liability to Recipient for claims brought by any other entity based on infringement of intellectual property rights or otherwise. As a condition to exercising the rights and licenses granted hereunder, each Recipient hereby assumes sole responsibility to secure any other intellectual property rights needed, if any. For example, if a third party patent license is required to allow Recipient to Distribute the Program, it is Recipient's responsibility to acquire that license before distributing the Program.
- d) Each Contributor represents that to its knowledge it has sufficient copyright rights in its Contribution, if any, to grant the copyright license set forth in this Agreement.
- e) Notwithstanding the terms of any Secondary License, no Contributor makes additional grants to any Recipient (other than those set forth in this Agreement) as a result of such Recipient's receipt of the Program under the terms of a Secondary License (if permitted under the terms of Section 3).



3. REOUIREMENTS

- b) the Contributor may Distribute the Program under a license different than this Agreement, provided that such license:
- i) effectively disclaims on behalf of all other Contributors all warranties and conditions, express and implied, including warranties or conditions of title and non-infringement, and implied warranties or conditions of merchantability and fitness for a particular purpose;
- ii) effectively excludes on behalf of all other Contributors all liability for damages, including direct, indirect, special, incidental and consequential damages, such as lost profits;
- iii) does not attempt to limit or alter the recipients' rights in the Source Code under section 3.2; and
- iv) requires any subsequent distribution of the Program by any party to be under a license that satisfies the requirements of this section 3.
 - 3.2 When the Program is Distributed as Source Code:
- a) it must be made available under this Agreement, or if the Program (i) is combined with other material in a separate file or files made available under a Secondary License, and (ii) the initial Contributor attached to the Source Code the notice described in Exhibit A of this Agreement, then the Program may be made available under the terms of such Secondary Licenses, and
- $\,$ b) a copy of this Agreement must be included with each copy of the Program.
- 3.3 Contributors may not remove or alter any copyright, patent, trademark, attribution notices, disclaimers of warranty, or limitations of liability ("notices") contained within the Program from any copy of the Program which they Distribute, provided that Contributors may add their own appropriate notices.

4. COMMERCIAL DISTRIBUTION

Commercial distributors of software may accept certain responsibilities with respect to end users, business partners and the like. While this license is intended to facilitate the commercial use of the Program, the Contributor who includes the Program in a commercial product offering should do so in a manner which does not create potential liability for other Contributors. Therefore, if a Contributor includes the Program in a commercial product offering, such Contributor ("Commercial Contributor") hereby agrees to defend and indemnify every other Contributor ("Indemnified Contributor") against any losses, damages and costs (collectively "Losses") arising from claims, lawsuits and other legal actions brought by a third party against the Indemnified Contributor to the extent caused by the acts or omissions of such Commercial Contributor in connection with its distribution of the Program in a commercial product offering. The obligations in this section do not apply to any claims or Losses relating to any actual or alleged intellectual property infringement.



In order to qualify, an Indemnified Contributor must: a) promptly notify the Commercial Contributor in writing of such claim, and b) allow the Commercial Contributor to control, and cooperate with the Commercial Contributor in, the defense and any related settlement negotiations. The Indemnified Contributor may participate in any such claim at its own expense.

For example, a Contributor might include the Program in a commercial product offering, Product X. That Contributor is then a Commercial Contributor. If that Commercial Contributor then makes performance claims, or offers warranties related to Product X, those performance claims and warranties are such Commercial Contributor's responsibility alone. Under this section, the Commercial Contributor would have to defend claims against the other Contributors related to those performance claims and warranties, and if a court requires any other Contributor to pay any damages as a result, the Commercial Contributor must pay those damages.

5. NO WARRANTY

EXCEPT AS EXPRESSLY SET FORTH IN THIS AGREEMENT, AND TO THE EXTENT PERMITTED BY APPLICABLE LAW, THE PROGRAM IS PROVIDED ON AN "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, EITHER EXPRESS OR IMPLIED INCLUDING, WITHOUT LIMITATION, ANY WARRANTIES OR CONDITIONS OF TITLE, NON-INFRINGEMENT, MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. Each Recipient is solely responsible for determining the appropriateness of using and distributing the Program and assumes all risks associated with its exercise of rights under this Agreement, including but not limited to the risks and costs of program errors, compliance with applicable laws, damage to or loss of data, programs or equipment, and unavailability or interruption of operations.

6. DISCLAIMER OF LIABILITY

EXCEPT AS EXPRESSLY SET FORTH IN THIS AGREEMENT, AND TO THE EXTENT PERMITTED BY APPLICABLE LAW, NEITHER RECIPIENT NOR ANY CONTRIBUTORS SHALL HAVE ANY LIABILITY FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING WITHOUT LIMITATION LOST PROFITS), HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OR DISTRIBUTION OF THE PROGRAM OR THE EXERCISE OF ANY RIGHTS GRANTED HEREUNDER, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

7. GENERAL

If any provision of this Agreement is invalid or unenforceable under applicable law, it shall not affect the validity or enforceability of the remainder of the terms of this Agreement, and without further action by the parties hereto, such provision shall be reformed to the minimum extent necessary to make such provision valid and enforceable.

If Recipient institutes patent litigation against any entity (including a cross-claim or counterclaim in a lawsuit) alleging that the Program itself (excluding combinations of the Program with other software or hardware) infringes such Recipient's patent(s), then such Recipient's rights granted under Section 2(b) shall terminate as of the



date such litigation is filed.

All Recipient's rights under this Agreement shall terminate if it fails to comply with any of the material terms or conditions of this Agreement and does not cure such failure in a reasonable period of time after becoming aware of such noncompliance. If all Recipient's rights under this Agreement terminate, Recipient agrees to cease use and distribution of the Program as soon as reasonably practicable. However, Recipient's obligations under this Agreement and any licenses granted by Recipient relating to the Program shall continue and survive.

Everyone is permitted to copy and distribute copies of this Agreement, but in order to avoid inconsistency the Agreement is copyrighted and may only be modified in the following manner. The Agreement Steward reserves the right to publish new versions (including revisions) of this Agreement from time to time. No one other than the Agreement Steward has the right to modify this Agreement. The Eclipse Foundation is the initial Agreement Steward. The Eclipse Foundation may assign the responsibility to serve as the Agreement Steward to a suitable separate entity. Each new version of the Agreement will be given a distinguishing version number. The Program (including Contributions) may always be Distributed subject to the version of the Agreement under which it was received. In addition, after a new version of the Agreement is published, Contributor may elect to Distribute the Program (including its Contributions) under the new version.

Except as expressly stated in Sections 2(a) and 2(b) above, Recipient receives no rights or licenses to the intellectual property of any Contributor under this Agreement, whether expressly, by implication, estoppel or otherwise. All rights in the Program not expressly granted under this Agreement are reserved. Nothing in this Agreement is intended to be enforceable by any entity that is not a Contributor or Recipient. No third-party beneficiary rights are created under this Agreement.

Exhibit A - Form of Secondary Licenses Notice

"This Source Code may also be made available under the following Secondary Licenses when the conditions for such availability set forth in the Eclipse Public License, v. 2.0 are satisfied: $\{name\ license(s),\ version(s),\ and\ exceptions\ or\ additional\ permissions\ here\}.$ "

Simply including a copy of this Agreement, including this Exhibit A is not sufficient to license the Source Code under Secondary Licenses.

If it is not possible or desirable to put the notice in a particular file, then You may include the notice in a location (such as a LICENSE file in a relevant directory) where a recipient would be likely to look for such a notice.

You may add additional accurate notices of copyright ownership.

 	-	 	 _	 	_	 	_		 	-	_	_	_		 	 _	_	_	_	 	 -	_	 	 _	 	 _	 	_	 	_	 	 	 -	 	 	_
 		 	 _	 	_	 	_	_	 		_	_	_	_	 	 -	_	_	_	 	 -	_	 	 _	 	 _	 	_	 	_	 	 	 . —	 	 _	_



GNU General Public License Version 2:

- * jnr-posix (com.github.jnr:jnr-posix:3.0.47 http://
 nexus.sonatype.org/oss-repository-hosting.html/jnr-posix)
- * Checker Qual (org.checkerframework:checker-compat-qual:2.0.0 http://checkerframework.org)

GNU GENERAL PUBLIC LICENSE Version 2, June 1991

Copyright (C) 1989, 1991 Free Software Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

Preamble

The licenses for most software are designed to take away your freedom to share and change it. By contrast, the GNU General Public License is intended to guarantee your freedom to share and change free software—to make sure the software is free for all its users. This General Public License applies to most of the Free Software Foundation's software and to any other program whose authors commit to using it. (Some other Free Software Foundation software is covered by the GNU Lesser General Public License instead.) You can apply it to your programs, too.

When we speak of free software, we are referring to freedom, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for this service if you wish), that you receive source code or can get it if you want it, that you can change the software or use pieces of it in new free programs; and that you know you can do these things.

To protect your rights, we need to make restrictions that forbid anyone to deny you these rights or to ask you to surrender the rights. These restrictions translate to certain responsibilities for you if you distribute copies of the software, or if you modify it.

For example, if you distribute copies of such a program, whether gratis or for a fee, you must give the recipients all the rights that you have. You must make sure that they, too, receive or can get the source code. And you must show them these terms so they know their rights.

We protect your rights with two steps: (1) copyright the software, and (2) offer you this license which gives you legal permission to copy, distribute and/or modify the software.

Also, for each author's protection and ours, we want to make certain that everyone understands that there is no warranty for this free software. If the software is modified by someone else and passed on, we want its recipients to know that what they have is not the original, so that any problems introduced by others will not reflect on the original



authors' reputations.

Finally, any free program is threatened constantly by software patents. We wish to avoid the danger that redistributors of a free program will individually obtain patent licenses, in effect making the program proprietary. To prevent this, we have made it clear that any patent must be licensed for everyone's free use or not licensed at all.

The precise terms and conditions for copying, distribution and modification follow.

GNU GENERAL PUBLIC LICENSE

TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION

O. This License applies to any program or other work which contains a notice placed by the copyright holder saying it may be distributed under the terms of this General Public License. The "Program", below, refers to any such program or work, and a "work based on the Program" means either the Program or any derivative work under copyright law: that is to say, a work containing the Program or a portion of it, either verbatim or with modifications and/or translated into another language. (Hereinafter, translation is included without limitation in the term "modification".) Each licensee is addressed as "you".

Activities other than copying, distribution and modification are not covered by this License; they are outside its scope. The act of running the Program is not restricted, and the output from the Program is covered only if its contents constitute a work based on the Program (independent of having been made by running the Program). Whether that is true depends on what the Program does.

1. You may copy and distribute verbatim copies of the Program's source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice and disclaimer of warranty; keep intact all the notices that refer to this License and to the absence of any warranty; and give any other recipients of the Program a copy of this License along with the Program.

You may charge a fee for the physical act of transferring a copy, and you may at your option offer warranty protection in exchange for a fee.

- 2. You may modify your copy or copies of the Program or any portion of it, thus forming a work based on the Program, and copy and distribute such modifications or work under the terms of Section 1 above, provided that you also meet all of these conditions:
 - a) You must cause the modified files to carry prominent notices stating that you changed the files and the date of any change.
 - b) You must cause any work that you distribute or publish, that in whole or in part contains or is derived from the Program or any part thereof, to be licensed as a whole at no charge to all third parties under the terms of this License.



c) If the modified program normally reads commands interactively when run, you must cause it, when started running for such interactive use in the most ordinary way, to print or display an announcement including an appropriate copyright notice and a notice that there is no warranty (or else, saying that you provide a warranty) and that users may redistribute the program under these conditions, and telling the user how to view a copy of this License. (Exception: if the Program itself is interactive but does not normally print such an announcement, your work based on the Program is not required to print an announcement.)

These requirements apply to the modified work as a whole. If identifiable sections of that work are not derived from the Program, and can be reasonably considered independent and separate works in themselves, then this License, and its terms, do not apply to those sections when you distribute them as separate works. But when you distribute the same sections as part of a whole which is a work based on the Program, the distribution of the whole must be on the terms of this License, whose permissions for other licensees extend to the entire whole, and thus to each and every part regardless of who wrote it.

Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Program.

In addition, mere aggregation of another work not based on the Program with the Program (or with a work based on the Program) on a volume of a storage or distribution medium does not bring the other work under the scope of this License.

- 3. You may copy and distribute the Program (or a work based on it, under Section 2) in object code or executable form under the terms of Sections 1 and 2 above provided that you also do one of the following:
- a) Accompany it with the complete corresponding machine-readable source code, which must be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange; or,
 - b) Accompany it with a written offer, valid for at least three years, to give any third party, for a charge no more than your cost of physically performing source distribution, a complete machine-readable copy of the corresponding source code, to be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange; or,
 - c) Accompany it with the information you received as to the offer to distribute corresponding source code. (This alternative is allowed only for noncommercial distribution and only if you received the program in object code or executable form with such an offer, in accord with Subsection b above.)

The source code for a work means the preferred form of the work for



making modifications to it. For an executable work, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the executable. However, as a special exception, the source code distributed need not include anything that is normally distributed (in either source or binary form) with the major components (compiler, kernel, and so on) of the operating system on which the executable runs, unless that component itself accompanies the executable.

If distribution of executable or object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place counts as distribution of the source code, even though third parties are not compelled to copy the source along with the object code.

- 4. You may not copy, modify, sublicense, or distribute the Program except as expressly provided under this License. Any attempt otherwise to copy, modify, sublicense or distribute the Program is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.
- 5. You are not required to accept this License, since you have not signed it. However, nothing else grants you permission to modify or distribute the Program or its derivative works. These actions are prohibited by law if you do not accept this License. Therefore, by modifying or distributing the Program (or any work based on the Program), you indicate your acceptance of this License to do so, and all its terms and conditions for copying, distributing or modifying the Program or works based on it.
- 6. Each time you redistribute the Program (or any work based on the Program), the recipient automatically receives a license from the original licensor to copy, distribute or modify the Program subject to these terms and conditions. You may not impose any further restrictions on the recipients' exercise of the rights granted herein. You are not responsible for enforcing compliance by third parties to this License.
- 7. If, as a consequence of a court judgment or allegation of patent infringement or for any other reason (not limited to patent issues), conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot distribute so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you may not distribute the Program at all. For example, if a patent license would not permit royalty-free redistribution of the Program by all those who receive copies directly or indirectly through you, then the only way you could satisfy both it and this License would be to refrain entirely from distribution of the Program.

If any portion of this section is held invalid or unenforceable under



any particular circumstance, the balance of the section is intended to apply and the section as a whole is intended to apply in other circumstances.

It is not the purpose of this section to induce you to infringe any patents or other property right claims or to contest validity of any such claims; this section has the sole purpose of protecting the integrity of the free software distribution system, which is implemented by public license practices. Many people have made generous contributions to the wide range of software distributed through that system in reliance on consistent application of that system; it is up to the author/donor to decide if he or she is willing to distribute software through any other system and a licensee cannot impose that choice.

This section is intended to make thoroughly clear what is believed to be a consequence of the rest of this License.

- 8. If the distribution and/or use of the Program is restricted in certain countries either by patents or by copyrighted interfaces, the original copyright holder who places the Program under this License may add an explicit geographical distribution limitation excluding those countries, so that distribution is permitted only in or among countries not thus excluded. In such case, this License incorporates the limitation as if written in the body of this License.

of the General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Program specifies a version number of this License which applies to it and "any later version", you have the option of following the terms and conditions

either of that version or of any later version published by the Free Software Foundation. If the Program does not specify a version number of

this License, you may choose any version ever published by the Free Software $\,$

Foundation.

10. If you wish to incorporate parts of the Program into other free programs whose distribution conditions are different, write to the author

to ask for permission. For software which is copyrighted by the Free Software Foundation, write to the Free Software Foundation; we sometimes make exceptions for this. Our decision will be guided by the two goals of preserving the free status of all derivatives of our free software and

of promoting the sharing and reuse of software generally.

NO WARRANTY



11. BECAUSE THE PROGRAM IS LICENSED FREE OF CHARGE, THERE IS NO WARRANTY

FOR THE PROGRAM, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE PROGRAM "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED

OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS

TO THE QUALITY AND PERFORMANCE OF THE PROGRAM IS WITH YOU. SHOULD THE PROGRAM PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.

12. IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING

WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MAY MODIFY AND/OR REDISTRIBUTE THE PROGRAM AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES,

INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARTSING

OUT OF THE USE OR INABILITY TO USE THE PROGRAM (INCLUDING BUT NOT LIMITED

TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE PROGRAM TO OPERATE WITH ANY OTHER

PROGRAMS), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

END OF TERMS AND CONDITIONS

How to Apply These Terms to Your New Programs

If you develop a new program, and you want it to be of the greatest possible use to the public, the best way to achieve this is to make it free software which everyone can redistribute and change under these terms.

To do so, attach the following notices to the program. It is safest to attach them to the start of each source file to most effectively convey the exclusion of warranty; and each file should have at least the "copyright" line and a pointer to where the full notice is found.

Copyright (C)

This program is free software; you can redistribute it and/or modify it under the terms of the GNU General Public License as published by the Free Software Foundation; either version 2 of the License, or (at your option) any later version.

This program is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU General Public License for more details.



You should have received a copy of the GNU General Public License along

with this program; if not, write to the Free Software Foundation, $\operatorname{Inc.}$,

51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA.

Also add information on how to contact you by electronic and paper mail.

If the program is interactive, make it output a short notice like this when it starts in an interactive mode:

Gnomovision version 69, Copyright (C) year name of author Gnomovision comes with ABSOLUTELY NO WARRANTY; for details type show w'

This is free software, and you are welcome to redistribute it under certain conditions; type `show c' for details.

The hypothetical commands `show w' and `show c' should show the appropriate

parts of the General Public License. Of course, the commands you use may

be called something other than `show w' and `show c'; they could even be mouse-clicks or menu items--whatever suits your program.

You should also get your employer (if you work as a programmer) or your school, if any, to sign a "copyright disclaimer" for the program, if necessary. Here is a sample; alter the names:

Yoyodyne, Inc., hereby disclaims all copyright interest in the program `Gnomovision' (which makes passes at compilers) written by James Hacker.

, 1 April 1989 Ty Coon, President of Vice

This General Public License does not permit incorporating your program into

proprietary programs. If your program is a subroutine library, you may consider it more useful to permit linking proprietary applications with the

library. If this is what you want to do, use the GNU Lesser General Public License instead of this License.

GNU Lesser General Public License (LGPL), Version 2.1:

- * jnr-posix (com.github.jnr:jnr-posix:3.0.47 http://
 nexus.sonatype.org/oss-repository-hosting.html/jnr-posix)
- * Hibernate Search Engine (org.hibernate:hibernate-search-engine:5.10.3.Final http://search.hibernate.org/hibernate-search-engine)
- * Hibernate Search Avro Serialization (org.hibernate:hibernate-search-serialization-avro:5.10.3.Final http://search.hibernate.org/



hibernate-search-serialization-avro)

* Hibernate Commons Annotations (org.hibernate.common:hibernate-commons-annotations:5.0.4.Final - http://hibernate.org)

GNU LESSER GENERAL PUBLIC LICENSE Version 2.1, February 1999

Copyright (C) 1991, 1999 Free Software Foundation, Inc. 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA Everyone is permitted to copy and distribute verbatim copies of this license document, but changing it is not allowed.

[This is the first released version of the Lesser GPL. It also counts as the successor of the GNU Library Public License, version 2, hence the version number 2.1.]

Preamble

The licenses for most software are designed to take away your freedom to share and change it. By contrast, the GNU General Public Licenses are intended to guarantee your freedom to share and change free software—to make sure the software is free for all its users.

This license, the Lesser General Public License, applies to some specially designated software packages—typically libraries—of the Free Software Foundation and other authors who decide to use it. You can use it too, but we suggest you first think carefully about whether this license or the ordinary General Public License is the better strategy to use in any particular case, based on the explanations below.

When we speak of free software, we are referring to freedom of use, not price. Our General Public Licenses are designed to make sure that you have the freedom to distribute copies of free software (and charge for this service if you wish); that you receive source code or can get it if you want it; that you can change the software and use pieces of it in new free programs; and that you are informed that you can do these things.

To protect your rights, we need to make restrictions that forbid distributors to deny you these rights or to ask you to surrender these rights. These restrictions translate to certain responsibilities for you if you distribute copies of the library or if you modify it.

