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Preface

Welcome to Berkeley DB 12c Release 1 (DB). This document describes the C++ STL API for DB library version 12.1.6.2. It is intended to describe the DB API, including all classes, methods, and functions. As such, this document is intended for C++ developers who are actively writing or maintaining applications that make use of DB databases.
Conventions Used in this Book

The following typographical conventions are used within this manual:

Class names are represented in monospaced font, as are method names. For example: "Db::open() is a Db class method."

Variable or non-literal text is presented in italics. For example: "Go to your DB_INSTALL directory."

Program examples are displayed in a monospaced font on a shaded background. For example:

```c
typedef struct vendor {
    char name[MAXFIELD];       // Vendor name
    char street[MAXFIELD];     // Street name and number
    char city[MAXFIELD];       // City
    char state[3];             // Two-digit US state code
    char zipcode[6];           // US zipcode
    char phone_number[13];     // Vendor phone number
} VENDOR;
```

Note

Finally, notes of interest are represented using a note block such as this.
For More Information

Beyond this manual, you may also find the following sources of information useful when building a DB application:

- Getting Started with Berkeley DB for C++
- Getting Started with Transaction Processing for C++
- Berkeley DB Getting Started with Replicated Applications for C++
- Berkeley DB C API Reference Guide
- Berkeley DB C++ API Reference Guide
- Berkeley DB TCL API Reference Guide
- Berkeley DB Installation and Build Guide
- Berkeley DB Programmer’s Reference Guide
- Berkeley DB Getting Started with the SQL APIs

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# Chapter 1. Dbstl Global Public Functions

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**Group**

None
close_db

Function Details

```c
void close_db(Db *pdb)
```

Close pdb regardless of reference count.

You must make sure pdb is not used by others before calling this method. You can close the underlying database of a container and assign another database with right configurations to it, if the configuration is not suitable for the container, there will be an `InvalidArgumentException` type of exception thrown. You can't use the container after you called close_db and before setting another valid database handle to the container via `db_container::set_db_handle()` function.

Parameters

pdb

The database handle to close.

Group: Functions to close database/environments.

Normally you don't have to close any database or environment handles, they will be closed automatically.

Though you still have the following API to close them.

Class

dbstl_global_functions
close_all_dbs

Function Details

```c
void close_all_dbs()
```

Close all open database handles regardless of reference count.

You can't use any container after you called close_all_dbs and before setting another valid database handle to the container via `db_container::set_db_handle()` function.

See Also

`close_db(Db *)`;

Group: Functions to close database/environments.

Normally you don't have to close any database or environment handles, they will be closed automatically.

Though you still have the following API to close them.

Class

`dbstl_global_functions`
close_db_env

Function Details

```c
void close_db_env(DbEnv *pdbenv)
```

Close specified database environment handle regardless of reference count.

Make sure the environment is not used by any other databases.

Parameters

pdbenv

The database environment handle to close.

Group: Functions to close database/environments.

Normally you don't have to close any database or environment handles, they will be closed automatically.

Though you still have the following API to close them.

Class

`dbstl_global_functions`
close_all_db_envs

**Function Details**

```c
void close_all_db_envs()
```

Close all open database environment handles regardless of reference count.

You can't use the container after you called close_db and before setting another valid database handle to the container via `db_container::set_db_handle()` function.

**See Also**

`close_db_env(DbEnv *)` ;

**Group: Functions to close database/environments.**

Normally you don't have to close any database or environment handles, they will be closed automatically.

Though you still have the following API to close them.

**Class**

`dbstl_global_functions`
begin_txn

Function Details

```c
DbTxn* begin_txn(u_int32_t flags,
                 DbEnv *env)
```

Begin a new transaction from the specified environment "env".

This function is called by dbstl user to begin an external transaction. The "flags" parameter is passed to DbEnv::txn_begin(). If a transaction created from the same database environment already exists and is unresolved, the new transaction is started as a child transaction of that transaction, and thus you can't specify the parent transaction.

Parameters

flags

It is set to DbEnv::txn_begin() function.

env

The environment to start a transaction from.

Return Value

The newly created transaction.

Group: Transaction control global functions.

dbstl transaction API.

You should call these API rather than DB C/C++ API to use Berkeley DB transaction features.

Class

dbstl_global_functions
commit_txn

Function Details

```c
void commit_txn(DbEnv *env,
    u_int32_t flags=0)
```

Commit current transaction opened in the environment "env".

This function is called by user to commit an external explicit transaction.

**Parameters**

*flags*

It is set to `DbTxn::commit()` funcion.

*env*

The environment whose current transaction is to be committed.

**See Also**

`commit_txn(DbEnv *, DbTxn *, u_int32_t)`;

```c
void commit_txn(DbEnv *env, DbTxn *txn,
    u_int32_t flags=0)
```

Commit a specified transaction and all its child transactions.

**Parameters**

*txn*

The transaction to commit, can be a parent transaction of a nested transaction group, all un-aborted child transactions of it will be committed.

*flags*

It is passed to each `DbTxn::commit()` call.

*env*

The environment where `txn` is started from.

**See Also**

`commit_txn(DbEnv *, u_int32_t)`;
Group: Transaction control global functions.

dbstl transaction API.

You should call these API rather than DB C/C++ API to use Berkeley DB transaction features.

Class

dbstl_global_functions
**abort_txn**

**Function Details**

```c
void abort_txn(DbEnv *env)
```

Abort current transaction of environment "env".

This function is called by dbstl user to abort an outside explicit transaction.

**Parameters**

**env**

The environment whose current transaction is to be aborted.

**See Also**

`abort_txn(DbEnv *, DbTxn *)` ;

```c
void abort_txn(DbEnv *env, 
               DbTxn  *txn)
```

Abort specified transaction "txn" and all its child transactions.

That is, "txn" can be a parent transaction of a nested transaction group.

**Parameters**

**txn**

The transaction to abort, can be a parent transaction of a nested transaction group, all child transactions of it will be aborted.

**env**

The environment where txn is started from.

**See Also**

`abort_txn(DbEnv *)` ;

**Group: Transaction control global functions.**

dbstl transaction API.

You should call these API rather than DB C/C++ API to use Berkeley DB transaction features.

**Class**

`dbstl_global_functions`
**current_txn**

**Function Details**

```c
DbTxn* current_txn(DbEnv *env)
```

Get current transaction of environment "env".

**Parameters**

*env*

The environment whose current transaction we want to get.

**Return Value**

Current transaction of env.

**Group:** Transaction control global functions.

dbstl transaction API.

You should call these API rather than DB C/C++ API to use Berkeley DB transaction features.

**Class**

dbstl_global_functions
set_current_txn_handle

Function Details

```
DbTxn* set_current_txn_handle(DbEnv *env,
DbTxn *newtxn)
```

Set environment env's current transaction handle to be newtxn.

The original transaction handle returned without aborting or committing. This function is used for users to use one transaction among multiple threads.

Parameters

newtxn

The new transaction to be as the current transaction of env.

env

The environment whose current transaction to replace.

Return Value

The old current transaction of env. It is not resolved.

Group: Transaction control global functions.

dbstl transaction API.

You should call these API rather than DB C/C++ API to use Berkeley DB transaction features.

Class

dbstl_global_functions
register_db

Function Details

    void register_db(Db *pdb1)

Register a Db handle "pdb1".

This handle and handles opened in it will be closed by ResourceManager, so application
code must not try to close or delete it. Users can do enough configuration before opening
the Db then register it via this function. All database handles should be registered via this
function in each thread using the handle. The only exception is the database handle opened
by dbstl::open_db should not be registered in the thread of the dbstl::open_db call.

Parameters

pdb1

The database handle to register into dbstl for current thread.

Class

dbstl_global_functions
**register_db_env**

**Function Details**

```cpp
void register_db_env(DbEnv *env1)
```

Register a DbEnv handle env1, this handle and handles opened in it will be closed by ResourceManager.