For example, if you distribute copies of the library, whether gratis or for a fee, you must give the recipients all the rights that we gave you. You must make sure that they, too, receive or can get the source code. If you link other code with the library, you must provide complete object files to the recipients, so that they can relink them with the library after making changes to the library and recompiling it. And you must show them these terms so they know their rights.

We protect your rights with a two-step method: (1) we copyright the library, and (2) we offer you this license, which gives you legal permission to copy, distribute and/or modify the library.



To protect each distributor, we want to make it very clear that there is no warranty for the free library. Also, if the library is modified by someone else and passed on, the recipients should know that what they have is not the original version, so that the original author's reputation will not be affected by problems that might be introduced by others.

Finally, software patents pose a constant threat to the existence of any free program. We wish to make sure that a company cannot effectively restrict the users of a free program by obtaining a restrictive license from a patent holder. Therefore, we insist that any patent license obtained for a version of the library must be consistent with the full freedom of use specified in this license.

Most GNU software, including some libraries, is covered by the ordinary GNU General Public License. This license, the GNU Lesser General Public License, applies to certain designated libraries, and is quite different from the ordinary General Public License. We use this license for certain libraries in order to permit linking those libraries into non-free programs.

When a program is linked with a library, whether statically or using a shared library, the combination of the two is legally speaking a combined work, a derivative of the original library. The ordinary General Public License therefore permits such linking only if the entire combination fits its criteria of freedom. The Lesser General Public License permits more lax criteria for linking other code with the library.

We call this license the "Lesser" General Public License because it does Less to protect the user's freedom than the ordinary General Public License. It also provides other free software developers Less of an advantage over competing non-free programs. These disadvantages are the reason we use the ordinary General Public License for many libraries. However, the Lesser license provides advantages in certain special circumstances.

For example, on rare occasions, there may be a special need to encourage the widest possible use of a certain library, so that it becomes

a de-facto standard. To achieve this, non-free programs must be allowed to use the library. A more frequent case is that a free library does the same job as widely used non-free libraries. In this case, there is little to gain by limiting the free library to free software only, so we use the Lesser General Public License.

In other cases, permission to use a particular library in non-free programs enables a greater number of people to use a large body of free software. For example, permission to use the GNU C Library in non-free programs enables many more people to use the whole GNU operating system, as well as its variant, the GNU/Linux operating system.

Although the Lesser General Public License is Less protective of the users' freedom, it does ensure that the user of a program that is



linked with the Library has the freedom and the wherewithal to run that program using a modified version of the Library.

The precise terms and conditions for copying, distribution and modification follow. Pay close attention to the difference between a "work based on the library" and a "work that uses the library". The former contains code derived from the library, whereas the latter must be combined with the library in order to run. \u0000C

GNU LESSER GENERAL PUBLIC LICENSE
TERMS AND CONDITIONS FOR COPYING, DISTRIBUTION AND MODIFICATION

O. This License Agreement applies to any software library or other program which contains a notice placed by the copyright holder or other authorized party saying it may be distributed under the terms of this Lesser General Public License (also called "this License"). Each licensee is addressed as "you".

A "library" means a collection of software functions and/or data prepared so as to be conveniently linked with application programs (which use some of those functions and data) to form executables.

The "Library", below, refers to any such software library or work which has been distributed under these terms. A "work based on the Library" means either the Library or any derivative work under copyright law: that is to say, a work containing the Library or a portion of it, either verbatim or with modifications and/or translated straightforwardly into another language. (Hereinafter, translation is included without limitation in the term "modification".)

"Source code" for a work means the preferred form of the work for making modifications to it. For a library, complete source code means all the source code for all modules it contains, plus any associated interface definition files, plus the scripts used to control compilation and installation of the library.

Activities other than copying, distribution and modification are not covered by this License; they are outside its scope. The act of running a program using the Library is not restricted, and output from such a program is covered only if its contents constitute a work based on the Library (independent of the use of the Library in a tool for writing it). Whether that is true depends on what the Library does and what the program that uses the Library does.

1. You may copy and distribute verbatim copies of the Library's complete source code as you receive it, in any medium, provided that you conspicuously and appropriately publish on each copy an appropriate copyright notice and disclaimer of warranty; keep intact all the notices that refer to this License and to the absence of any warranty; and distribute a copy of this License along with the Library.

You may charge a fee for the physical act of transferring a copy, and you may at your option offer warranty protection in exchange for a fee.



\u000C

- 2. You may modify your copy or copies of the Library or any portion of it, thus forming a work based on the Library, and copy and distribute such modifications or work under the terms of Section 1 above, provided that you also meet all of these conditions:
 - a) The modified work must itself be a software library.
 - b) You must cause the files modified to carry prominent notices stating that you changed the files and the date of any change.
 - c) You must cause the whole of the work to be licensed at no charge to all third parties under the terms of this License.
 - d) If a facility in the modified Library refers to a function or a table of data to be supplied by an application program that uses the facility, other than as an argument passed when the facility is invoked, then you must make a good faith effort to ensure that, in the event an application does not supply such function or table, the facility still operates, and performs whatever part of its purpose remains meaningful.

(For example, a function in a library to compute square roots has a purpose that is entirely well-defined independent of the application. Therefore, Subsection 2d requires that any application-supplied function or table used by this function must be optional: if the application does not supply it, the square root function must still compute square roots.)

These requirements apply to the modified work as a whole. If identifiable sections of that work are not derived from the Library, and can be reasonably considered independent and separate works in themselves, then this License, and its terms, do not apply to those sections when you distribute them as separate works. But when you distribute the same sections as part of a whole which is a work based on the Library, the distribution of the whole must be on the terms of this License, whose permissions for other licensees extend to the entire whole, and thus to each and every part regardless of who wrote it.

Thus, it is not the intent of this section to claim rights or contest your rights to work written entirely by you; rather, the intent is to exercise the right to control the distribution of derivative or collective works based on the Library.

In addition, mere aggregation of another work not based on the Library with the Library (or with a work based on the Library) on a volume of a storage or distribution medium does not bring the other work under the scope of this License.

3. You may opt to apply the terms of the ordinary GNU General Public License instead of this License to a given copy of the Library. To do this, you must alter all the notices that refer to this License, so that they refer to the ordinary GNU General Public License, version 2, instead of to this License. (If a newer version than version 2 of the



ordinary GNU General Public License has appeared, then you can specify that version instead if you wish.) Do not make any other change in these notices.

\u000C

Once this change is made in a given copy, it is irreversible for that copy, so the ordinary GNU General Public License applies to all subsequent copies and derivative works made from that copy.

This option is useful when you wish to copy part of the code of the Library into a program that is not a library.

4. You may copy and distribute the Library (or a portion or derivative of it, under Section 2) in object code or executable form under the terms of Sections 1 and 2 above provided that you accompany it with the complete corresponding machine-readable source code, which must be distributed under the terms of Sections 1 and 2 above on a medium customarily used for software interchange.

If distribution of object code is made by offering access to copy from a designated place, then offering equivalent access to copy the source code from the same place satisfies the requirement to distribute the source code, even though third parties are not compelled to copy the source along with the object code.

5. A program that contains no derivative of any portion of the Library, but is designed to work with the Library by being compiled or linked with it, is called a "work that uses the Library". Such a work, in isolation, is not a derivative work of the Library, and therefore falls outside the scope of this License.

However, linking a "work that uses the Library" with the Library creates an executable that is a derivative of the Library (because it contains portions of the Library), rather than a "work that uses the library". The executable is therefore covered by this License. Section 6 states terms for distribution of such executables.

When a "work that uses the Library" uses material from a header file that is part of the Library, the object code for the work may be a derivative work of the Library even though the source code is not. Whether this is true is especially significant if the work can be linked without the Library, or if the work is itself a library. The threshold for this to be true is not precisely defined by law.

If such an object file uses only numerical parameters, data structure layouts and accessors, and small macros and small inline functions (ten lines or less in length), then the use of the object file is unrestricted, regardless of whether it is legally a derivative work. (Executables containing this object code plus portions of the Library will still fall under Section 6.)

Otherwise, if the work is a derivative of the Library, you may distribute the object code for the work under the terms of Section 6. Any executables containing that work also fall under Section 6, whether or not they are linked directly with the Library itself. \u0000C



6. As an exception to the Sections above, you may also combine or link a "work that uses the Library" with the Library to produce a work containing portions of the Library, and distribute that work under terms of your choice, provided that the terms permit modification of the work for the customer's own use and reverse engineering for debugging such modifications.

You must give prominent notice with each copy of the work that the Library is used in it and that the Library and its use are covered by this License. You must supply a copy of this License. If the work during execution displays copyright notices, you must include the copyright notice for the Library among them, as well as a reference directing the user to the copy of this License. Also, you must do one of these things:

- a) Accompany the work with the complete corresponding machine-readable source code for the Library including whatever changes were used in the work (which must be distributed under Sections 1 and 2 above); and, if the work is an executable linked with the Library, with the complete machine-readable "work that uses the Library", as object code and/or source code, so that the user can modify the Library and then relink to produce a modified executable containing the modified Library. (It is understood that the user who changes the contents of definitions files in the Library will not necessarily be able to recompile the application to use the modified definitions.)
- b) Use a suitable shared library mechanism for linking with the Library. A suitable mechanism is one that (1) uses at run time a copy of the library already present on the user's computer system, rather than copying library functions into the executable, and (2) will operate properly with a modified version of the library, if the user installs one, as long as the modified version is interface-compatible with the version that the work was made with.
- c) Accompany the work with a written offer, valid for at least three years, to give the same user the materials specified in Subsection 6a, above, for a charge no more than the cost of performing this distribution.
- d) If distribution of the work is made by offering access to copy from a designated place, offer equivalent access to copy the above specified materials from the same place.
- e) Verify that the user has already received a copy of these materials or that you have already sent this user a copy.

For an executable, the required form of the "work that uses the Library" must include any data and utility programs needed for reproducing the executable from it. However, as a special exception, the materials to be distributed need not include anything that is normally distributed (in either source or binary form) with the major components (compiler, kernel, and so on) of the operating system on which the executable runs, unless that component itself accompanies the executable.



It may happen that this requirement contradicts the license restrictions of other proprietary libraries that do not normally accompany the operating system. Such a contradiction means you cannot use both them and the Library together in an executable that you distribute.

\u000C

- 7. You may place library facilities that are a work based on the Library side-by-side in a single library together with other library facilities not covered by this License, and distribute such a combined library, provided that the separate distribution of the work based on the Library and of the other library facilities is otherwise permitted, and provided that you do these two things:
 - a) Accompany the combined library with a copy of the same work based on the Library, uncombined with any other library facilities. This must be distributed under the terms of the Sections above.
 - b) Give prominent notice with the combined library of the fact that part of it is a work based on the Library, and explaining where to find the accompanying uncombined form of the same work.
- 8. You may not copy, modify, sublicense, link with, or distribute the Library except as expressly provided under this License. Any attempt otherwise to copy, modify, sublicense, link with, or distribute the Library is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.
- 9. You are not required to accept this License, since you have not signed it. However, nothing else grants you permission to modify or distribute the Library or its derivative works. These actions are prohibited by law if you do not accept this License. Therefore, by modifying or distributing the Library (or any work based on the Library), you indicate your acceptance of this License to do so, and all its terms and conditions for copying, distributing or modifying the Library or works based on it.
- 10. Each time you redistribute the Library (or any work based on the Library), the recipient automatically receives a license from the original licensor to copy, distribute, link with or modify the Library subject to these terms and conditions. You may not impose any further restrictions on the recipients' exercise of the rights granted herein. You are not responsible for enforcing compliance by third parties with this License.

\u000C

11. If, as a consequence of a court judgment or allegation of patent infringement or for any other reason (not limited to patent issues), conditions are imposed on you (whether by court order, agreement or otherwise) that contradict the conditions of this License, they do not excuse you from the conditions of this License. If you cannot distribute so as to satisfy simultaneously your obligations under this License and any other pertinent obligations, then as a consequence you



may not distribute the Library at all. For example, if a patent license would not permit royalty-free redistribution of the Library by all those who receive copies directly or indirectly through you, then the only way you could satisfy both it and this License would be to refrain entirely from distribution of the Library.

If any portion of this section is held invalid or unenforceable under any

particular circumstance, the balance of the section is intended to apply,

and the section as a whole is intended to apply in other circumstances.

It is not the purpose of this section to induce you to infringe any patents or other property right claims or to contest validity of any such claims; this section has the sole purpose of protecting the integrity of the free software distribution system which is implemented by public license practices. Many people have made generous contributions to the wide range of software distributed through that system in reliance on consistent application of that system; it is up to the author/donor to decide if he or she is willing to distribute software through any other system and a licensee cannot impose that choice.

This section is intended to make thoroughly clear what is believed to be a consequence of the rest of this License.

12. If the distribution and/or use of the Library is restricted in certain countries either by patents or by copyrighted interfaces, the original copyright holder who places the Library under this License may add

an explicit geographical distribution limitation excluding those countries,

so that distribution is permitted only in or among countries not thus excluded. In such case, this License incorporates the limitation as if written in the body of this License.

13. The Free Software Foundation may publish revised and/or new versions of the Lesser General Public License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns.

Each version is given a distinguishing version number. If the Library specifies a version number of this License which applies to it and "any later version", you have the option of following the terms and conditions either of that version or of any later version published by the Free Software Foundation. If the Library does not specify a license version number, you may choose any version ever published by the Free Software Foundation.

14. If you wish to incorporate parts of the Library into other free programs whose distribution conditions are incompatible with these, write to the author to ask for permission. For software which is copyrighted by the Free Software Foundation, write to the Free Software Foundation; we sometimes make exceptions for this. Our decision will be guided by the two goals of preserving the free status



of all derivatives of our free software and of promoting the sharing and reuse of software generally.

NO WARRANTY

15. BECAUSE THE LIBRARY IS LICENSED FREE OF CHARGE, THERE IS NO WARRANTY FOR THE LIBRARY, TO THE EXTENT PERMITTED BY APPLICABLE LAW. EXCEPT WHEN OTHERWISE STATED IN WRITING THE COPYRIGHT HOLDERS AND/OR OTHER PARTIES PROVIDE THE LIBRARY "AS IS" WITHOUT WARRANTY OF ANY KIND, EITHER EXPRESSED OR IMPLIED, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. THE ENTIRE RISK AS TO THE QUALITY AND PERFORMANCE OF THE LIBRARY IS WITH YOU. SHOULD THE LIBRARY PROVE DEFECTIVE, YOU ASSUME THE COST OF ALL NECESSARY SERVICING, REPAIR OR CORRECTION.

16. IN NO EVENT UNLESS REQUIRED BY APPLICABLE LAW OR AGREED TO IN WRITING WILL ANY COPYRIGHT HOLDER, OR ANY OTHER PARTY WHO MAY MODIFY AND/OR REDISTRIBUTE THE LIBRARY AS PERMITTED ABOVE, BE LIABLE TO YOU FOR DAMAGES, INCLUDING ANY GENERAL, SPECIAL, INCIDENTAL OR CONSEQUENTIAL DAMAGES ARISING OUT OF THE USE OR INABILITY TO USE THE LIBRARY (INCLUDING BUT NOT LIMITED TO LOSS OF DATA OR DATA BEING RENDERED INACCURATE OR LOSSES SUSTAINED BY YOU OR THIRD PARTIES OR A FAILURE OF THE LIBRARY TO OPERATE WITH ANY OTHER SOFTWARE), EVEN IF SUCH HOLDER OR OTHER PARTY HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH DAMAGES.

END OF TERMS AND CONDITIONS

\u000C

How to Apply These Terms to Your New Libraries

If you develop a new library, and you want it to be of the greatest possible use to the public, we recommend making it free software that everyone can redistribute and change. You can do so by permitting redistribution under these terms (or, alternatively, under the terms of the ordinary General Public License).

To apply these terms, attach the following notices to the library. It is

safest to attach them to the start of each source file to most effectively

convey the exclusion of warranty; and each file should have at least the "copyright" line and a pointer to where the full notice is found.

Copyright (C)

This library is free software; you can redistribute it and/or modify it under the terms of the GNU Lesser General Public License as published by the Free Software Foundation; either version 2.1 of the License, or (at your option) any later version.

This library is distributed in the hope that it will be useful, but WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY or FITNESS FOR A PARTICULAR PURPOSE. See the GNU



Lesser General Public License for more details.

You should have received a copy of the GNU Lesser General Public License along with this library; if not, write to the Free Software Foundation, Inc., 51 Franklin Street, Fifth Floor, Boston, MA 02110-1301 USA

Also add information on how to contact you by electronic and paper mail.

You should also get your employer (if you work as a programmer) or your school, if any, to sign a "copyright disclaimer" for the library, if necessary. Here is a sample; alter the names:

Yoyodyne, Inc., hereby disclaims all copyright interest in the library `Frob' (a library for tweaking knobs) written by James Random Hacker.

```
, 1 April 1990
Ty Coon, President of Vice
```

That's all there is to it!

MIT License:

* jnr-x86asm (com.github.jnr:jnr-x86asm:1.0.2 - http://
github.com/jnr/jnr-x86asm)

* JOpt Simple (net.sf.jopt-simple:jopt-simple:4.6 - http://pholser.github.com/jopt-simple)

- * Checker Qual (org.checkerframework:checker-compat-qual:2.0.0 http://checkerframework.org)
- * Animal Sniffer Annotations (org.codehaus.mojo:animal-sniffer-annotations:1.14 http://mojo.codehaus.org/animal-sniffer/animal-sniffer-annotations)
- * Animal Sniffer Annotations (org.codehaus.mojo:animal-sniffer-annotations:1.9 http://mojo.codehaus.org/animal-sniffer/animal-sniffer-annotations)
- * JCL 1.2 implemented over SLF4J (org.slf4j:jcl-over-slf4j:1.7.25 http://www.slf4j.org)
- * SLF4J API Module (org.slf4j:slf4j-api:1.7.25 http://www.slf4j.org)
- * SLF4J Simple Binding (org.slf4j:slf4j-simple:1.7.25 http://www.slf4j.org)

Copyright

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:



The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

Public Domain:

* AOP alliance (aopalliance:aopalliance:1.0 - http://aopalliance.sourceforge.net)

- * Backport of JSR 166 (backport-util-concurrent:backport-util-concurrent:3.1 http://backport-jsr166.sourceforge.net/)
- * reactive-streams (org.reactivestreams:reactive-streams:1.0.2
 http://www.reactive-streams.org/)

CREATIVE COMMONS CORPORATION IS NOT A LAW FIRM AND DOES NOT PROVIDE LEGAL SERVICES. DISTRIBUTION OF THIS DOCUMENT DOES NOT CREATE AN ATTORNEY-CLIENT RELATIONSHIP. CREATIVE COMMONS PROVIDES THIS INFORMATION ON AN "AS-IS" BASIS. CREATIVE COMMONS MAKES NO WARRANTIES REGARDING THE USE OF THIS DOCUMENT OR THE INFORMATION OR WORKS PROVIDED HEREUNDER, AND DISCLAIMS LIABILITY FOR DAMAGES RESULTING FROM THE USE OF THIS DOCUMENT OR THE INFORMATION OR WORKS PROVIDED HEREUNDER.

Statement of Purpose

The laws of most jurisdictions throughout the world automatically confer exclusive Copyright and Related Rights (defined below) upon the creator and subsequent owner(s) (each and all, an "owner") of an original work of authorship and/or a database (each, a "Work").

Certain owners wish to permanently relinquish those rights to a Work for the purpose of contributing to a commons of creative, cultural and scientific works ("Commons") that the public can reliably and without fear of later claims of infringement build upon, modify, incorporate in other works, reuse and redistribute as freely as possible in any form whatsoever and for any purposes, including without limitation commercial purposes. These owners may contribute to the Commons to promote the ideal of a free culture and the further production of creative, cultural and scientific works, or to gain reputation or greater distribution for their Work in part through the use and efforts of others.

For these and/or other purposes and motivations, and without any expectation of additional consideration or compensation, the person associating CCO with a Work (the "Affirmer"), to the extent that he or she is an owner of Copyright and Related Rights in the Work, voluntarily elects to apply CCO to the Work and publicly distribute the



Work under its terms, with knowledge of his or her Copyright and Related Rights in the Work and the meaning and intended legal effect of CCO on those rights.

1. Copyright and Related Rights. A Work made available under CCO may be protected by copyright and related or neighboring rights ("Copyright and Related Rights"). Copyright and Related Rights include, but are not limited to, the following:

the right to reproduce, adapt, distribute, perform, display, communicate, and translate a Work;

moral rights retained by the original author(s) and/or performer(s);
 publicity and privacy rights pertaining to a person's image or
likeness depicted in a Work;

rights protecting against unfair competition in regards to a Work, subject to the limitations in paragraph 4(a), below;

rights protecting the extraction, dissemination, use and reuse of data in a Work;

database rights (such as those arising under Directive 96/9/EC of the European Parliament and of the Council of 11 March 1996 on the legal protection of databases, and under any national implementation thereof, including any amended or successor version of such directive); and

other similar, equivalent or corresponding rights throughout the world based on applicable law or treaty, and any national implementations thereof.

- 2. Waiver. To the greatest extent permitted by, but not in contravention of, applicable law, Affirmer hereby overtly, fully, permanently, irrevocably and unconditionally waives, abandons, and surrenders all of Affirmer's Copyright and Related Rights and associated claims and causes of action, whether now known or unknown (including existing as well as future claims and causes of action), in the Work (i) in all territories worldwide, (ii) for the maximum duration provided by applicable law or treaty (including future time extensions), (iii) in any current or future medium and for any number of copies, and (iv) for any purpose whatsoever, including without limitation commercial, advertising or promotional purposes (the "Waiver"). Affirmer makes the Waiver for the benefit of each member of the public at large and to the detriment of Affirmer's heirs and successors, fully intending that such Waiver shall not be subject to revocation, rescission, cancellation, termination, or any other legal or equitable action to disrupt the quiet enjoyment of the Work by the public as contemplated by Affirmer's express Statement of Purpose.
- 3. Public License Fallback. Should any part of the Waiver for any reason be judged legally invalid or ineffective under applicable law, then the Waiver shall be preserved to the maximum extent permitted taking into account Affirmer's express Statement of Purpose. In addition, to the extent the Waiver is so judged Affirmer hereby grants to each affected person a royalty-free, non transferable, non sublicensable, non exclusive, irrevocable and unconditional license to exercise Affirmer's Copyright and Related Rights in the Work (i) in all territories worldwide, (ii) for the maximum duration provided by applicable law or treaty (including future time extensions), (iii) in



any current or future medium and for any number of copies, and (iv) for any purpose whatsoever, including without limitation commercial, advertising or promotional purposes (the "License"). The License shall be deemed effective as of the date CCO was applied by Affirmer to the Work. Should any part of the License for any reason be judged legally invalid or ineffective under applicable law, such partial invalidity or ineffectiveness shall not invalidate the remainder of the License, and in such case Affirmer hereby affirms that he or she will not (i) exercise any of his or her remaining Copyright and Related Rights in the Work or (ii) assert any associated claims and causes of action with respect to the Work, in either case contrary to Affirmer's express Statement of Purpose.

4. Limitations and Disclaimers.

No trademark or patent rights held by Affirmer are waived, abandoned, surrendered, licensed or otherwise affected by this document.

Affirmer offers the Work as-is and makes no representations or warranties of any kind concerning the Work, express, implied, statutory or otherwise, including without limitation warranties of title, merchantability, fitness for a particular purpose, non infringement, or the absence of latent or other defects, accuracy, or the present or absence of errors, whether or not discoverable, all to the greatest extent permissible under applicable law.

Affirmer disclaims responsibility for clearing rights of other persons that may apply to the Work or any use thereof, including without limitation any person's Copyright and Related Rights in the Work. Further, Affirmer disclaims responsibility for obtaining any necessary consents, permissions or other rights required for any use of the Work.

Affirmer understands and acknowledges that Creative Commons is not a party to this document and has no duty or obligation with respect to this CCO or use of the Work.

The Apache Software License, Version 2.0:

- * ant (ant:ant:1.6.5 http://www.apache.org/ant/)
- * A Swiss Army Knife for OSGi (biz.aQute.bnd:bndlib:2.4.0 http://www.aQute.biz/Code/Bnd/bndlib)
- * Jackson-core (com.fasterxml.jackson.core:jackson-core:2.1.3 http://wiki.fasterxml.com/JacksonHome)
- * Caffeine cache (com.github.ben-manes.caffeine:2.6.2 https://github.com/ben-manes/caffeine)
 - * jffi (com.github.jnr:jffi:1.2.16 http://github.com/jnr/jffi)
 - * jffi (com.github.jnr:jffi:1.2.17 http://github.com/jnr/jffi)
 - * jnr-a64asm (com.github.jnr:jnr-a64asm:1.0.0 http://

nexus.sonatype.org/oss-repository-hosting.html/jnr-a64asm)

- * jnr-constants (com.github.jnr:jnr-constants:0.9.11 http://
 github.com/jnr/jnr-constants)
- * jnr-enxio (com.github.jnr:jnr-enxio:0.20 http://
 github.com/jnr/jnr-enxio)
 - * jnr-ffi (com.github.jnr:jnr-ffi:2.1.9 http://github.com/jnr/



```
jnr-ffi)
        * jnr-unixsocket (com.github.jnr:jnr-unixsocket:0.22 - http://
github.com/jnr/jnr-unixsocket)
        * Google APIs Client Library for Java (com.google.api-
client:google-api-client:1.21.0 - https://github.com/google/google-api-
java-client/google-api-client)
        * com.google.api.grpc:grpc-google-common-protos
(com.google.api.grpc:grpc-google-common-protos:0.1.0 - https://
github.com/googleapis/googleapis)
        * com.google.api.grpc:proto-google-common-protos
(com.google.api.grpc:proto-google-common-protos:0.1.9 - https://
github.com/googleapis/googleapis)
        * com.google.api.grpc:proto-google-iam-v1
(com.google.api.grpc:proto-google-iam-v1:0.1.9 - https://github.com/
googleapis/googleapis)
        * AutoValue (com.google.auto.value:auto-value:1.2 - https://
github.com/google/auto/auto-value)
        * com.google.cloud.datastore:datastore-v1-proto-client
(com.google.cloud.datastore:datastore-v1-proto-client:1.3.0 - https://
cloud.google.com/datastore/datastore-v1-proto-client/)
        * com.google.cloud.datastore:datastore-v1-protos
(com.google.cloud.datastore:datastore-v1-protos:1.3.0 - https://
cloud.google.com/datastore/)
        * FindBugs-jsr305 (com.google.code.findbugs:jsr305:3.0.0 -
http://findbugs.sourceforge.net/)
        * Gson (com.google.code.gson:gson:2.7 - https://github.com/
google/gson/gson)
        * Gson (com.google.code.gson:gson:2.8.1 - https://github.com/
google/gson/gson)
        * error-prone annotations
(com.google.errorprone:error_prone_annotations:2.1.3 - http://
nexus.sonatype.org/oss-repository-hosting.html/error_prone_parent/
error_prone_annotations)
        * Guava: Google Core Libraries for Java
(com.google.guava:guava:19.0 - https://github.com/google/guava/guava)
        * Guava: Google Core Libraries for Java
(com.google.guava:guava:25.1-android - https://github.com/google/guava/
guava)
        * Google HTTP Client Library for Java (com.google.http-
client:google-http-client:1.21.0 - https://github.com/google/google-
http-java-client/google-http-client)
        * Google App Engine extensions to the Google HTTP Client
Library for Java. (com.google.http-client:google-http-client-
appengine:1.21.0 - https://github.com/google/google-http-java-client/
google-http-client-appengine)
        * Jackson extensions to the Google HTTP Client Library for
Java. (com.google.http-client:google-http-client-jackson:1.21.0 -
```

* Jackson 2 extensions to the Google HTTP Client Library for Java. (com.google.http-client:google-http-client-jackson2:1.21.0 - https://github.com/google/google-http-java-client/google-http-client-jackson2)

https://github.com/google/google-http-java-client/google-http-client-

* Protocol Buffer extensions to the Google HTTP Client Library for Java. (com.google.http-client:google-http-client-protobuf:1.20.0 -

jackson)

```
https://github.com/google/google-http-java-client/google-http-client-
protobuf)
        * Google Guice - Core Library (com.google.inject:guice:4.2.1 -
https://github.com/google/guice/guice)
        * J2ObjC Annotations (com.google.j2objc:j2objc-annotations:1.1
- https://github.com/google/j2objc/)
        * Google OAuth Client Library for Java (com.google.oauth-
client:google-oauth-client:1.21.0 - https://github.com/google/google-
oauth-java-client/google-oauth-client)
        * xmemcached (com.googlecode.xmemcached:xmemcached:2.4.5 -
https://github.com/killme2008/xmemcached)
        * hazelcast (com.hazelcast:hazelcast:3.9.4 - http://
www.hazelcast.com/hazelcast/)
        * hazelcast-client (com.hazelcast:hazelcast-client:3.9.4 -
http://www.hazelcast.com/hazelcast-client/)
        * ProtoParser (com.squareup:protoparser:4.0.3 - http://
github.com/square/protoparser/)
        * OkHttp (com.squareup.okhttp:okhttp:2.5.0 - https://github.com/
square/okhttp/okhttp)
        * Okio (com.squareup.okio:okio:1.6.0 - https://github.com/
square/okio/okio)
        * Apache Commons Codec (commons-codec:commons-codec:1.10 -
http://commons.apache.org/proper/commons-codec/)
        * Codec (commons-codec:commons-codec:1.3 - http://
jakarta.apache.org/commons/codec/)
        * Commons Codec (commons-codec:commons-codec:1.6 - http://
commons.apache.org/codec/)
        * Apache Commons IO (commons-io:commons-io:2.5 - http://
commons.apache.org/proper/commons-io/)
        * Commons Logging (commons-logging:commons-logging:1.1.1 -
http://commons.apache.org/logging)
        * Commons Logging (commons-logging:commons-logging:1.1.3 -
http://commons.apache.org/proper/commons-logging/)
        * Netty/Buffer (io.netty:netty-buffer:4.1.28.Final - http://
netty.io/netty-buffer/)
        * Netty/Buffer (io.netty:netty-buffer:4.1.3.Final - http://
netty.io/netty-buffer/)
        * Netty/Codec (io.netty:netty-codec:4.1.28.Final - http://
netty.io/netty-codec/)
        * Netty/Codec (io.netty:netty-codec:4.1.3.Final - http://
netty.io/netty-codec/)
        * Netty/Codec/HTTP (io.netty:netty-codec-http:4.1.3.Final -
http://netty.io/netty-codec-http/)
        * Netty/Codec/HTTP2 (io.netty:netty-codec-http2:4.1.3.Final -
http://netty.io/netty-codec-http2/)
        * Netty/Common (io.netty:netty-common:4.1.28.Final - http://
netty.io/netty-common/)
        * Netty/Common (io.netty:netty-common:4.1.3.Final - http://
netty.io/netty-common/)
        * Netty/Handler (io.netty:netty-handler:4.1.28.Final - http://
netty.io/netty-handler/)
        * Netty/Handler (io.netty:netty-handler:4.1.3.Final - http://
netty.io/netty-handler/)
        * Netty/Resolver (io.netty:netty-resolver:4.1.28.Final - http://
netty.io/netty-resolver/)
```

```
* Netty/Resolver (io.netty:netty-resolver:4.1.3.Final - http://
netty.io/netty-resolver/)
        * Netty/Transport (io.netty:netty-transport:4.1.28.Final -
http://netty.io/netty-transport/)
        * Netty/Transport (io.netty:netty-transport:4.1.3.Final -
http://netty.io/netty-transport/)
        * Netty/Transport/Native/Epoll (io.netty:netty-transport-native-
epoll:4.1.28.Final - http://netty.io/netty-transport-native-epoll/)
        * Netty/Transport/Native/Unix/Common (io.netty:netty-transport-
native-unix-common:4.1.28.Final - http://netty.io/netty-transport-
native-unix-common/)
        * RxJava (io.reactivex.rxjava2:rxjava:2.2.4 - https://
github.com/ReactiveX/RxJava)
        * Joda-Time (joda-time:joda-time:2.9.2 - http://www.joda.org/
joda-time/)
        * Apache Ant Core (org.apache.ant:1.8.4 - http://
ant.apache.org/ant/)
        * Apache Ant Launcher (org.apache.ant:ant-launcher:1.8.4 -
http://ant.apache.org/ant-launcher/)
        * Apache Avro (org.apache.avro:avro:1.7.6 - http://
avro.apache.org)
        * Commons Compress (org.apache.commons:commons-compress:1.4.1 -
http://commons.apache.org/compress/)
        * Apache Commons Lang (org.apache.commons:commons-lang3:3.8.1 -
http://commons.apache.org/proper/commons-lang/)
        * Commons Math (org.apache.commons:commons-math3:3.2 - http://
commons.apache.org/proper/commons-math/)
        * Apache Felix Framework
(org.apache.felix:org.apache.felix.framework:6.0.3 - http://
felix.apache.org/org.apache.felix.framework/)
        * HttpClient (org.apache.httpcomponents:httpclient:4.0.1 -
http://hc.apache.org/httpcomponents-client)
        * Apache HttpClient (org.apache.httpcomponents:httpclient:4.5.6
- http://hc.apache.org/httpcomponents-client)
        * HttpCore (org.apache.httpcomponents:httpcore:4.0.1 - http://
hc.apache.org/httpcomponents-core/)
        * Apache HttpCore (org.apache.httpcomponents:httpcore:4.4.10 -
http://hc.apache.org/httpcomponents-core-ga)
        * Lucene Common Analyzers (org.apache.lucene:lucene-analyzers-
common:5.5.5 - http://lucene.apache.org/lucene-parent/lucene-analyzers-
common)
        * Lucene Core (org.apache.lucene:lucene-core:5.5.5 - http://
lucene.apache.org/lucene-parent/lucene-core)
        * Lucene Facets (org.apache.lucene:lucene-facet:5.5.5 - http://
lucene.apache.org/lucene-parent/lucene-facet)
        * Lucene Miscellaneous (org.apache.lucene:lucene-misc:5.5.5 -
http://lucene.apache.org/lucene-parent/lucene-misc)
        * Lucene Queries (org.apache.lucene:lucene-queries:5.5.5 -
http://lucene.apache.org/lucene-parent/lucene-queries)
        * Lucene QueryParsers (org.apache.lucene:lucene-
queryparser:5.5.5 - http://lucene.apache.org/lucene-parent/lucene-
queryparser)
        * EL 2.2 plugin (org.apache.openwebbeans:openwebbeans-
el22:2.0.11 - openwebbeans.apache.org/openwebbeans-el22)
        * OpenWebBeans Core (org.apache.openwebbeans:openwebbeans-
```



```
impl:2.0.11 - openwebbeans.apache.org/openwebbeans-impl)
        * Jetty 9 plugin (org.apache.openwebbeans:openwebbeans-
jetty9:2.0.11 - openwebbeans.apache.org/openwebbeans-jetty9)
        * SPI definition (org.apache.openwebbeans:openwebbeans-
spi:2.0.11 - openwebbeans.apache.org/openwebbeans-spi)
        * Web plugin (org.apache.openwebbeans:openwebbeans-web:2.0.11 -
openwebbeans.apache.org/openwebbeans-web)
        * Apache Standard Taglib Implementation
(org.apache.taglibs:taglibs-standard-impl:1.2.5 - http://
tomcat.apache.org/taglibs/standard-1.2.5/taglibs-standard-impl)
        * Apache Standard Taglib Specification API
(org.apache.taglibs:taglibs-standard-spec:1.2.5 - http://
tomcat.apache.org/taglibs/standard-1.2.5/taglibs-standard-spec)
        * org.apiguardian:apiguardian-api (org.apiguardian:apiguardian-
api:1.1.0 - https://github.com/apiguardian-team/apiguardian)
        * Jackson (org.codehaus.jackson:jackson-core-asl:1.9.11 -
http://jackson.codehaus.org)
        * Jackson (org.codehaus.jackson:jackson-core-asl:1.9.13 -
http://jackson.codehaus.org)
        * Data Mapper for Jackson (org.codehaus.jackson:jackson-mapper-
asl:1.9.13 - http://jackson.codehaus.org)
        * Plexus Classworlds (org.codehaus.plexus:plexus-
classworlds:2.5.2 - http://plexus.codehaus.org/plexus-classworlds/)
        * Plexus :: Component Annotations (org.codehaus.plexus:plexus-
component-annotations:1.5.5 - http://plexus.codehaus.org/plexus-
containers/plexus-component-annotations/)
        * Plexus :: Component Annotations (org.codehaus.plexus:plexus-
component-annotations:1.7.1 - http://codehaus-plexus.github.io/plexus-
containers/plexus-component-annotations/)
        * Plexus Interpolation API (org.codehaus.plexus:plexus-
interpolation:1.11 - http://plexus.codehaus.org/plexus-components/
plexus-interpolation)
        * Plexus Interpolation API (org.codehaus.plexus:plexus-
interpolation:1.25 - http://codehaus-plexus.github.io/plexus-
interpolation/)
        * Plexus Common Utilities (org.codehaus.plexus:plexus-
utils:3.1.0 - http://codehaus-plexus.github.io/plexus-utils/)
        * org.conscrypt:conscrypt-openjdk-uber (org.conscrypt:conscrypt-
openjdk-uber:2.1.0 - https://conscrypt.org/)
        * Jetty :: Apache JSP Implementation (org.eclipse.jetty:apache-
jsp:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Apache :: JSTL module (org.eclipse.jetty:apache-
jstl:9.4.21.v20190916 - http://tomcat.apache.org/taglibs/standard/)
        * Jetty :: Infinispan Session Manager Common
(org.eclipse.jetty:infinispan-common:9.4.21.v20190916 - http://
www.eclipse.org/jetty)
        * Jetty :: Infinispan Session Manager Remote
(org.eclipse.jetty:infinispan-remote-query:9.4.21.v20190916 - http://
www.eclipse.org/jetty)
        * Jetty :: ALPN :: Client (org.eclipse.jetty:jetty-alpn-
client:9.4.21.v20190916 - https://eclipse.org/jetty/jetty-alpn-parent/
jetty-alpn-client)
        * Jetty :: ALPN :: Conscrypt Server Implementation
(org.eclipse.jetty:jetty-alpn-conscrypt-server:9.4.21.v20190916 -
https://eclipse.org/jetty/jetty-alpn-parent/jetty-alpn-conscrypt-server)
```

```
* Jetty :: ALPN :: OpenJDK8 Client Implementation
(org.eclipse.jetty:jetty-alpn-openjdk8-client:9.4.21.v20190916 -
https://eclipse.org/jetty/jetty-alpn-parent/jetty-alpn-openjdk8-client)
        * Jetty :: ALPN :: OpenJDK8 Server Implementation
(org.eclipse.jetty:jetty-alpn-openjdk8-server:9.4.21.v20190916 -
https://eclipse.org/jetty/jetty-alpn-parent/jetty-alpn-openjdk8-server)
        * Jetty :: ALPN :: Server (org.eclipse.jetty:jetty-alpn-
server:9.4.21.v20190916 - https://eclipse.org/jetty/jetty-alpn-parent/
jetty-alpn-server)
        * Jetty :: Servlet Annotations (org.eclipse.jetty:jetty-
annotations:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Asynchronous HTTP Client (org.eclipse.jetty:jetty-
client:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Continuation (org.eclipse.jetty:jetty-
continuation:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Deployers (org.eclipse.jetty:jetty-
deploy:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Distribution Assemblies (org.eclipse.jetty:jetty-
distribution: 9.4.21.v20190916 - https://eclipse.org/jetty/jetty-
distribution)
        * Jetty :: Hazelcast Session Manager (org.eclipse.jetty:jetty-
hazelcast:9.4.21.v20190916 - https://eclipse.org/jetty/jetty-hazelcast)
        * Jetty :: Http Utility (org.eclipse.jetty:jetty-
http:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: IO Utility (org.eclipse.jetty:jetty-
io:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: JAAS (org.eclipse.jetty:jetty-jaas:9.4.21.v20190916
- https://eclipse.org/jetty/jetty-jaas)
        * Jetty :: JMX Management (org.eclipse.jetty:jetty-
jmx:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: JNDI Naming (org.eclipse.jetty:jetty-
jndi:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: NoSQL Session Managers (org.eclipse.jetty:jetty-
nosql:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Plus (org.eclipse.jetty:jetty-plus:9.4.21.v20190916
- http://www.eclipse.org/jetty)
        * Jetty :: Proxy (org.eclipse.jetty:jetty-
proxy:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Quick Start (org.eclipse.jetty:jetty-
quickstart:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Rewrite Handler (org.eclipse.jetty:jetty-
rewrite:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Security (org.eclipse.jetty:jetty-
security:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Server Core (org.eclipse.jetty:jetty-
server:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Servlet Handling (org.eclipse.jetty:jetty-
servlet:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Utility Servlets and Filters
(org.eclipse.jetty:jetty-servlets:9.4.21.v20190916 - http://
www.eclipse.org/jetty)
        * Jetty :: Utilities (org.eclipse.jetty:jetty-util:9.3.0.RC0 -
http://www.eclipse.org/jetty)
        * Jetty :: Utilities (org.eclipse.jetty:jetty-
util:9.4.21.v20190916 - http://www.eclipse.org/jetty)
```

```
* Jetty :: Utilities :: Ajax(JSON) (org.eclipse.jetty:jetty-
util-ajax:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: Webapp Application Support (org.eclipse.jetty:jetty-
webapp:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: XML utilities (org.eclipse.jetty:jetty-
xml:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Test :: Jetty Test Webapp (org.eclipse.jetty:test-jetty-
webapp:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty :: ALPN :: API (org.eclipse.jetty.alpn:alpn-
api:1.1.3.v20160715 - http://www.eclipse.org/jetty/alpn-api)
        * Example Async Rest :: Jar (org.eclipse.jetty.example-async-
rest:example-async-rest-jar:9.4.21.v20190916 - https://eclipse.org/
jetty/examples-parent/example-async-rest/example-async-rest-jar)
        * Jetty :: FastCGI :: Client (org.eclipse.jetty.fcgi:fcgi-
client:9.4.21.v20190916 - https://eclipse.org/jetty/fcgi-parent/fcgi-
client)
        * Jetty :: GCloud :: Session Manager
(org.eclipse.jetty.gcloud:jetty-gcloud-session-manager:9.4.21.v20190916
- https://eclipse.org/jetty/qcloud-parent/jetty-qcloud-session-manager)
        * Jetty :: HTTP2 :: Client (org.eclipse.jetty.http2:http2-
client:9.4.21.v20190916 - https://eclipse.org/jetty/http2-parent/http2-
client)
        * Jetty :: HTTP2 :: Common (org.eclipse.jetty.http2:http2-
common:9.4.21.v20190916 - https://eclipse.org/jetty/http2-parent/http2-
common)
        * Jetty :: HTTP2 :: HPACK (org.eclipse.jetty.http2:http2-
hpack: 9.4.21.v20190916 - https://eclipse.org/jetty/http2-parent/http2-
hpack)
        * Jetty :: HTTP2 :: Server (org.eclipse.jetty.http2:http2-
server:9.4.21.v20190916 - https://eclipse.org/jetty/http2-parent/http2-
server)
        * Jetty :: Memcached :: Sessions
(org.eclipse.jetty.memcached:jetty-memcached-sessions:9.4.21.v20190916
- https://eclipse.org/jetty/memcached-parent/jetty-memcached-sessions)
        * Jetty Orbit :: Activation
(org.eclipse.jetty.orbit:javax.activation:1.1.0.v201105071233 - http://
www.eclipse.org/jetty/jetty-orbit/javax.activation)
        * Jetty Orbit :: Glassfish Mail
(org.eclipse.jetty.orbit:javax.mail.glassfish:1.4.1.v201005082020 -
http://www.eclipse.org/jetty/jetty-orbit/javax.mail.glassfish)
        * Jetty Orbit :: JASPI API
(org.eclipse.jetty.orbit:javax.security.auth.message:1.0.0.v201108011116
 - http://www.eclipse.org/jetty/jetty-orbit/javax.security.auth.message)
        * Jetty Orbit :: JSP JSTL
(org.eclipse.jetty.orbit:javax.servlet.jsp.jstl:1.2.0.v201105211821 -
http://www.eclipse.org/jetty/jetty-orbit/javax.servlet.jsp.jstl)
        * Jetty :: OSGi :: Boot (org.eclipse.jetty.osgi:jetty-osgi-
boot:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Jetty Tests :: JMX :: WebApp (org.eclipse.jetty.tests:jmx-
webapp:9.4.21.v20190916 - http://www.eclipse.org/jetty)
        * Test :: CDI :: Common Demo Webapp
(org.eclipse.jetty.tests:test-cdi-common-webapp:9.4.21.v20190916 -
http://www.eclipse.org/jetty/test-cdi-common-webapp)
        * Jetty Tests :: WebApp :: Servlet Spec ::
ServletContainerInitializer Test Jar (org.eclipse.jetty.tests:test-
```

```
container-initializer:9.4.21.v20190916 - http://www.eclipse.org/jetty/
test-servlet-spec-parent/test-container-initializer)
        * Jetty Tests :: WebApp :: JNDI (org.eclipse.jetty.tests:test-
jndi-webapp:9.4.21.v20190916 - http://www.eclipse.org/jetty/test-jndi-
webapp)
        * Jetty Tests :: WebApp :: Mock Resources
(org.eclipse.jetty.tests:test-mock-resources:9.4.21.v20190916 - http://
www.eclipse.org/jetty/test-mock-resources)
        * Jetty Tests :: Sessions :: Common
(org.eclipse.jetty.tests:test-sessions-common:9.4.21.v20190916 - http://
www.eclipse.org/jetty)
        * Jetty Tests :: Webapps :: Spec Webapp
(org.eclipse.jetty.tests:test-spec-webapp:9.4.21.v20190916 - http://
www.eclipse.org/jetty/test-servlet-spec-parent/test-spec-webapp)
        * Jetty Tests :: WebApp :: Servlet Spec :: Fragment Jar
(org.eclipse.jetty.tests:test-web-fragment:9.4.21.v20190916 - http://
www.eclipse.org/jetty/test-servlet-spec-parent/test-web-fragment)
        * Jetty :: Servlet API and Schemas for OSGi
(org.eclipse.jetty.toolchain:jetty-osgi-servlet-api:3.1.0.M3 - http://
www.eclipse.org/jetty/jetty-toolchain/jetty-osgi-servlet-api)
        * Jetty :: Schemas (org.eclipse.jetty.toolchain:jetty-
schemas:3.1.2 - https://eclipse.org/jetty/jetty-schemas)
        * Jetty Toolchain :: Test Helper
(org.eclipse.jetty.toolchain:jetty-test-helper:5.3 - https://
eclipse.org/jetty/jetty-test-helper)
        * Jetty :: Websocket :: javax.websocket :: Client
Implementation (org.eclipse.jetty.websocket:javax-websocket-client-
impl:9.4.21.v20190916 - http://www.eclipse.org/jetty/javax-websocket-
client-impl)
        * Jetty :: Websocket :: javax.websocket.server :: Server
Implementation (org.eclipse.jetty.websocket:javax-websocket-server-
impl:9.4.21.v20190916 - http://www.eclipse.org/jetty/javax-websocket-
server-impl)
        * Jetty :: Websocket :: API
(org.eclipse.jetty.websocket:websocket-api:9.4.21.v20190916 - http://
www.eclipse.org/jetty/websocket-api)
        * Jetty :: Websocket :: Client
(org.eclipse.jetty.websocket:websocket-client:9.4.21.v20190916 - http://
www.eclipse.org/jetty/websocket-client)
        * Jetty :: Websocket :: Common
(org.eclipse.jetty.websocket:websocket-common:9.4.21.v20190916 - http://
www.eclipse.org/jetty/websocket-common)
        * Jetty :: Websocket :: Server
(org.eclipse.jetty.websocket:websocket-server:9.4.21.v20190916 - http://
www.eclipse.org/jetty/websocket-server)
        * Jetty :: Websocket :: Servlet Interface
(org.eclipse.jetty.websocket:websocket-servlet:9.4.21.v20190916 -
http://www.eclipse.org/jetty/websocket-servlet)
        * Infinispan Hot Rod Client (org.infinispan:infinispan-client-
hotrod:9.4.8.Final - http://www.infinispan.org/infinispan-client-hotrod)
        * Infinispan Commons (org.infinispan:infinispan-
commons:9.4.8.Final - http://www.infinispan.org/infinispan-commons)
        * Infinispan Core (org.infinispan:infinispan-core:9.4.8.Final -
http://www.infinispan.org/infinispan-core)
        * Infinispan Directory Provider for Hibernate Search
```

```
(org.infinispan:infinispan-directory-provider:9.4.8.Final - http://
www.infinispan.org/infinispan-lucene-parent/infinispan-directory-
provider)
        * Infinispan Lucene Directory Implementation
(org.infinispan:infinispan-lucene-directory:9.4.8.Final - http://
www.infinispan.org/infinispan-lucene-parent/infinispan-lucene-directory)
        * Infinispan Object Querying and Filtering API
(org.infinispan:infinispan-objectfilter:9.4.8.Final - http://
www.infinispan.org/infinispan-objectfilter)
        * Infinispan Query (org.infinispan:infinispan-query:9.4.8.Final
- http://www.infinispan.org/infinispan-query)
        * Infinispan Query DSL API (org.infinispan:infinispan-query-
dsl:9.4.8.Final - http://www.infinispan.org/infinispan-query-dsl)
        * Infinispan Remote Query Client (org.infinispan:infinispan-
remote-query-client: 9.4.8.Final - http://www.infinispan.org/infinispan-
remote-query-client)
        * ProtoStream - core
(org.infinispan.protostream:protostream:4.2.2.Final - http://
infinispan.org/protostream)
        * classfilewriter (org.jboss.classfilewriter:jboss-
classfilewriter:1.2.4.Final - https://github.com/jbossas/jboss-
classfilewriter)
        * JBoss Logging 3 (org.jboss.logging:jboss-logging:3.3.2.Final
- http://www.jboss.org)
        * JBoss Marshalling OSGi Bundle (org.jboss.marshalling:jboss-
marshalling-osgi:2.0.6.Final - http://www.jboss.org/jboss-marshalling-
parent/jboss-marshalling-osgi)
        * Weld APIs (org.jboss.weld:weld-api:3.1.SP1 - http://weld.cdi-
spec.org)
        * Weld Implementation (Core) (org.jboss.weld:weld-core-
impl:3.1.2.Final - http://weld.cdi-spec.org)
        * Weld SPIs for container integration (org.jboss.weld:weld-
spi:3.1.SP1 - http://weld.cdi-spec.org)
        * Weld Environment Common (org.jboss.weld.environment:weld-
environment-common:3.1.2.Final - http://weld.cdi-spec.org)
        * Weld JSF (org.jboss.weld.module:weld-jsf:3.1.2.Final - http://
weld.cdi-spec.org)
        * Weld Web (org.jboss.weld.module:weld-web:3.1.2.Final - http://
weld.cdi-spec.org)
        * Weld Probe Core (org.jboss.weld.probe:weld-probe-
core:3.1.2.Final - http://weld.cdi-spec.org/weld-core-parent/weld-probe-
parent/weld-probe-core)
        * Weld Servlet Core (org.jboss.weld.servlet:weld-servlet-
core:3.1.2.Final - http://weld.cdi-spec.org)
        * JGroups (org.jgroups:jgroups:4.0.18.Final - http://
www.jgroups.org)
        * MongoDB Java Driver (org.mongodb:mongo-java-driver:2.13.2 -
http://www.mongodb.org)
        * MortBay :: Apache EL :: API and Implementation
(org.mortbay.jasper:apache-el:8.5.40 - https://github.com/jetty-project/
jasper-jsp/apache-el)
        * MortBay :: Apache Jasper :: JSP Implementation
(org.mortbay.jasper:apache-jsp:8.5.40 - https://github.com/jetty-
project/jasper-jsp/apache-jsp)
        * org.opentest4j:opentest4j:opentest4j:1.2.0 -
```

- * Spring Beans (org.springframework:spring-beans:3.2.8.RELEASE https://github.com/SpringSource/spring-framework)
- * Spring Core (org.springframework:spring-core:3.2.8.RELEASE https://github.com/SpringSource/spring-framework)
- * Google Cloud Core (com.google.cloud:google-cloud-core:1.0.0 https://github.com/GoogleCloudPlatform/google-cloud-java/tree/master/google-cloud-core)
- * Google Cloud Core HTTP (com.google.cloud:google-cloud-core-http:1.0.0 https://github.com/GoogleCloudPlatform/google-cloud-java/tree/master/google-cloud-core-http)
- * Google Cloud Datastore (com.google.cloud:google-cloud-datastore:1.0.0 https://github.com/GoogleCloudPlatform/google-cloud-java/tree/master/google-cloud-datastore)

See above for The Apache Software License, Version 2.0

The JSON License:

* JSON in Java (org.json:json:20160810 - https://github.com/douglascrockford/JSON-java)

Copyright (c) 2002 JSON.org

Permission is hereby granted, free of charge, to any person obtaining a copy

in the Software without restriction, including without limitation the rights

to use, copy, modify, merge, publish, distribute, sublicense, and/or sell

copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all

copies or substantial portions of the Software.



The Software shall be used for Good, not Evil.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR

IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE

AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM.

OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

Javassist 3.27

Copyright (C) 1999-2019 by Shigeru Chiba, All rights reserved. Contributors Bill Burke, Jason Green.

Javassist (JAVA programming ASSISTant) makes Java bytecode manipulation simple. It is a class library for editing bytecodes in Java; it enables Java programs to define a new class at runtime and to modify a class file when the JVM loads it. Unlike other similar bytecode editors, Javassist provides two levels of API: source level and bytecode level. If the users use the source- level API, they can edit a class file without knowledge of the specifications of the Java bytecode. The whole API is designed with only the vocabulary of the Java language. You can even specify inserted bytecode in the form of source text; Javassist compiles it on the fly. On the other hand, the bytecode-level API allows the users to directly edit a class file as other editors.

This software may distributed under the Mozilla Public License Version 1.1, the GNU Lesser General Public License Version 2.1 or later, or the Apache License Version 2.0.Apache License. Oracle elects Apache 2.0

Version 2.0, January 2004

http://www.apache.org/licenses/

TERMS AND CONDITIONS FOR USE, REPRODUCTION, AND DISTRIBUTION

1. Definitions.

"License" shall mean the terms and conditions for use, reproduction, and distribution as defined by Sections 1 through 9 of this document.

"Licensor" shall mean the copyright owner or entity authorized by the copyright owner that is granting the License.

"Legal Entity" shall mean the union of the acting entity and all other entities that control, are controlled by, or are under common control



with that entity. For the purposes of this definition, "control" means (i) the power, direct or indirect, to cause the direction or management of such entity, whether by contract or otherwise, or (ii) ownership of fifty percent (50%) or more of the outstanding shares, or (iii) beneficial ownership of such entity.

"You" (or "Your") shall mean an individual or Legal Entity exercising permissions granted by this License.

"Source" form shall mean the preferred form for making modifications, including but not limited to software source code, documentation source, and configuration files.

"Object" form shall mean any form resulting from mechanical transformation or translation of a Source form, including but not limited to compiled object code, generated documentation, and conversions to other media types.

"Work" shall mean the work of authorship, whether in Source or Object form, made available under the License, as indicated by a copyright notice that is included in or attached to the work (an example is provided in the Appendix below).

"Derivative Works" shall mean any work, whether in Source or Object form, that is based on (or derived from) the Work and for which the editorial revisions, annotations, elaborations, or other modifications represent, as a whole, an original work of authorship. For the purposes of this License, Derivative Works shall not include works that remain separable from, or merely link (or bind by name) to the interfaces of, the Work and Derivative Works thereof.

"Contribution" shall mean any work of authorship, including the original version of the Work and any modifications or additions to that Work or Derivative Works thereof, that is intentionally submitted to Licensor for inclusion in the Work by the copyright owner or by an individual or Legal Entity authorized to submit on behalf of the copyright owner. For the purposes of this definition, "submitted" means any form of electronic, verbal, or written communication sent to the Licensor or its representatives, including but not limited to communication on electronic mailing lists, source code control systems, and issue tracking systems that are managed by, or on behalf of, the Licensor for the purpose of discussing and improving the Work, but excluding communication that is conspicuously marked or otherwise designated in writing by the copyright owner as "Not a Contribution."

"Contributor" shall mean Licensor and any individual or Legal Entity on behalf of whom a Contribution has been received by Licensor and subsequently incorporated within the Work.

2. Grant of Copyright License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable copyright license to reproduce, prepare Derivative Works of, publicly display, publicly perform, sublicense, and distribute the Work and such Derivative Works in Source or Object form.



- 3. Grant of Patent License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable (except as stated in this section) patent license to make, have made, use, offer to sell, sell, import, and otherwise transfer the Work, where such license applies only to those patent claims licensable by such Contributor that are necessarily infringed by their Contribution(s) alone or by combination of their Contribution(s) with the Work to which such Contribution(s) was submitted. If You institute patent litigation against any entity (including a cross-claim or counterclaim in a lawsuit) alleging that the Work or a Contribution incorporated within the Work constitutes direct or contributory patent infringement, then any patent licenses granted to You under this License for that Work shall terminate as of the date such litigation is filed.
- 4. Redistribution. You may reproduce and distribute copies of the Work or Derivative Works thereof in any medium, with or without modifications, and in Source or Object form, provided that You meet the following conditions:

You must give any other recipients of the Work or Derivative Works a copy of this License; and

You must cause any modified files to carry prominent notices stating that You changed the files; and

You must retain, in the Source form of any Derivative Works that You distribute, all copyright, patent, trademark, and attribution notices from the Source form of the Work, excluding those notices that do not pertain to any part of the Derivative Works; and

If the Work includes a "NOTICE" text file as part of its distribution, then any Derivative Works that You distribute must include a readable copy of the attribution notices contained within such NOTICE file, excluding those notices that do not pertain to any part of the Derivative Works, in at least one of the following places: within a NOTICE text file distributed as part of the Derivative Works; within the Source form or documentation, if provided along with the Derivative Works; or, within a display generated by the Derivative Works, if and wherever such third-party notices normally appear. The contents of the NOTICE file are for informational purposes only and do not modify the License. You may add Your own attribution notices within Derivative Works that You distribute, alongside or as an addendum to the NOTICE text from the Work, provided that such additional attribution notices cannot be construed as modifying the License.

You may add Your own copyright statement to Your modifications and may provide additional or different license terms and conditions for use, reproduction, or distribution of Your modifications, or for any such Derivative Works as a whole, provided Your use, reproduction, and distribution of the Work otherwise complies with the conditions stated in this License.

5. Submission of Contributions. Unless You explicitly state otherwise, any Contribution intentionally submitted for inclusion in the Work by You to the Licensor shall be under the terms and conditions of this License, without any additional terms or conditions. Notwithstanding



the above, nothing herein shall supersede or modify the terms of any separate license agreement you may have executed with Licensor regarding such Contributions.

- 6. Trademarks. This License does not grant permission to use the trade names, trademarks, service marks, or product names of the Licensor, except as required for reasonable and customary use in describing the origin of the Work and reproducing the content of the NOTICE file.
- 7. Disclaimer of Warranty. Unless required by applicable law or agreed to in writing, Licensor provides the Work (and each Contributor provides its Contributions) on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied, including, without limitation, any warranties or conditions of TITLE, NON-INFRINGEMENT, MERCHANTABILITY, or FITNESS FOR A PARTICULAR PURPOSE. You are solely responsible for determining the appropriateness of using or redistributing the Work and assume any risks associated with Your exercise of permissions under this License.
- 8. Limitation of Liability. In no event and under no legal theory, whether in tort (including negligence), contract, or otherwise, unless required by applicable law (such as deliberate and grossly negligent acts) or agreed to in writing, shall any Contributor be liable to You for damages, including any direct, indirect, special, incidental, or consequential damages of any character arising as a result of this License or out of the use or inability to use the Work (including but not limited to damages for loss of goodwill, work stoppage, computer failure or malfunction, or any and all other commercial damages or losses), even if such Contributor has been advised of the possibility of such damages.
- 9. Accepting Warranty or Additional Liability. While redistributing the Work or Derivative Works thereof, You may choose to offer, and charge a fee for, acceptance of support, warranty, indemnity, or other liability obligations and/or rights consistent with this License. However, in accepting such obligations, You may act only on Your own behalf and on Your sole responsibility, not on behalf of any other Contributor, and only if You agree to indemnify, defend, and hold each Contributor harmless for any liability incurred by, or claims asserted against, such Contributor by reason of your accepting any such warranty or additional liability.

END OF TERMS AND CONDITIONS

avsc 5.4.21

Copyright (c) 2015-2017, Matthieu Monsch.

Permission is hereby granted, free of charge, to any person obtaining a copy of

this software and associated documentation files (the "Software"), to deal in

the Software without restriction, including without limitation the



rights to

use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies

of the Software, and to permit persons to whom the Software is furnished to do

so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all

copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR

IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE

AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM.

OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

babel-polyfill 7.8.7

MIT License

Copyright (c) 2014-present Sebastian McKenzie and other contributors

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

4th party Dependencies

-----Dependencies



MIT

====

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

@babel/cli

licenses: MIT

repository: https://github.com/babel/babel/tree/master/packages/babel-

cli

publisher: Sebastian McKenzie

email: sebmck@gmail.com

Copyright (c) 2014-present Sebastian McKenzie and other contributors

@babel/code-frame

licenses: MIT

repository: https://github.com/babel/babel/tree/master/packages/babel-

code-frame

publisher: Sebastian McKenzie

email: sebmck@gmail.com

Copyright (c) 2014-present Sebastian McKenzie and other contributors

@babel/core

licenses: MIT

repository: https://github.com/babel/babel/tree/master/packages/babel-

core

publisher: Sebastian McKenzie

email: sebmck@gmail.com

Copyright (c) 2014-present Sebastian McKenzie and other contributors

@babel/generator

licenses: MIT

repository: https://github.com/babel/babel/tree/master/packages/babel-

generator

publisher: Sebastian McKenzie
email: sebmck@gmail.com

Copyright (c) 2014-present Sebastian McKenzie and other contributors



```
@babel/helper-annotate-as-pure
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
helper-annotate-as-pure
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/helper-builder-binary-assignment-operator-visitor
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
helper-builder-binary-assignment-operator-visitor
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/helper-call-delegate
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
helper-call-delegate
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/helper-create-class-features-plugin
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
helper-create-class-features-plugin
publisher: The Babel Team
url: https://babeljs.io/team
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/helper-define-map
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
helper-define-map
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/helper-explode-assignable-expression
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
helper-explode-assignable-expression
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/helper-function-name
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
helper-function-name
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/helper-get-function-arity
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
helper-get-function-arity
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/helper-hoist-variables
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
helper-hoist-variables
```



```
Copyright (c) 2014-present Sebastian McKenzie and other contributors
@babel/helper-member-expression-to-functions
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
helper-member-expression-to-functions
publisher: Justin Ridgewell
email: justin@ridgewell.name
Copyright (c) 2014-present Sebastian McKenzie and other contributors
licenseFile: d:\elearning\node_modules\@babel\helper-member-expression-
to-functions\LICENSE
 @babel/helper-module-imports
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
helper-module-imports
publisher: Logan Smyth
email: loganfsmyth@gmail.com
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/helper-module-transforms
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
helper-module-transforms
publisher: Logan Smyth
email: loganfsmyth@gmail.com
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/helper-optimise-call-expression
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
helper-optimise-call-expression
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/helper-plugin-utils
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
helper-plugin-utils
publisher: Logan Smyth
email: loganfsmyth@gmail.com
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/helper-regex
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
helper-regex
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/helper-remap-async-to-generator
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
helper-remap-async-to-generator
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/helper-replace-supers
```

```
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
helper-replace-supers
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/helper-simple-access
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
helper-simple-access
publisher: Logan Smyth
email: loganfsmyth@gmail.com
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/helper-split-export-declaration
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
helper-split-export-declaration
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/helper-wrap-function
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
helper-wrap-function
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/helpers
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
helpers
publisher: Sebastian McKenzie
email: sebmck@gmail.com
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/highlight
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
highlight
publisher: suchipi
email: me@suchipi.com
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/parser
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
parser
publisher: Sebastian McKenzie
email: sebmck@gmail.com
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-proposal-async-generator-functions
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-proposal-async-generator-functions
Copyright (c) 2014-present Sebastian McKenzie and other contributors
```

```
@babel/plugin-proposal-class-properties
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-proposal-class-properties
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-proposal-json-strings
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-proposal-json-strings
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-proposal-object-rest-spread
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-proposal-object-rest-spread
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-proposal-optional-catch-binding
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-proposal-optional-catch-binding
Copyright (c) 2014-present Sebastian McKenzie and other contributors
@babel/plugin-proposal-unicode-property-regex
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-proposal-unicode-property-regex
Copyright (c) 2014-present Sebastian McKenzie and other contributors
@babel/plugin-syntax-async-generators
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-syntax-async-generators
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-syntax-json-strings
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-syntax-json-strings
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-syntax-object-rest-spread
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-syntax-object-rest-spread
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-syntax-optional-catch-binding
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-syntax-optional-catch-binding
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-syntax-typescript
```



```
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-syntax-typescript
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-arrow-functions
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-arrow-functions
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-async-to-generator
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-async-to-generator
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-block-scoped-functions
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-block-scoped-functions
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-block-scoping
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-block-scoping
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-classes
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-classes
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-computed-properties
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-computed-properties
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-destructuring
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-destructuring
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-dotall-regex
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-dotall-regex
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-duplicate-keys
licenses: MIT
```

```
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-duplicate-keys
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-exponentiation-operator
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-exponentiation-operator
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-for-of
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-for-of
Copyright (c) 2014-present Sebastian McKenzie and other contributors
@babel/plugin-transform-function-name
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-function-name
Copyright (c) 2014-present Sebastian McKenzie and other contributors
@babel/plugin-transform-literals
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-literals
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-member-expression-literals
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-member-expression-literals
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-modules-amd
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-modules-amd
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-modules-commonjs
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-modules-commonjs
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-modules-systemjs
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-modules-systemjs
Copyright (c) 2014-present Sebastian McKenzie and other contributors
@babel/plugin-transform-modules-umd
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
```



```
plugin-transform-modules-umd
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-named-capturing-groups-regex
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-named-capturing-groups-regex
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-new-target
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-new-target
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-object-super
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-object-super
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-parameters
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-parameters
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-property-literals
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-property-literals
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-regenerator
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-regenerator
publisher: Ben Newman
email: bn@cs.stanford.edu
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-reserved-words
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-reserved-words
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-shorthand-properties
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-shorthand-properties
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-spread
licenses: MIT
```

```
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-spread
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-sticky-regex
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-sticky-regex
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-template-literals
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-template-literals
Copyright (c) 2014-present Sebastian McKenzie and other contributors
@babel/plugin-transform-typeof-symbol
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-typeof-symbol
Copyright (c) 2014-present Sebastian McKenzie and other contributors
@babel/plugin-transform-typescript
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-typescript
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/plugin-transform-unicode-regex
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
plugin-transform-unicode-regex
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/preset-env
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
preset-env
publisher: Henry Zhu
email: hi@henryzoo.com
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/preset-typescript
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
preset-typescript
Copyright (c) 2014-present Sebastian McKenzie and other contributors
@babel/template
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
template
publisher: Sebastian McKenzie
email: sebmck@gmail.com
Copyright (c) 2014-present Sebastian McKenzie and other contributors
```



```
@babel/traverse
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
publisher: Sebastian McKenzie
email: sebmck@gmail.com
Copyright (c) 2014-present Sebastian McKenzie and other contributors
 @babel/types
licenses: MIT
repository: https://github.com/babel/babel/tree/master/packages/babel-
types
publisher: Sebastian McKenzie
email: sebmck@gmail.com
Copyright (c) 2014-present Sebastian McKenzie and other contributors
ansi-styles@3.2.1
licenses: MIT
repository: https://github.com/chalk/ansi-styles
publisher: Sindre Sorhus
email: sindresorhus@gmail.com
url: sindresorhus.com
Copyright (c) Sindre Sorhus (sindresorhus.com)
 arr-diff@4.0.0
licenses: MIT
repository: https://github.com/jonschlinkert/arr-diff
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-2017, Jon Schlinkert
 arr-flatten@1.1.0
licenses: MIT
repository: https://github.com/jonschlinkert/arr-flatten
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-2017, Jon Schlinkert.
 arr-union@3.1.0
licenses: MIT
repository: https://github.com/jonschlinkert/arr-union
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-2016, Jon Schlinkert.
array-unique@0.3.2
licenses: MIT
repository: https://github.com/jonschlinkert/array-unique
publisher: Jon Schlinkert
Copyright (c) 2014-2016, Jon Schlinkert
Copyright (c) 2014-2016, Jon Schlinkert
 assign-symbols@1.0.0
licenses: MIT
```

```
repository: https://github.com/jonschlinkert/assign-symbols
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-present, Jon Schlinkert.
 async-each@1.0.3
licenses: MIT
repository: https://github.com/paulmillr/async-each
publisher: Paul Miller
url: https://paulmillr.com/
Copyright (c) 2016 Paul Miller (paulmillr.com)
atob@2.1.2
licenses: (MIT OR Apache-2.0)
repository: git://git.coolaj86.com/coolaj86/atob.js
publisher: AJ ONeal
email: coolaj86@gmail.com
url: https://coolaj86.com
Copyright (c) 2015 AJ ONeal
balanced-match@1.0.0
licenses: MIT
repository: https://github.com/juliangruber/balanced-match
publisher: Julian Gruber
email: mail@juliangruber.com
url: http://juliangruber.com
Copyright (c) 2013 Julian Gruber
base@0.11.2
licenses: MIT
repository: https://github.com/node-base/base
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-2017, Jon Schlinkert.
binary-extensions@1.13.1
licenses: MIT
repository: https://github.com/sindresorhus/binary-extensions
publisher: Sindre Sorhus
email: sindresorhus@gmail.com
url: sindresorhus.com
Copyright (c) 2019 Sindre Sorhus (https://sindresorhus.com), Paul
Miller (https://paulmillr.com)
brace-expansion@1.1.11
licenses: MIT
repository: https://github.com/juliangruber/brace-expansion
publisher: Julian Gruber
email: mail@juliangruber.com
url: http://juliangruber.com
Copyright (c) 2013 Julian Gruber
braces@2.3.2
licenses: MIT
repository: https://github.com/micromatch/braces
```

```
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-2018, Jon Schlinkert.
browserslist@4.5.6
licenses: MIT
repository: https://github.com/browserslist/browserslist
publisher: Andrey Sitnik
email: andrey@sitnik.ru
Copyright 2014 Andrey Sitnik
 cache-base@1.0.1
licenses: MIT
repository: https://github.com/jonschlinkert/cache-base
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-2018, Jon Schlinkert.
 chalk@2.4.2
licenses: MIT
repository: https://github.com/chalk/chalk
Copyright (c) Sindre Sorhus (sindresorhus.com)
 chokidar@2.1.5
licenses: MIT
repository: https://github.com/paulmillr/chokidar
publisher: Paul Miller
url: https://paulmillr.com
Copyright (c) 2012-2019 Paul Miller (https://paulmillr.com), Elan
Shanker
 class-utils@0.3.6
licenses: MIT
repository: https://github.com/jonschlinkert/class-utils
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015, 2017-2018, Jon Schlinkert.
 collection-visit@1.0.0
licenses: MIT
repository: https://github.com/jonschlinkert/collection-visit
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-2016, Jon Schlinkert
 color-convert@1.9.3
licenses: MIT
repository: https://github.com/Qix-/color-convert
publisher: Heather Arthur
email: fayearthur@gmail.com
Copyright (c) 2011-2016 Heather Arthur
 color-name@1.1.3
licenses: MIT
repository: https://github.com/dfcreative/color-name
```

```
publisher: DY
email: dfcreative@gmail.com
Copyright (c) 2015 Dmitry Ivanov
 commander@2.20.0
licenses: MIT
repository: https://github.com/tj/commander.js
publisher: TJ Holowaychuk
email: tj@vision-media.ca
Copyright (c) 2011 TJ Holowaychuk
 component-emitter@1.3.0
licenses: MIT
repository: https://github.com/component/emitter
Copyright (c) 2014 Component contributors
 concat-map@0.0.1
licenses: MIT
repository: https://github.com/substack/node-concat-map
publisher: James Halliday
email: mail@substack.net
url: http://substack.net
No Copyright
convert-source-map@1.6.0
licenses: MIT
repository: https://github.com/thlorenz/convert-source-map
publisher: Thorsten Lorenz
email: thlorenz@gmx.de
url: http://thlorenz.com
Copyright 2013 Thorsten Lorenz.
 copy-descriptor@0.1.1
licenses: MIT
repository: https://github.com/jonschlinkert/copy-descriptor
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-2016, Jon Schlinkert
 core-js-compat@3.0.1
licenses: MIT
repository: https://github.com/zloirock/core-js
Copyright (c) 2014-2019 Denis Pushkarev
core-js-pure@3.0.1
licenses: MIT
repository: https://github.com/zloirock/core-js
Copyright (c) 2014-2019 Denis Pushkarev
 core-js@3.0.1
licenses: MIT
repository: https://github.com/zloirock/core-js
Copyright (c) 2014-2019 Denis Pushkarev
 core-util-is@1.0.2
```

```
licenses: MIT
repository: https://github.com/isaacs/core-util-is
publisher: Isaac Z. Schlueter
email: i@izs.me
url: http://blog.izs.me/
Copyright Node.js contributors. All rights reserved
debug@2.6.9
licenses: MIT
repository: https://github.com/visionmedia/debug
publisher: TJ Holowaychuk
email: tj@vision-media.ca
Copyright (c) 2014 TJ Holowaychuk
 debug@4.1.1
licenses: MIT
repository: https://github.com/visionmedia/debug
publisher: TJ Holowaychuk
email: tj@vision-media.ca
Copyright (c) 2014 TJ Holowaychuk
 decode-uri-component@0.2.0
licenses: MIT
repository: https://github.com/SamVerschueren/decode-uri-component
publisher: Sam Verschueren
email: sam.verschueren@gmail.com
url: github.com/SamVerschueren
Copyright (c) Sam Verschueren (github.com/SamVerschueren)
define-property@0.2.5
licenses: MIT
repository: https://github.com/jonschlinkert/define-property
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-2018, Jon Schlinkert.
define-property@1.0.0
licenses: MIT
repository: https://github.com/jonschlinkert/define-property
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-2018, Jon Schlinkert.
 define-property@2.0.2
licenses: MIT
repository: https://github.com/jonschlinkert/define-property
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-2018, Jon Schlinkert.
 escape-string-regexp@1.0.5
licenses: MIT
repository: https://github.com/sindresorhus/escape-string-regexp
publisher: Sindre Sorhus
email: sindresorhus@gmail.com
```

```
url: sindresorhus.com
Copyright (c) Sindre Sorhus (sindresorhus.com)
 expand-brackets@2.1.4
licenses: MIT
repository: https://github.com/jonschlinkert/expand-brackets
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-2018, Jon Schlinkert
 extend-shallow@2.0.1
licenses: MIT
repository: https://github.com/jonschlinkert/extend-shallow
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-2015, 2017, Jon Schlinkert.
 extend-shallow@3.0.2
licenses: MIT
repository: https://github.com/jonschlinkert/extend-shallow
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-2015, 2017, Jon Schlinkert.
extglob@2.0.4
licenses: MIT
repository: https://github.com/micromatch/extglob
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-2018, Jon Schlinkert.
 fill-range@4.0.0
licenses: MIT
repository: https://github.com/jonschlinkert/fill-range
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-present, Jon Schlinkert.
 for-in@1.0.2
licenses: MIT
repository: https://github.com/jonschlinkert/for-in
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-2017, Jon Schlinkert
 fragment-cache@0.2.1
licenses: MIT
repository: https://github.com/jonschlinkert/fragment-cache
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2016-2017, Jon Schlinkert
 fs-readdir-recursive@1.1.0
licenses: MIT
repository: https://github.com/fs-utils/fs-readdir-recursive
```

publisher: Jonathan Ong email: me@jongleberry.com url: http://jongleberry.com Copyright (c) 2014 Jonathan Ong me@jongleberry.com get-value@2.0.6 licenses: MIT repository: https://github.com/jonschlinkert/get-value publisher: Jon Schlinkert url: https://github.com/jonschlinkert Copyright (c) 2014-2018, Jon Schlinkert. globals@11.12.0 licenses: MIT repository: https://github.com/sindresorhus/globals publisher: Sindre Sorhus email: sindresorhus@gmail.com url: sindresorhus.com Copyright (c) Sindre Sorhus (sindresorhus.com) has-flag@3.0.0 licenses: MIT repository: https://github.com/sindresorhus/has-flag publisher: Sindre Sorhus email: sindresorhus@gmail.com url: sindresorhus.com Copyright (c) Sindre Sorhus (sindresorhus.com) has-value@0.3.1 licenses: MIT repository: https://github.com/jonschlinkert/has-value publisher: Jon Schlinkert url: https://github.com/jonschlinkert Copyright (c) 2014-2018, Jon Schlinkert. has-value@1.0.0 licenses: MIT repository: https://github.com/jonschlinkert/has-value publisher: Jon Schlinkert url: https://github.com/jonschlinkert Copyright (c) 2014-2018, Jon Schlinkert. has-values@0.1.4 licenses: MIT repository: https://github.com/jonschlinkert/has-values publisher: Jon Schlinkert url: https://github.com/jonschlinkert Copyright (c) 2014-2018, Jon Schlinkert. has-values@1.0.0 licenses: MIT repository: https://github.com/jonschlinkert/has-values publisher: Jon Schlinkert url: https://github.com/jonschlinkert Copyright (c) 2014-2018, Jon Schlinkert.

```
invariant@2.2.4
licenses: MIT
repository: https://github.com/zertosh/invariant
publisher: Andres Suarez
email: zertosh@gmail.com
Copyright (c) 2013-present, Facebook, Inc.
 is-accessor-descriptor@0.1.6
licenses: MIT
repository: https://github.com/jonschlinkert/is-accessor-descriptor
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-present, Jon Schlinkert.
 is-accessor-descriptor@1.0.0
licenses: MIT
repository: https://github.com/jonschlinkert/is-accessor-descriptor
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-present, Jon Schlinkert.
 is-binary-path@1.0.1
licenses: MIT
repository: https://github.com/sindresorhus/is-binary-path
publisher: Sindre Sorhus
email: sindresorhus@gmail.com
url: sindresorhus.com
Copyright (c) 2019 Sindre Sorhus (https://sindresorhus.com), Paul
Miller (https://paulmillr.com)
 is-buffer@1.1.6
licenses: MIT
repository: https://github.com/feross/is-buffer
publisher: Feross Aboukhadijeh
email: feross@feross.org
url: http://feross.org/
Copyright (c) Feross Aboukhadijeh
is-data-descriptor@0.1.4
licenses: MIT
repository: https://github.com/jonschlinkert/is-data-descriptor
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-present, Jon Schlinkert.
is-data-descriptor@1.0.0
licenses: MIT
repository: https://github.com/jonschlinkert/is-data-descriptor
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-present, Jon Schlinkert.
 is-descriptor@0.1.6
licenses: MIT
```

```
repository: https://github.com/jonschlinkert/is-descriptor
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-present, Jon Schlinkert.
 is-descriptor@1.0.2
licenses: MIT
repository: https://github.com/jonschlinkert/is-descriptor
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-present, Jon Schlinkert.
 is-extendable@0.1.1
licenses: MIT
repository: https://github.com/jonschlinkert/is-extendable
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-2017, Jon Schlinkert.
 is-extendable@1.0.1
licenses: MIT
repository: https://github.com/jonschlinkert/is-extendable
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-2017, Jon Schlinkert.
 is-extglob@2.1.1
licenses: MIT
repository: https://github.com/jonschlinkert/is-extglob
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-2016, Jon Schlinkert
 is-glob@3.1.0
licenses: MIT
repository: https://github.com/jonschlinkert/is-glob
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-2017, Jon Schlinkert.
 is-qlob@4.0.1
licenses: MIT
repository: https://github.com/micromatch/is-glob
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-2017, Jon Schlinkert.
 is-number@3.0.0
licenses: MIT
repository: https://github.com/jonschlinkert/is-number
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-present, Jon Schlinkert.
 is-plain-obj@1.1.0
```

```
licenses: MIT
repository: https://github.com/sindresorhus/is-plain-obj
publisher: Sindre Sorhus
email: sindresorhus@gmail.com
url: sindresorhus.com
Copyright (c) Sindre Sorhus (sindresorhus.com)
is-plain-object@2.0.4
licenses: MIT
repository: https://github.com/jonschlinkert/is-plain-object
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-2017, Jon Schlinkert.
 is-windows@1.0.2
licenses: MIT
repository: https://github.com/jonschlinkert/is-windows
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-2018, Jon Schlinkert.
 isarray@1.0.0
licenses: MIT
repository: https://github.com/juliangruber/isarray
publisher: Julian Gruber
email: mail@juliangruber.com
url: http://juliangruber.com
Copyright (c) 2013 Julian Gruber
 isobject@2.1.0
licenses: MIT
repository: https://github.com/jonschlinkert/isobject
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-2017, Jon Schlinkert.
 isobject@3.0.1
licenses: MIT
repository: https://github.com/jonschlinkert/isobject
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-2017, Jon Schlinkert.
 js-levenshtein@1.1.6
licenses: MIT
repository: https://github.com/gustf/js-levenshtein
publisher: Gustaf Andersson
email: gustaf@me.com
Copyright (c) 2017 Gustaf Andersson
 js-tokens@4.0.0
licenses: MIT
repository: https://github.com/lydell/js-tokens
publisher: Simon Lydell
Copyright (c) 2014, 2015, 2016, 2017, 2018 Simon Lydell
```

```
jsesc@0.5.0
licenses: MIT
repository: https://github.com/mathiasbynens/jsesc
publisher: Mathias Bynens
url: http://mathiasbynens.be/
Copyright Mathias Bynens
 jsesc@2.5.2
licenses: MIT
repository: https://github.com/mathiasbynens/jsesc
publisher: Mathias Bynens
url: https://mathiasbynens.be/
Copyright Mathias Bynens
 json5@2.1.0
licenses: MIT
repository: https://github.com/json5/json5
publisher: Aseem Kishore
email: aseem.kishore@gmail.com
Copyright (c) 2012-2018 Aseem Kishore, and others.
kind-of@3.2.2
licenses: MIT
repository: https://github.com/jonschlinkert/kind-of
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-2017, Jon Schlinkert.
kind-of@4.0.0
licenses: MIT
repository: https://github.com/jonschlinkert/kind-of
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-2017, Jon Schlinkert.
kind-of@5.1.0
licenses: MIT
repository: https://github.com/jonschlinkert/kind-of
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-2017, Jon Schlinkert.
kind-of@6.0.2
licenses: MIT
repository: https://github.com/jonschlinkert/kind-of
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-2017, Jon Schlinkert.
 lodash@4.17.11
licenses: MIT
repository: https://github.com/lodash/lodash
publisher: John-David Dalton
email: john.david.dalton@gmail.com
```

```
url: http://allyoucanleet.com/
Copyright JS Foundation and other contributors
 loose-envify@1.4.0
licenses: MIT
repository: https://github.com/zertosh/loose-envify
publisher: Andres Suarez
email: zertosh@qmail.com
Copyright (c) 2015 Andres Suarez
map-cache@0.2.2
licenses: MIT
repository: https://github.com/jonschlinkert/map-cache
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-2016, Jon Schlinkert.
map-visit@1.0.0
licenses: MIT
repository: https://github.com/jonschlinkert/map-visit
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-2016, Jon Schlinkert
micromatch@3.1.10
licenses: MIT
repository: https://github.com/micromatch/micromatch
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-present, Jon Schlinkert.
minimist@0.0.8
licenses: MIT
repository: https://github.com/substack/minimist
publisher: James Halliday
email: mail@substack.net
url: http://substack.net
No Copyright info
minimist@1.2.0
licenses: MIT
repository: https://github.com/substack/minimist
publisher: James Halliday
email: mail@substack.net
url: http://substack.net
No Copyright info
mixin-deep@1.3.1
licenses: MIT
repository: https://github.com/jonschlinkert/mixin-deep
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-present, Jon Schlinkert.
mkdirp@0.5.1
```

```
licenses: MIT
repository: https://github.com/substack/node-mkdirp
publisher: James Halliday
email: mail@substack.net
url: http://substack.net
Copyright 2010 James Halliday (mail@substack.net)
ms@2.0.0
licenses: MIT
repository: https://github.com/zeit/ms
Copyright (c) 2016 Zeit, Inc.
 ms@2.1.1
licenses: MIT
repository: https://github.com/zeit/ms
Copyright (c) 2016 Zeit, Inc.
nanomatch@1.2.13
licenses: MIT
repository: https://github.com/micromatch/nanomatch
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2016-2018, Jon Schlinkert.
node-releases@1.1.17
licenses: MIT
repository: https://github.com/chicoxyzzy/node-releases
publisher: Sergey Rubanov
email: chi187@gmail.com
Copyright (c) 2017 Sergey Rubanov (https://github.com/chicoxyzzy)
normalize-path@2.1.1
licenses: MIT
repository: https://github.com/jonschlinkert/normalize-path
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-2018, Jon Schlinkert.
 normalize-path@3.0.0
licenses: MIT
repository: https://github.com/jonschlinkert/normalize-path
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-2018, Jon Schlinkert.
 object-copy@0.1.0
licenses: MIT
repository: https://github.com/jonschlinkert/object-copy
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2016-2017, Jon Schlinkert
 object-visit@1.0.1
licenses: MIT
repository: https://github.com/jonschlinkert/object-visit
```

```
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015, 2017, Jon Schlinkert
 object.pick@1.3.0
licenses: MIT
repository: https://github.com/jonschlinkert/object.pick
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-2016, Jon Schlinkert.
pascalcase@0.1.1
licenses: MIT
repository: https://github.com/jonschlinkert/pascalcase
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015, Jon Schlinkert.
path-dirname@1.0.2
licenses: MIT
repository: https://github.com/es128/path-dirname
publisher: Elan Shanker
Copyright (c) Elan Shanker and Node.js contributors. All rights
reserved.
path-is-absolute@1.0.1
licenses: MIT
repository: https://github.com/sindresorhus/path-is-absolute
publisher: Sindre Sorhus
email: sindresorhus@gmail.com
url: sindresorhus.com
Copyright (c) Sindre Sorhus (sindresorhus.com)
path-parse@1.0.6
licenses: MIT
repository: https://github.com/jbgutierrez/path-parse
publisher: Javier Blanco
email: http://jbgutierrez.info
Copyright (c) 2015 Javier Blanco
posix-character-classes@0.1.1
licenses: MIT
repository: https://github.com/jonschlinkert/posix-character-classes
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2016-2017, Jon Schlinkert
private@0.1.8
licenses: MIT
repository: https://github.com/benjamn/private
publisher: Ben Newman
email: bn@cs.stanford.edu
Copyright (c) 2014 Ben Newman
process-nextick-args@2.0.0
```

```
licenses: MIT
repository: https://github.com/calvinmetcalf/process-nextick-args
Copyright (c) 2015 Calvin Metcalf
 readable-stream@2.3.6
licenses: MIT
repository: https://github.com/nodejs/readable-stream
Copyright Node.js contributors. All rights reserved.
 readdirp@2.2.1
licenses: MIT
repository: https://github.com/paulmillr/readdirp
publisher: Thorsten Lorenz
email: thlorenz@gmx.de
url: thlorenz.com
Copyright (c) 2012-2019 Thorsten Lorenz, Paul Miller (https://
paulmillr.com)
regenerate-unicode-properties@8.0.2
licenses: MIT
repository: https://github.com/mathiasbynens/regenerate-unicode-
properties
publisher: Mathias Bynens
url: https://mathiasbynens.be/
Copyright Mathias Bynens
regenerate@1.4.0
licenses: MIT
repository: https://github.com/mathiasbynens/regenerate
publisher: Mathias Bynens
url: https://mathiasbynens.be/
Copyright Mathias Bynens
regenerator-transform@0.13.4
licenses: MIT
repository: https://github.com/facebook/regenerator/tree/master/
packages/regenerator-transform
publisher: Ben Newman
email: bn@cs.stanford.edu
Copyright (c) 2014-present, Facebook, Inc.
 regex-not@1.0.2
licenses: MIT
repository: https://github.com/jonschlinkert/regex-not
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2016, 2018, Jon Schlinkert.
regexp-tree@0.1.6
licenses: MIT
repository: https://github.com/DmitrySoshnikov/regexp-tree
publisher: Dmitry Soshnikov
Copyright (c) 2017 Dmitry Soshnikov
 regexpu-core@4.5.4
```

```
licenses: MIT
repository: https://github.com/mathiasbynens/regexpu-core
publisher: Mathias Bynens
url: https://mathiasbynens.be/
Copyright Mathias Bynens
regjsgen@0.5.0
licenses: MIT
repository: https://github.com/bnjmnt4n/regjsgen
publisher: Benjamin Tan
url: https://bnjmnt4n.now.sh/
Copyright 2014-2018 Benjamin Tan
repeat-element@1.1.3
licenses: MIT
repository: https://github.com/jonschlinkert/repeat-element
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-present, Jon Schlinkert.
repeat-string@1.6.1
licenses: MIT
repository: https://github.com/jonschlinkert/repeat-string
publisher: Jon Schlinkert
url: http://github.com/jonschlinkert
Copyright (c) 2014-2015, Jon Schlinkert.
resolve-url@0.2.1
licenses: MIT
repository: https://github.com/lydell/resolve-url
publisher: Simon Lydell
Copyright (c) 2014 Simon Lydell
resolve@1.10.1
licenses: MIT
repository: https://github.com/browserify/resolve
publisher: James Halliday
email: mail@substack.net
url: http://substack.net
No Copyright Info
ret@0.1.15
licenses: MIT
repository: https://github.com/fent/ret.js
publisher: Roly Fentanes
url: https://github.com/fent
https://github.com/fent/ret.js
 safe-buffer@5.1.2
licenses: MIT
repository: https://github.com/feross/safe-buffer
publisher: Feross Aboukhadijeh
email: feross@feross.org
url: http://feross.org
Copyright (c) Feross Aboukhadijeh
```

```
safe-regex@1.1.0
licenses: MIT
repository: https://github.com/substack/safe-regex
publisher: James Halliday
email: mail@substack.net
url: http://substack.net
https://github.com/substack/safe-regex
 set-value@0.4.3
licenses: MIT
repository: https://github.com/jonschlinkert/set-value
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-2018, Jon Schlinkert.
 set-value@2.0.0
licenses: MIT
repository: https://github.com/jonschlinkert/set-value
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2014-2018, Jon Schlinkert.
 slash@2.0.0
licenses: MIT
repository: https://github.com/sindresorhus/slash
publisher: Sindre Sorhus
email: sindresorhus@gmail.com
url: sindresorhus.com
Copyright (c) Sindre Sorhus (sindresorhus.com)
 snapdragon-node@2.1.1
licenses: MIT
repository: https://github.com/jonschlinkert/snapdragon-node
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2017-present, Jon Schlinkert.
 snapdragon-util@3.0.1
licenses: MIT
repository: https://github.com/jonschlinkert/snapdragon-util
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2017-2018, Jon Schlinkert.
 snapdragon@0.8.2
licenses: MIT
repository: https://github.com/jonschlinkert/snapdragon
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2017-2018, Jon Schlinkert.
 source-map-resolve@0.5.2
licenses: MIT
repository: https://github.com/lydell/source-map-resolve
```

```
publisher: Simon Lydell
Copyright (c) 2014, 2015, 2016, 2017 Simon Lydell
 source-map-url@0.4.0
licenses: MIT
repository: https://github.com/lydell/source-map-url
publisher: Simon Lydell
Copyright (c) 2014 Simon Lydell
 split-string@3.1.0
licenses: MIT
repository: https://github.com/jonschlinkert/split-string
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-present, Jon Schlinkert.
 static-extend@0.1.2
licenses: MIT
repository: https://github.com/jonschlinkert/static-extend
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2016, Jon Schlinkert.
string_decoder@1.1.1
licenses: MIT
repository: https://github.com/nodejs/string_decoder
Copyright Node.js contributors. All rights reserved.
 supports-color@5.5.0
licenses: MIT
repository: https://github.com/chalk/supports-color
publisher: Sindre Sorhus
email: sindresorhus@gmail.com
url: sindresorhus.com
Copyright (c) Sindre Sorhus (sindresorhus.com)
 to-fast-properties@2.0.0
licenses: MIT
repository: https://github.com/sindresorhus/to-fast-properties
publisher: Sindre Sorhus
email: sindresorhus@qmail.com
url: sindresorhus.com
Copyright (c) 2014 Petka Antonov
2015 Sindre Sorhus
 to-object-path@0.3.0
licenses: MIT
repository: https://github.com/jonschlinkert/to-object-path
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-2016, Jon Schlinkert.
 to-regex-range@2.1.1
licenses: MIT
repository: https://github.com/micromatch/to-regex-range
```

```
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-present, Jon Schlinkert.
 to-regex@3.0.2
licenses: MIT
repository: https://github.com/jonschlinkert/to-regex
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2016-2018, Jon Schlinkert.
 trim-right@1.0.1
licenses: MIT
repository: https://github.com/sindresorhus/trim-right
publisher: Sindre Sorhus
email: sindresorhus@gmail.com
url: sindresorhus.com
Copyright (c) Sindre Sorhus (sindresorhus.com)
 unicode-canonical-property-names-ecmascript@1.0.4
licenses: MIT
repository: https://github.com/mathiasbynens/unicode-canonical-property-
names-ecmascript
publisher: Mathias Bynens
url: https://mathiasbynens.be/
Copyright Mathias Bynens
 unicode-match-property-ecmascript@1.0.4
licenses: MIT
repository: https://github.com/mathiasbynens/unicode-match-property-
ecmascript
publisher: Mathias Bynens
url: https://mathiasbynens.be/
Copyright Mathias Bynens
unicode-match-property-value-ecmascript@1.1.0
licenses: MIT
repository: https://github.com/mathiasbynens/unicode-match-property-
value-ecmascript
publisher: Mathias Bynens
url: https://mathiasbynens.be/
Copyright Mathias Bynens
 unicode-property-aliases-ecmascript@1.0.5
licenses: MIT
repository: https://github.com/mathiasbynens/unicode-property-aliases-
ecmascript
publisher: Mathias Bynens
url: https://mathiasbynens.be/
Copyright Mathias Bynens
 union-value@1.0.0
licenses: MIT
repository: https://github.com/jonschlinkert/union-value
publisher: Jon Schlinkert
```

```
url: https://github.com/jonschlinkert
Copyright (c) 2015-present, Jon Schlinkert.
unset-value@1.0.0
licenses: MIT
repository: https://github.com/jonschlinkert/unset-value
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015, 2017, Jon Schlinkert
upath@1.1.2
licenses: MIT
repository: https://github.com/anodynos/upath
publisher: Angelos Pikoulas
email: agelos.pikoulas@gmail.com
Copyright(c) 2014-2017 Angelos Pikoulas (agelos.pikoulas@gmail.com)
urix@0.1.0
licenses: MIT
repository: https://github.com/lydell/urix
publisher: Simon Lydell
Copyright (c) 2013 Simon Lydell
use@3.1.1
licenses: MIT
repository: https://github.com/jonschlinkert/use
publisher: Jon Schlinkert
url: https://github.com/jonschlinkert
Copyright (c) 2015-present, Jon Schlinkert.
util-deprecate@1.0.2
licenses: MIT
repository: https://github.com/TooTallNate/util-deprecate
publisher: Nathan Rajlich
email: nathan@tootallnate.net
url: http://n8.io/
Copyright (c) 2014 Nathan Rajlich
ISC
=====
The ISC License
```

Permission to use, copy, modify, and/or distribute this software for any purpose with or without fee is hereby granted, provided that the above copyright notice and this permission notice appear in all copies.

THE SOFTWARE IS PROVIDED "AS IS" AND THE AUTHOR DISCLAIMS ALL WARRANTIES WITH REGARD TO THIS SOFTWARE INCLUDING ALL IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS. IN NO EVENT SHALL THE AUTHOR BE LIABLE FOR ANY SPECIAL, DIRECT, INDIRECT, OR CONSEQUENTIAL DAMAGES OR ANY DAMAGES WHATSOEVER RESULTING FROM LOSS OF USE, DATA OR PROFITS, WHETHER IN AN ACTION OF CONTRACT, NEGLIGENCE OR OTHER TORTIOUS ACTION, ARISING OUT OF

IN CONNECTION WITH THE USE OR PERFORMANCE OF THIS SOFTWARE.

```
anymatch@2.0.0
licenses: ISC
repository: https://github.com/micromatch/anymatch
publisher: Elan Shanker
url: http://github.com/es128
Copyright (c) 2014 Elan Shanker
 electron-to-chromium@1.3.131
licenses: ISC
repository: https://github.com/kilian/electron-to-chromium
publisher: Kilian Valkhof
Copyright 2018 Kilian Valkhof
 fs.realpath@1.0.0
licenses: ISC
repository: https://github.com/isaacs/fs.realpath
publisher: Isaac Z. Schlueter
email: i@izs.me
url: http://blog.izs.me/
Copyright (c) Isaac Z. Schlueter and Contributors
glob-parent@3.1.0
licenses: ISC
repository: https://github.com/es128/glob-parent
publisher: Elan Shanker
url: https://github.com/es128
Copyright (c) 2015, 2019 Elan Shanker
glob@7.1.3
licenses: ISC
repository: https://github.com/isaacs/node-glob
publisher: Isaac Z. Schlueter
email: i@izs.me
url: http://blog.izs.me/
Copyright (c) Isaac Z. Schlueter and Contributors
graceful-fs@4.1.15
licenses: ISC
repository: https://github.com/isaacs/node-graceful-fs
Copyright (c) Isaac Z. Schlueter, Ben Noordhuis, and Contributors
 inflight@1.0.6
licenses: ISC
repository: https://github.com/npm/inflight
publisher: Isaac Z. Schlueter
email: i@izs.me
url: http://blog.izs.me/
Copyright (c) Isaac Z. Schlueter
 inherits@2.0.3
licenses: ISC
repository: https://github.com/isaacs/inherits
Copyright (c) Isaac Z. Schlueter
 minimatch@3.0.4
```

```
licenses: ISC
repository: https://github.com/isaacs/minimatch
publisher: Isaac Z. Schlueter
email: i@izs.me
url: http://blog.izs.me
Copyright (c) Isaac Z. Schlueter and Contributors
once@1.4.0
licenses: ISC
repository: https://github.com/isaacs/once
publisher: Isaac Z. Schlueter
email: i@izs.me
url: http://blog.izs.me/
Copyright (c) Isaac Z. Schlueter and Contributors
output-file-sync@2.0.1
licenses: ISC
repository: https://github.com/shinnn/output-file-sync
publisher: Shinnosuke Watanabe
url: https://github.com/shinnn
Copyright 2017 - 2018 Shinnosuke Watanabe
remove-trailing-separator@1.1.0
licenses: ISC
repository: https://github.com/darsain/remove-trailing-separator
publisher: darsain
Copyright (c) 2017 Tomas Sardyha
 semver@5.7.0
licenses: ISC
repository: https://github.com/npm/node-semver
https://github.com/npm/node-semver
 semver@6.0.0
licenses: ISC
repository: https://github.com/npm/node-semver
Copyright (c) Isaac Z. Schlueter and Contributors
wrappy@1.0.2
licenses: ISC
repository: https://github.com/npm/wrappy
publisher: Isaac Z. Schlueter
email: i@izs.me
url: http://blog.izs.me/
Copyright (c) Isaac Z. Schlueter and Contributors
BSD
=======
Redistribution and use in source and binary forms, with or without
modification, are permitted provided that the following conditions are
met:
```

- * Redistributions of source code must retain the above copyright notice, this list of conditions and the following disclaimer.
- * Redistributions in binary form must reproduce the above copyright

notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.

THIS SOFTWARE IS PROVIDED BY THE COPYRIGHT HOLDERS AND CONTRIBUTORS "AS IS"

AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO,

IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE

ARE DISCLAIMED. IN NO EVENT SHALL BE LIABLE FOR ANY

DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES

(INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES;

LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND

ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT

(INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS SOFTWARE, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

esutils@2.0.2 licenses: BSD

repository: https://github.com/estools/esutils

Copyright (C) 2013 Yusuke Suzuki (twitter: @Constellation) and other contributors.

regjsparser@0.6.0
licenses: BSD-2-Clause

repository: https://github.com/jviereck/regjsparser

publisher: 'Julian Viereck'
email: julian.viereck@gmail.com

Copyright (c) Julian Viereck and Contributors, All Rights Reserved.

source-map@0.5.7
licenses: BSD-3-Clause

repository: https://github.com/mozilla/source-map

publisher: Nick Fitzgerald
email: nfitzgerald@mozilla.com

Copyright (c) 2009-2011, Mozilla Foundation and contributors

CC-BY-4.0

=========

Attribution 4.0 International

Creative Commons Corporation ("Creative Commons") is not a law firm and does not provide legal services or legal advice. Distribution of Creative Commons public licenses does not create a lawyer-client or other relationship. Creative Commons makes its licenses and related information available on an "as-is" basis. Creative Commons gives no warranties regarding its licenses, any material licensed under their



terms and conditions, or any related information. Creative Commons disclaims all liability for damages resulting from their use to the fullest extent possible.

Using Creative Commons Public Licenses

Creative Commons public licenses provide a standard set of terms and conditions that creators and other rights holders may use to share original works of authorship and other material subject to copyright and certain other rights specified in the public license below. The following considerations are for informational purposes only, are not exhaustive, and do not form part of our licenses.

Considerations for licensors: Our public licenses are intended for use by those authorized to give the public permission to use material in ways otherwise restricted by copyright and certain other rights. Our licenses are irrevocable. Licensors should read and understand the terms and conditions of the license they choose before applying it. Licensors should also secure all rights necessary before applying our licenses so that the public can reuse the material as expected. Licensors should clearly mark any material not subject to the license. This includes other CC-licensed material, or material used under an exception or limitation to copyright. More considerations for licensors: wiki.creativecommons.org/Considerations_for_licensors

Considerations for the public: By using one of our public licenses, a licensor grants the public permission to use the licensed material under specified terms and conditions. If the licensor's permission is not necessary for any reason--for example, because of any applicable exception or limitation to copyright--then that use is not regulated by the license. Our licenses grant only permissions under copyright and certain other rights that a licensor has authority to grant. Use of the licensed material may still be restricted for other reasons, including because others have copyright or other rights in the material. A licensor may make special requests, such as asking that all changes be marked or described. Although not required by our licenses, you are encouraged to respect those requests where reasonable. More_considerations for the public:

wiki.creativecommons.org/Considerations_for_licensees

Creative Commons Attribution 4.0 International Public License

By exercising the Licensed Rights (defined below), You accept and agree to be bound by the terms and conditions of this Creative Commons Attribution 4.0 International Public License ("Public License"). To the extent this Public License may be interpreted as a contract, You are granted the Licensed Rights in consideration of Your acceptance of these terms and conditions, and the Licensor grants You such rights in consideration of benefits the Licensor receives from making the



Licensed Material available under these terms and conditions.

Section 1 -- Definitions.

- a. Adapted Material means material subject to Copyright and Similar Rights that is derived from or based upon the Licensed Material and in which the Licensed Material is translated, altered, arranged, transformed, or otherwise modified in a manner requiring permission under the Copyright and Similar Rights held by the Licensor. For purposes of this Public License, where the Licensed Material is a musical work, performance, or sound recording, Adapted Material is always produced where the Licensed Material is synched in timed relation with a moving image.
- b. Adapter's License means the license You apply to Your Copyright and Similar Rights in Your contributions to Adapted Material in accordance with the terms and conditions of this Public License.
- c. Copyright and Similar Rights means copyright and/or similar rights closely related to copyright including, without limitation, performance, broadcast, sound recording, and Sui Generis Database Rights, without regard to how the rights are labeled or categorized. For purposes of this Public License, the rights specified in Section 2(b)(1)-(2) are not Copyright and Similar Rights.
- d. Effective Technological Measures means those measures that, in the absence of proper authority, may not be circumvented under laws fulfilling obligations under Article 11 of the WIPO Copyright Treaty adopted on December 20, 1996, and/or similar international agreements.
- e. Exceptions and Limitations means fair use, fair dealing, and/or any other exception or limitation to Copyright and Similar Rights that applies to Your use of the Licensed Material.
- f. Licensed Material means the artistic or literary work, database, or other material to which the Licensor applied this Public License.
- g. Licensed Rights means the rights granted to You subject to the terms and conditions of this Public License, which are limited to all Copyright and Similar Rights that apply to Your use of the Licensed Material and that the Licensor has authority to license.
- h. Licensor means the individual(s) or entity(ies) granting rights under this Public License.
- i. Share means to provide material to the public by any means or process that requires permission under the Licensed Rights, such as reproduction, public display, public performance, distribution, dissemination, communication, or importation, and to make material available to the public including in ways that members of the public may access the material from a place and at a time



individually chosen by them.

- j. Sui Generis Database Rights means rights other than copyright resulting from Directive 96/9/EC of the European Parliament and of the Council of 11 March 1996 on the legal protection of databases, as amended and/or succeeded, as well as other essentially equivalent rights anywhere in the world.
- k. You means the individual or entity exercising the Licensed Rights under this Public License. Your has a corresponding meaning.

Section 2 -- Scope.

- a. License grant.
 - Subject to the terms and conditions of this Public License, the Licensor hereby grants You a worldwide, royalty-free, non-sublicensable, non-exclusive, irrevocable license to exercise the Licensed Rights in the Licensed Material to:
 - a. reproduce and Share the Licensed Material, in whole or in part; and
 - b. produce, reproduce, and Share Adapted Material.
 - Exceptions and Limitations. For the avoidance of doubt, where Exceptions and Limitations apply to Your use, this Public License does not apply, and You do not need to comply with its terms and conditions.
 - 3. Term. The term of this Public License is specified in Section 6(a).
 - 4. Media and formats; technical modifications allowed. The Licensor authorizes You to exercise the Licensed Rights in all media and formats whether now known or hereafter created, and to make technical modifications necessary to do so. The Licensor waives and/or agrees not to assert any right or authority to forbid You from making technical modifications necessary to exercise the Licensed Rights, including technical modifications necessary to circumvent Effective Technological Measures. For purposes of this Public License, simply making modifications authorized by this Section 2(a) (4) never produces Adapted Material.
 - 5. Downstream recipients.
 - a. Offer from the Licensor -- Licensed Material. Every recipient of the Licensed Material automatically receives an offer from the Licensor to exercise the Licensed Rights under the terms and conditions of this Public License.
 - b. No downstream restrictions. You may not offer or impose



any additional or different terms or conditions on, or apply any Effective Technological Measures to, the Licensed Material if doing so restricts exercise of the Licensed Rights by any recipient of the Licensed Material.

6. No endorsement. Nothing in this Public License constitutes or may be construed as permission to assert or imply that You are, or that Your use of the Licensed Material is, connected with, or sponsored, endorsed, or granted official status by, the Licensor or others designated to receive attribution as provided in Section 3(a)(1)(A)(i).

b. Other rights.

- 1. Moral rights, such as the right of integrity, are not licensed under this Public License, nor are publicity, privacy, and/or other similar personality rights; however, to the extent possible, the Licensor waives and/or agrees not to assert any such rights held by the Licensor to the limited extent necessary to allow You to exercise the Licensed Rights, but not otherwise.
- Patent and trademark rights are not licensed under this Public License.
- 3. To the extent possible, the Licensor waives any right to collect royalties from You for the exercise of the Licensed Rights, whether directly or through a collecting society under any voluntary or waivable statutory or compulsory licensing scheme. In all other cases the Licensor expressly reserves any right to collect such royalties.

Section 3 -- License Conditions.

Your exercise of the Licensed Rights is expressly made subject to the following conditions.

a. Attribution.

- 1. If You Share the Licensed Material (including in modified form), You must:
 - a. retain the following if it is supplied by the Licensor with the Licensed Material:
 - i. identification of the creator(s) of the Licensed Material and any others designated to receive attribution, in any reasonable manner requested by the Licensor (including by pseudonym if designated);
 - ii. a copyright notice;



- iii. a notice that refers to this Public License;
- iv. a notice that refers to the disclaimer of
 warranties;
- v. a URI or hyperlink to the Licensed Material to the extent reasonably practicable;
- b. indicate if You modified the Licensed Material and retain an indication of any previous modifications; and
- c. indicate the Licensed Material is licensed under this Public License, and include the text of, or the URI or hyperlink to, this Public License.
- 2. You may satisfy the conditions in Section 3(a)(1) in any reasonable manner based on the medium, means, and context in which You Share the Licensed Material. For example, it may be reasonable to satisfy the conditions by providing a URI or hyperlink to a resource that includes the required information.
- 3. If requested by the Licensor, You must remove any of the information required by Section 3(a)(1)(A) to the extent reasonably practicable.
- 4. If You Share Adapted Material You produce, the Adapter's License You apply must not prevent recipients of the Adapted Material from complying with this Public License.

Section 4 -- Sui Generis Database Rights.

Where the Licensed Rights include Sui Generis Database Rights that apply to Your use of the Licensed Material:

- a. for the avoidance of doubt, Section 2(a)(1) grants You the right to extract, reuse, reproduce, and Share all or a substantial portion of the contents of the database;
- b. if You include all or a substantial portion of the database contents in a database in which You have Sui Generis Database Rights, then the database in which You have Sui Generis Database Rights (but not its individual contents) is Adapted Material; and
- c. You must comply with the conditions in Section 3(a) if You Share all or a substantial portion of the contents of the database.

For the avoidance of doubt, this Section 4 supplements and does not replace Your obligations under this Public License where the Licensed Rights include other Copyright and Similar Rights.

Section 5 -- Disclaimer of Warranties and Limitation of Liability.



- a. UNLESS OTHERWISE SEPARATELY UNDERTAKEN BY THE LICENSOR, TO THE EXTENT POSSIBLE, THE LICENSOR OFFERS THE LICENSED MATERIAL AS-IS AND AS-AVAILABLE, AND MAKES NO REPRESENTATIONS OR WARRANTIES OF ANY KIND CONCERNING THE LICENSED MATERIAL, WHETHER EXPRESS, IMPLIED, STATUTORY, OR OTHER. THIS INCLUDES, WITHOUT LIMITATION, WARRANTIES OF TITLE, MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE, NON-INFRINGEMENT, ABSENCE OF LATENT OR OTHER DEFECTS, ACCURACY, OR THE PRESENCE OR ABSENCE OF ERRORS, WHETHER OR NOT KNOWN OR DISCOVERABLE. WHERE DISCLAIMERS OF WARRANTIES ARE NOT ALLOWED IN FULL OR IN PART, THIS DISCLAIMER MAY NOT APPLY TO YOU.
- b. TO THE EXTENT POSSIBLE, IN NO EVENT WILL THE LICENSOR BE LIABLE TO YOU ON ANY LEGAL THEORY (INCLUDING, WITHOUT LIMITATION, NEGLIGENCE) OR OTHERWISE FOR ANY DIRECT, SPECIAL, INDIRECT, INCIDENTAL, CONSEQUENTIAL, PUNITIVE, EXEMPLARY, OR OTHER LOSSES, COSTS, EXPENSES, OR DAMAGES ARISING OUT OF THIS PUBLIC LICENSE OR USE OF THE LICENSED MATERIAL, EVEN IF THE LICENSOR HAS BEEN ADVISED OF THE POSSIBILITY OF SUCH LOSSES, COSTS, EXPENSES, OR DAMAGES. WHERE A LIMITATION OF LIABILITY IS NOT ALLOWED IN FULL OR IN PART, THIS LIMITATION MAY NOT APPLY TO YOU.
- c. The disclaimer of warranties and limitation of liability provided above shall be interpreted in a manner that, to the extent possible, most closely approximates an absolute disclaimer and waiver of all liability.

Section 6 -- Term and Termination.

- a. This Public License applies for the term of the Copyright and Similar Rights licensed here. However, if You fail to comply with this Public License, then Your rights under this Public License terminate automatically.
- b. Where Your right to use the Licensed Material has terminated under Section 6(a), it reinstates:
 - automatically as of the date the violation is cured, provided it is cured within 30 days of Your discovery of the violation; or
 - 2. upon express reinstatement by the Licensor.

For the avoidance of doubt, this Section 6(b) does not affect any right the Licensor may have to seek remedies for Your violations of this Public License.

- c. For the avoidance of doubt, the Licensor may also offer the Licensed Material under separate terms or conditions or stop distributing the Licensed Material at any time; however, doing so will not terminate this Public License.
- d. Sections 1, 5, 6, 7, and 8 survive termination of this Public License.



Section 7 -- Other Terms and Conditions.

- a. The Licensor shall not be bound by any additional or different terms or conditions communicated by You unless expressly agreed.
- b. Any arrangements, understandings, or agreements regarding the Licensed Material not stated herein are separate from and independent of the terms and conditions of this Public License.

Section 8 -- Interpretation.

- a. For the avoidance of doubt, this Public License does not, and shall not be interpreted to, reduce, limit, restrict, or impose conditions on any use of the Licensed Material that could lawfully be made without permission under this Public License.
- b. To the extent possible, if any provision of this Public License is deemed unenforceable, it shall be automatically reformed to the minimum extent necessary to make it enforceable. If the provision cannot be reformed, it shall be severed from this Public License without affecting the enforceability of the remaining terms and conditions.
- c. No term or condition of this Public License will be waived and no failure to comply consented to unless expressly agreed to by the Licensor.
- d. Nothing in this Public License constitutes or may be interpreted as a limitation upon, or waiver of, any privileges and immunities that apply to the Licensor or You, including from the legal processes of any jurisdiction or authority.

Creative Commons is not a party to its public licenses. Notwithstanding, Creative Commons may elect to apply one of its public licenses to material it publishes and in those instances will be considered the "Licensor." The text of the Creative Commons public licenses is dedicated to the public domain under the CCO Public Domain Dedication. Except for the limited purpose of indicating that material is shared under a Creative Commons public license or as otherwise permitted by the Creative Commons policies published at creativecommons.org/policies, Creative Commons does not authorize the use of the trademark "Creative Commons" or any other trademark or logo of Creative Commons without its prior written consent including, without limitation, in connection with any unauthorized modifications to any of its public licenses or any other arrangements, understandings, or agreements concerning use of licensed material. For the avoidance of doubt, this paragraph does not form part of the public licenses.

Creative Commons may be contacted at creativecommons.org.



caniuse-lite@1.0.30000966

licenses: CC-BY-4.0

repository: https://github.com/ben-eb/caniuse-lite

publisher: Ben Briggs
email: beneb.info@gmail.com

The data in this repo is available for use under a CC BY 4.0 license

(http://creativecommons.org/licenses/by/4.0/).

For attribution just mention somewhere that the source is caniuse.com

CodeMirror 5.53.2

MIT License

Copyright (C) 2017 by Marijn Haverbeke and others

Permission is hereby granted, free of charge, to any person obtaining a copy

of this software and associated documentation files (the "Software"), to deal

in the Software without restriction, including without limitation the rights

to use, copy, modify, merge, publish, distribute, sublicense, and/or sell

copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in

all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR

IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE

AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM,

OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN

THE SOFTWARE.

Dexie.js 3.0.1

Dexie.js

Copyright (c) 2014-2017 David Fahlander



Licensed under the Apache License, Version 2.0 (the "License"); you may not use this file except in compliance with the License. You may obtain a copy of the License at

http://www.apache.org/licenses/LICENSE-2.0

Unless required by applicable law or agreed to in writing, software distributed under the License is distributed on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied. See the License for the specific language governing permissions and limitations under the License.

Apache License

Version 2.0, January 2004
http://www.apache.org/licenses/

TERMS AND CONDITIONS FOR USE, REPRODUCTION, AND DISTRIBUTION

1. Definitions.

"License" shall mean the terms and conditions for use, reproduction,

and distribution as defined by Sections 1 through 9 of this document.

"Licensor" shall mean the copyright owner or entity authorized by the copyright owner that is granting the License.

"Legal Entity" shall mean the union of the acting entity and all other entities that control, are controlled by, or are under common

control with that entity. For the purposes of this definition, "control" means (i) the power, direct or indirect, to cause the direction or management of such entity, whether by contract or otherwise, or (ii) ownership of fifty percent (50%) or more of the outstanding shares, or (iii) beneficial ownership of such entity.

"You" (or "Your") shall mean an individual or Legal Entity exercising permissions granted by this License.

"Source" form shall mean the preferred form for making modifications,

including but not limited to software source code, documentation source, and configuration files.

"Object" form shall mean any form resulting from mechanical transformation or translation of a Source form, including but not limited to compiled object code, generated documentation, and conversions to other media types.

"Work" shall mean the work of authorship, whether in Source or Object form, made available under the License, as indicated by a copyright notice that is included in or attached to the work (an example is provided in the Appendix below).

"Derivative Works" shall mean any work, whether in Source or



Object

form, that is based on (or derived from) the Work and for which the $\ensuremath{\,}^{}$

editorial revisions, annotations, elaborations, or other modifications

represent, as a whole, an original work of authorship. For the purposes

of this License, Derivative Works shall not include works that remain

separable from, or merely link (or bind by name) to the interfaces of,

the Work and Derivative Works thereof.

"Contribution" shall mean any work of authorship, including the original version of the Work and any modifications or additions

to that Work or Derivative Works thereof, that is intentionally submitted to Licensor for inclusion in the Work by the copyright owner

or by an individual or Legal Entity authorized to submit on behalf of

the copyright owner. For the purposes of this definition, "submitted" $% \frac{1}{2}$

 $% \left(1\right) =\left(1\right) \left(1\right) +\left(1\right) +\left(1\right) \left(1\right) +\left(1\right) \left(1\right) +\left(1\right) +\left(1\right) \left(1\right) +\left(1\right) +\left(1\right) \left(1\right) +\left(1$

to the Licensor or its representatives, including but not limited to

communication on electronic mailing lists, source code control systems,

and issue tracking systems that are managed by, or on behalf of, the $% \left(1\right) =\left(1\right) \left(1\right) +\left(1\right) \left(1\right) \left(1\right) +\left(1\right) \left(1\right) \left($

Licensor for the purpose of discussing and improving the Work, but excluding communication that is conspicuously marked or otherwise designated in writing by the copyright owner as "Not a Contribution."

"Contributor" shall mean Licensor and any individual or Legal Entity

on behalf of whom a Contribution has been received by Licensor and subsequently incorporated within the Work.

- 2. Grant of Copyright License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable copyright license to reproduce, prepare Derivative Works of, publicly display, publicly perform, sublicense, and distribute the Work and such Derivative Works in Source or Object form.
- 3. Grant of Patent License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable (except as stated in this section) patent license to make, have made,

use, offer to sell, sell, import, and otherwise transfer the Work, where such license applies only to those patent claims licensable



by such Contributor that are necessarily infringed by their Contribution(s) alone or by combination of their Contribution(s) with the Work to which such Contribution(s) was submitted. If You institute patent litigation against any entity (including a cross-claim or counterclaim in a lawsuit) alleging that the Work or a Contribution incorporated within the Work constitutes direct or contributory patent infringement, then any patent licenses granted to You under this License for that Work shall terminate as of the date such litigation is filed.

- 4. Redistribution. You may reproduce and distribute copies of the Work or Derivative Works thereof in any medium, with or without modifications, and in Source or Object form, provided that You meet the following conditions:
 - (a) You must give any other recipients of the Work or Derivative Works a copy of this License; and
 - (b) You must cause any modified files to carry prominent notices stating that You changed the files; and
 - (c) You must retain, in the Source form of any Derivative Works that You distribute, all copyright, patent, trademark, and attribution notices from the Source form of the Work, excluding those notices that do not pertain to any part of the Derivative Works; and
- (d) If the Work includes a "NOTICE" text file as part of its distribution, then any Derivative Works that You distribute

must

include a readable copy of the attribution notices contained within such NOTICE file, excluding those notices that do not pertain to any part of the Derivative Works, in at least one of the following places: within a NOTICE text file distributed as part of the Derivative Works; within the Source form or documentation, if provided along with the Derivative Works;

or,

within a display generated by the Derivative Works, if and wherever such third-party notices normally appear. The $\,$

contents

of the NOTICE file are for informational purposes only and do not modify the License. You may add Your own attribution notices within Derivative Works that You distribute, alongside or as an addendum to the NOTICE text from the Work, provided that such additional attribution notices cannot be construed as modifying the License.

You may add Your own copyright statement to Your modifications and may provide additional or different license terms and conditions for use, reproduction, or distribution of Your modifications, or for any such Derivative Works as a whole, provided Your use, reproduction, and distribution of the Work otherwise complies with the conditions stated in this License.

5. Submission of Contributions. Unless You explicitly state



otherwise,

any Contribution intentionally submitted for inclusion in the Work by You to the Licensor shall be under the terms and conditions of this License, without any additional terms or conditions.

Notwithstanding the above, nothing herein shall supersede or modify

the terms of any separate license agreement you may have executed with Licensor regarding such Contributions.

6. Trademarks. This License does not grant permission to use the trade

names, trademarks, service marks, or product names of the Licensor, $% \left(1\right) =\left(1\right) \left(1\right) +\left(1\right) \left(1\right) \left(1\right) +\left(1\right) \left(1$

except as required for reasonable and customary use in describing the $% \left(1\right) =\left(1\right) \left(1\right)$

origin of the Work and reproducing the content of the NOTICE file.

7. Disclaimer of Warranty. Unless required by applicable law or agreed to in writing, Licensor provides the Work (and each Contributor provides its Contributions) on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied, including, without limitation, any warranties or conditions

of TITLE, NON-INFRINGEMENT, MERCHANTABILITY, or FITNESS FOR A PARTICULAR PURPOSE. You are solely responsible for determining the appropriateness of using or redistributing the Work and assume any risks associated with Your exercise of permissions under this License.

8. Limitation of Liability. In no event and under no legal theory, whether in tort (including negligence), contract, or otherwise, unless required by applicable law (such as deliberate and grossly negligent acts) or agreed to in writing, shall any Contributor be liable to You for damages, including any direct, indirect, special,

incidental, or consequential damages of any character arising as a result of this License or out of the use or inability to use the Work (including but not limited to damages for loss of goodwill, work stoppage, computer failure or malfunction, or any and all other commercial damages or losses), even if such Contributor has been advised of the possibility of such damages.

9. Accepting Warranty or Additional Liability. While redistributing the Work or Derivative Works thereof, You may choose to offer, and charge a fee for, acceptance of support, warranty, indemnity, or other liability obligations and/or rights consistent with this License. However, in accepting such obligations, You may act only on Your own behalf and on Your sole responsibility, not on behalf of any other Contributor, and only if You agree to indemnify, defend, and hold each Contributor harmless for any liability incurred by, or claims asserted against, such Contributor by reason

of your accepting any such warranty or additional liability.

END OF TERMS AND CONDITIONS



APPENDIX: How to apply the Apache License to your work.

To apply the Apache License to your work, attach the following boilerplate notice, with the fields enclosed by brackets "{}" replaced with your own identifying information. (Don't include the brackets!) The text should be enclosed in the appropriate comment syntax for the file format. We also recommend that a file or class name and description of purpose be included on the same "printed page" as the copyright notice for easier identification within third-party archives.

Copyright {yyyy} {name of copyright owner}

Licensed under the Apache License, Version 2.0 (the "License"); you may not use this file except in compliance with the License. You may obtain a copy of the License at

http://www.apache.org/licenses/LICENSE-2.0

Unless required by applicable law or agreed to in writing, software distributed under the License is distributed on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.

See the License for the specific language governing permissions and limitations under the License.

SheetJS 0 15 5

```
SheetJS is licensed under Apache 2.0. License Text below.
SheetJS bundles 4th party JSZip which is dependent on Pako. The
copyright and license text is here.
JSZip - A Javascript class for generating and reading zip files
(c) 2009-2014 Stuart Knightley
Dual licenced under the MIT license or GPLv3. See https://
raw.github.com/Stuk/jszip/master/LICENSE.markdown.
JSZip uses the library pako released under the MIT license :
https://github.com/nodeca/pako/blob/master/LICENSE
Note: since JSZip 3 removed critical functionality, this version
assigns to the
`JSZipSync` variable. Another JSZip version can be loaded in parallel.
_____
Apache License
                         Version 2.0, January 2004
                      http://www.apache.org/licenses/
```

TERMS AND CONDITIONS FOR USE, REPRODUCTION, AND DISTRIBUTION

1. Definitions.

"License" shall mean the terms and conditions for use, reproduction.

and distribution as defined by Sections 1 through 9 of this document.

"Licensor" shall mean the copyright owner or entity authorized by the copyright owner that is granting the License.

"Legal Entity" shall mean the union of the acting entity and all other entities that control, are controlled by, or are under common

control with that entity. For the purposes of this definition, "control" means (i) the power, direct or indirect, to cause the direction or management of such entity, whether by contract or otherwise, or (ii) ownership of fifty percent (50%) or more of the outstanding shares, or (iii) beneficial ownership of such entity.

"You" (or "Your") shall mean an individual or Legal Entity exercising permissions granted by this License.

"Source" form shall mean the preferred form for making modifications, $% \left(\frac{1}{2}\right) =\frac{1}{2}\left(\frac{1}{2}\right) ^{2}$

including but not limited to software source code, documentation source, and configuration files.

"Object" form shall mean any form resulting from mechanical transformation or translation of a Source form, including but not limited to compiled object code, generated documentation, and conversions to other media types.

"Work" shall mean the work of authorship, whether in Source or Object form, made available under the License, as indicated by a copyright notice that is included in or attached to the work (an example is provided in the Appendix below).

"Derivative Works" shall mean any work, whether in Source or Object $% \left(1\right) =\left(1\right) \left(1\right) +\left(1\right) \left(1\right) \left(1\right) +\left(1\right) \left(1$

form, that is based on (or derived from) the Work and for which the $\,$

editorial revisions, annotations, elaborations, or other ${\tt modifications}$

represent, as a whole, an original work of authorship. For the purposes

of this License, Derivative Works shall not include works that $\ensuremath{\mathsf{remain}}$

separable from, or merely link (or bind by name) to the interfaces of, $% \left(1\right) =\left(1\right) \left(1\right) \left($

the Work and Derivative Works thereof.

"Contribution" shall mean any work of authorship, including the original version of the Work and any modifications or additions

to that Work or Derivative Works thereof, that is intentionally



submitted to Licensor for inclusion in the Work by the copyright owner

or by an individual or Legal Entity authorized to submit on behalf of

the copyright owner. For the purposes of this definition, "submitted" $% \left(\frac{1}{2}\right) =\frac{1}{2}\left(\frac{1}{2}\right) ^{2}$

 $\ensuremath{\mathsf{means}}$ any form of electronic, verbal, or written communication sent

to the Licensor or its representatives, including but not limited to

communication on electronic mailing lists, source code control systems,

and issue tracking systems that are managed by, or on behalf of, the $% \left(1\right) =\left(1\right) \left(1\right) +\left(1\right) \left(1\right) \left(1\right) +\left(1\right) \left(1\right) \left($

Licensor for the purpose of discussing and improving the Work, but excluding communication that is conspicuously marked or otherwise designated in writing by the copyright owner as "Not a Contribution."

"Contributor" shall mean Licensor and any individual or Legal Entity

on behalf of whom a Contribution has been received by Licensor and subsequently incorporated within the Work.

- 2. Grant of Copyright License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable copyright license to reproduce, prepare Derivative Works of, publicly display, publicly perform, sublicense, and distribute the Work and such Derivative Works in Source or Object form.
- 3. Grant of Patent License. Subject to the terms and conditions of this License, each Contributor hereby grants to You a perpetual, worldwide, non-exclusive, no-charge, royalty-free, irrevocable (except as stated in this section) patent license to make, have made,

use, offer to sell, sell, import, and otherwise transfer the Work, where such license applies only to those patent claims licensable by such Contributor that are necessarily infringed by their Contribution(s) alone or by combination of their Contribution(s) with the Work to which such Contribution(s) was submitted. If You institute patent litigation against any entity (including a cross-claim or counterclaim in a lawsuit) alleging that the Work or a Contribution incorporated within the Work constitutes direct or contributory patent infringement, then any patent licenses granted to You under this License for that Work shall terminate as of the date such litigation is filed.

- 4. Redistribution. You may reproduce and distribute copies of the Work or Derivative Works thereof in any medium, with or without modifications, and in Source or Object form, provided that You meet the following conditions:
 - (a) You must give any other recipients of the Work or Derivative Works a copy of this License; and



- (b) You must cause any modified files to carry prominent notices stating that You changed the files; and
- (c) You must retain, in the Source form of any Derivative Works that You distribute, all copyright, patent, trademark, and attribution notices from the Source form of the Work, excluding those notices that do not pertain to any part of the Derivative Works; and
- (d) If the Work includes a "NOTICE" text file as part of its distribution, then any Derivative Works that You distribute

must

include a readable copy of the attribution notices contained within such NOTICE file, excluding those notices that do not pertain to any part of the Derivative Works, in at least one of the following places: within a NOTICE text file distributed as part of the Derivative Works; within the Source form or documentation, if provided along with the Derivative Works;

or,

within a display generated by the Derivative Works, if and wherever such third-party notices normally appear. The $\,$

contents

of the NOTICE file are for informational purposes only and do not modify the License. You may add Your own attribution notices within Derivative Works that You distribute, alongside or as an addendum to the NOTICE text from the Work, provided that such additional attribution notices cannot be construed as modifying the License.

You may add Your own copyright statement to Your modifications and may provide additional or different license terms and conditions for use, reproduction, or distribution of Your modifications, or for any such Derivative Works as a whole, provided Your use, reproduction, and distribution of the Work otherwise complies with the conditions stated in this License.

5. Submission of Contributions. Unless You explicitly state otherwise,

any Contribution intentionally submitted for inclusion in the Work by You to the Licensor shall be under the terms and conditions of this License, without any additional terms or conditions.

Notwithstanding the above, nothing herein shall supersede or \mbox{modify}

the terms of any separate license agreement you may have executed with Licensor regarding such Contributions.

6. Trademarks. This License does not grant permission to use the trade

names, trademarks, service marks, or product names of the Licensor, $\$

except as required for reasonable and customary use in describing the $% \left(1\right) =\left(1\right) \left(1\right)$

origin of the Work and reproducing the content of the NOTICE file.



7. Disclaimer of Warranty. Unless required by applicable law or agreed to in writing, Licensor provides the Work (and each Contributor provides its Contributions) on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied, including, without limitation, any warranties or conditions

of TITLE, NON-INFRINGEMENT, MERCHANTABILITY, or FITNESS FOR A PARTICULAR PURPOSE. You are solely responsible for determining the appropriateness of using or redistributing the Work and assume any risks associated with Your exercise of permissions under this License.

8. Limitation of Liability. In no event and under no legal theory, whether in tort (including negligence), contract, or otherwise, unless required by applicable law (such as deliberate and grossly negligent acts) or agreed to in writing, shall any Contributor be liable to You for damages, including any direct, indirect, special,

incidental, or consequential damages of any character arising as a result of this License or out of the use or inability to use the Work (including but not limited to damages for loss of goodwill, work stoppage, computer failure or malfunction, or any and all other commercial damages or losses), even if such Contributor has been advised of the possibility of such damages.

9. Accepting Warranty or Additional Liability. While redistributing the Work or Derivative Works thereof, You may choose to offer, and charge a fee for, acceptance of support, warranty, indemnity, or other liability obligations and/or rights consistent with this License. However, in accepting such obligations, You may act only on Your own behalf and on Your sole responsibility, not on behalf of any other Contributor, and only if You agree to indemnify, defend, and hold each Contributor harmless for any liability incurred by, or claims asserted against, such Contributor by reason

of your accepting any such warranty or additional liability.

END OF TERMS AND CONDITIONS

APPENDIX: How to apply the Apache License to your work.

To apply the Apache License to your work, attach the following boilerplate notice, with the fields enclosed by brackets "{}" replaced with your own identifying information. (Don't include the brackets!) The text should be enclosed in the appropriate comment syntax for the file format. We also recommend that a file or class name and description of purpose be included on the same "printed page" as the copyright notice for easier identification within third-party archives.

Copyright (C) 2012-present SheetJS LLC

Licensed under the Apache License, Version 2.0 (the "License"); you may not use this file except in compliance with the License. You may obtain a copy of the License at



http://www.apache.org/licenses/LICENSE-2.0

Unless required by applicable law or agreed to in writing, software distributed under the License is distributed on an "AS IS" BASIS, WITHOUT WARRANTIES OR CONDITIONS OF ANY KIND, either express or implied.

See the License for the specific language governing permissions and limitations under the License.

jQuery 3.5.1

Copyright JS Foundation and other contributors, https://js.foundation/

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish, distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

external/sizzle

Copyright JS Foundation and other contributors, https://js.foundation/

This software consists of voluntary contributions made by many individuals. For exact contribution history, see the revision history available at https://github.com/jquery/sizzle

The following license applies to all parts of this software except as documented below:

====

Permission is hereby granted, free of charge, to any person obtaining a copy of this software and associated documentation files (the "Software"), to deal in the Software without restriction, including without limitation the rights to use, copy, modify, merge, publish,



distribute, sublicense, and/or sell copies of the Software, and to permit persons to whom the Software is furnished to do so, subject to the following conditions:

The above copyright notice and this permission notice shall be included in all copies or substantial portions of the Software.

THE SOFTWARE IS PROVIDED "AS IS", WITHOUT WARRANTY OF ANY KIND, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO THE WARRANTIES OF MERCHANTABILITY, FITNESS FOR A PARTICULAR PURPOSE AND NONINFRINGEMENT. IN NO EVENT SHALL THE AUTHORS OR COPYRIGHT HOLDERS BE LIABLE FOR ANY CLAIM, DAMAGES OR OTHER LIABILITY, WHETHER IN AN ACTION OF CONTRACT, TORT OR OTHERWISE, ARISING FROM, OUT OF OR IN CONNECTION WITH THE SOFTWARE OR THE USE OR OTHER DEALINGS IN THE SOFTWARE.

====

All files located in the node_modules and external directories are externally maintained libraries used by this software which have their own licenses; we recommend you read them, as their terms may differ from the terms above.



Index

A	Cross Site Request Forgery (CSRF) attacks, D-13
access token	CSRF (Cross Site Request Forgery) attacks,
acquiring, <i>D-12</i>	D-13
securing, D-19	cURL, 5-5
using, D-14	,
Apache Tomcat, 1-2	D
about, 1-42	D
configuring Oracle REST Data Services	database users, 1-4
images, 1-42	defaults.xml
deploying to, 1-42	enabling detailed request error messages,
downloading, 1-42	C-1
authentication	defaults.xmll, file format, <i>B-2</i>
against WebLogic user repositories, 5-77	DEFINE_HANDLER procedure, 8-4, 9-2
angeni sa a a a a a gra a a a a a a a p a a a a a a a a a	DEFINE_MODULE procedure, 8-6, 9-4
В	DEFINE_PARAMETER procedure, 8-7, 9-5
В	DEFINE_PRIVILEGE procedure, 8-9, 9-7
bequeath connection, 1-46	DEFINE_SERVICE procedure, 8-11, 9-10
·	<u> </u>
browser origins, <i>D-15</i>	DEFINE_TEMPLATE procedure, 8-14, 9-13
	DELETE_CLIENT procedure, 11-2
C	DELETE_MODULE procedure, 8-16, 9-14
	DELETE_PRIVILEGE procedure, 8-16, 9-15
command-line interface, 1-4	DELETE_ROLE procedure, 8-17, 9-15
configdir command, <i>B-1</i>	deploy options
locating configuration files, <i>B-1</i>	Apache Tomcat, 1-42
locating configuration folder, <i>B-1</i>	deployment options
configuration file editable parameters	Oracle WebLogic Server, 1-37
jdbc.MaxConnectionReuseCount, B-5	DER
jdbc.MinLimit, B-6	converting private key to DER, 1-35
security.requestValidationFunction, <i>B-10</i>	downloading
security.verifySSL, <i>B-10</i>	Apache Tomcat, 1-42
soda.defaultLimit, B-10	Oracle WebLogic Server, 1-37
soda.maxLimit, <i>B-10</i>	DROP_REST_FOR_SCHEMA procedure, 8-17,
configuration files, <i>B-1</i>	9-16
format of, B-2	
locating using configdir command, B-1	E
configuration folder	
setting location, <i>B-1</i>	ENABLE_OBJECT procedure, 8-18, 9-17, 9-24,
structure of, B-1	9-25
CORS (Cross Origin Resource Sharing), D-15	ENABLE_SCHEMA procedure, 8-19, 9-19
CREATE_CLIENT procedure, 11-1	
CREATE_ROLE procedure, 8-1, 9-1	
CREATE_SERVICE procedure (deprecated), 8-1	
Cross Origin Resource Sharing (CORS), D-15	



G	Oracle REST Data Services (continued)
ClassFish Comiss	environment, 2-5
GlassFish Server	Excel settings, 2-5
installing the deployment, 1-43	installation overview, 1-3
GRANT_CLIENT_ROLE procedure, 11-3 graphical user interface administration, 1-32	installing, 1-3
graphical user interface auministration, 1-32	PL/SQL API for Oracle REST Data
	PL/SQL API for Oracle REST Data
<u> </u>	Services, 5-82
	pre- and post- processing, 2-5 running in standalone mode, 1-34
image gallery example, <i>D-1</i>	security, 2-5
installation options	system requirements, 1-2
standalone mode, 1-34	Oracle REST Data Services configuration file
installation overview, 1-3	enabling detailed request error messages,
	C-1
J	Oracle REST Data Services package
	CREATE_SERVICE (deprecated), 8-1
Java EE application servers	Oracle WebLogic Server, 1-2
about supported, 1-2	about, 1-37
JSON	deploy to, 1-37
using to pass parameters, 5-32	downloading, 1-37
	installing, 1-37
M	installing the deployment, 1-39
	- · · ·
multiple database configuration, 2-1	ORDS package
about the request URL, 2-1	CREATE_ROLE, <i>8-1</i> , <i>9-1</i>
configuring additional databases, 2-2	DEFINE MODULE, 8-4, 9-2
routing request rules, 2-3	DEFINE DAPAMETER 8.7.0.5
routing requests based on URL prefix, 2-4	DEFINE_PARAMETER, 8-7, 9-5
	DEFINE_PRIVILEGE, 8-9, 9-7
	DEFINE_SERVICE, 8-11, 9-10
0	DEFINE_TEMPLATE, 8-14, 9-13
OAUTH package	DELETE_MODULE, 8-16, 9-14
CREATE_CLIENT, 11-1	DELETE_PRIVILEGE, 8-16, 9-15
DELETE_CLIENT, 11-2	DELETE_ROLE, 8-17, 9-15
GRANT_CLIENT_ROLE, 11-3	DROP_REST_FOR_SCHEMA, 8-17, 9-16
RENAME_CLIENT, 11-4	ENABLE_OBJECT, 8-18, 9-17, 9-24, 9-25
REVOKE CLIENT ROLE, 11-4	ENABLE_SCHEMA, 8-19, 9-19
UPDATE_CLIENT, 11-5	PUBLISH_MODULE, 8-20, 9-20
OAuth2, default behavior, 1-33	RENAME_MODULE, 8-21, 9-20
Oracle REST Data Services	RENAME_PRIVILEGE, 8-22, 9-21
	RENAME_ROLE, 8-22, 9-22
about, 1-1	SET_MODULE_ORIGINS_ALLOWED, 8-23,
about upgrading, 1-44	9-23
administering with graphical user interface,	SET_URL_MAPPING, <i>8-24</i> , <i>9-23</i>
1-32	
bequeath connection, 1-46	Р
caching, 2-5	<u></u>
configuration files, <i>B-1</i>	passing parameters
configuring, 1-3, 1-7, 2-1	using JSON, 5-32
configuring multiple databases, 2-1	using query strings, 5-40
configuring with command-line interface, 1-4,	using route patterns, 5-36
1-7	private key
database users, 1-4	converting to DER, 1-35
developing RESTful services, 2-7	PUBLISH_MODULE procedure, 8-20, 9-20
downloading, 1-3	. 532.6.155622 procedure, 6 20, 6 20

R	SET_URL_MAPPING procedure, 8-24, 9-23 SQL Developer Oracle REST Data Services Administration, 1-32
RENAME CLIENT procedure, 11-4	
RENAME MODULE procedure, 8-21, 9-20	standalone mode
RENAME PRIVILEGE procedure, 8-22, 9-21	starting, 1-34
RENAME ROLE procedure, 8-22, 9-22	stopping the server, 1-36
resource handler, 5-3	standalone mode, running in, <i>1-34</i>
resource module, 5-3	structure of configuration folder, <i>B-1</i>
resource template, 5-3	supported Java EE application servers, 1-2
RESTful services	system requirements, 1-2
about, 5-2	
accessing from third-party application, <i>D-11</i>	т
configuring for cross-origin resource sharing,	Т
D-15	troubleshooting, <i>C-1</i>
developing, 2-7	enabling detailed request error messages,
getting started with, 5-2	C-1
image gallery example, <i>D-1</i>	
integrating with existing group/role models,	11
5-79	U
sample services, 5-55	UPDATE CLIENT procedure, 11-5
securing, <i>D-8</i>	upsert operation, 5-15
terminology, 5-3	URI pattern, 5-3
user roles, 5-74	URI template, 5-3
using cURL, 5-5	url-mapping.xml
REVOKE_CLIENT_ROLE procedure, 11-4	file format, B-2
role-mapping.xml file, 5-79	request rules routing, B-2
route pattern, 5-3	user roles for RESTful services, 5-74
	using query strings
S	to pass optional parameters, 5-40
<u> </u>	using route patterns
Same Origin Policy, <i>D-15</i>	for passing required parameters, 5-36
SET_MODULE_ORIGINS_ALLOWED	
procedure. 8-23, 9-23	