Application code must not try to close or delete it. Users can do enough config before opening the DbEnv and then register it via this function. All environment handles should be registered via this function in each thread using the handle. The only exception is the environment handle opened by dbstl::open_db_env should not be registered in the thread of the dbstl::open_db_env call.

**Parameters**

**env1**

The environment to register into dbstl for current thread.

**Class**

`dbstl_global_functions`
open_db

Function Details

Db* open_db(DbEnv *penv, const char *filename, DBTYPE dbtype,
             u_int32_t oflags, u_int32_t set_flags, int mode=0644, DbTxn *txn=NULL,
             u_int32_t cflags=0,
             const char *dbname=NULL)

Helper function to open a database and register it into dbstl for the calling thread.

Users still need to register it in any other thread using it if it is shared by multiple threads, via
register_db() function. Users don't need to delete or free the memory of the returned object,
dbstl will take care of that. When you don't use dbstl::open_db() but explicitly call DB C++ API
to open a database, you must new the Db object, rather than create it on stack, and you must
delete the Db object by yourself.

Parameters

penv

The environment to open the database from.

taxn

The transaction to open the database from, passed to Db::open.

dbtype

The database type, passed to Db::open.

oflags

The database open flags, passed to Db::open.

filename

The database file name, passed to Db::open.

mode

The database open mode, passed to Db::open.

cflags

The create flags passed to Db class constructor.

dbname

The database name, passed to Db::open.
set_flags

The flags to be set to the created database handle.

**Return Value**

The opened database handle.

**See Also**

register_db(Db *);
open_db_env;

**Class**

dbstl_global_functions
open_env

Function Details

```cpp
DbEnv* open_env(const char *env_home, u_int32_t set_flags,
               u_int32_t oflags=DB_CREATE|DB_INIT_MPOOL,
               u_int32_t cachesize=4 *1024 *1024, int mode=0644,
               u_int32_t cflags=0)
```

Helper function to open an environment and register it into dbstl for the calling thread.

Users still need to register it in any other thread if it is shared by multiple threads, via `register_db_env()` function above. Users don't need to delete or free the memory of the returned object, dbstl will take care of that.

When you don't use `dbstl::open_env()` but explicitly call DB C++ API to open an environment, you must new the DbEnv object, rather than create it on stack, and you must delete the DbEnv object by yourself.

**Parameters**

**oflags**

Environment open flags, passed to DbEnv::open.

**set_flags**

Flags to set to the created environment before opening it.

**mode**

Environment region files mode, passed to DbEnv::open.

**cflags**

DbEnv constructor creation flags, passed to DbEnv::DbEnv.

**cachesize**

Environment cache size, by default 4M bytes.

**env_home**

Environment home directory, it must exist. Passed to DbEnv::open.

**Return Value**

The opened database environment handle.

**See Also**

register_db_env(DbEnv *) ;
open_db;

Class
dbstl_global_functions
alloc_mutex

**Function Details**

```cpp
db_mutex_t alloc_mutex()
```

Allocate a Berkeley DB mutex.

**Return Value**

Berkeley DB mutex handle.

**Group: Mutex API based on Berkeley DB mutex.**

These functions are in-process mutex support which uses Berkeley DB mutex mechanisms.

You can call these functions to do portable synchronization for your code.

**Class**

`dbstl_global_functions`
lock_mutex

Function Details

```c
int lock_mutex(db_mutex_t mtx)
```

Lock a mutex, wait if it is held by another thread.

**Parameters**

mtx

The mutex handle to lock.

**Return Value**

0 if succeed, non-zero otherwise, call db_strerror to get message.

**Group:** Mutex API based on Berkeley DB mutex.

These functions are in-process mutex support which uses Berkeley DB mutex mechanisms.

You can call these functions to do portable synchronization for your code.

**Class**

dbstl_global_functions
unlock_mutex

Function Details

```c
int unlock_mutex(db_mutex_t mtx)
```

Unlock a mutex, and return immediately.

**Parameters**

mtx

The mutex handle to unlock.

**Return Value**

0 if succeed, non-zero otherwise, call db_strerror to get message.

**Group: Mutex API based on Berkeley DB mutex.**

These functions are in-process mutex support which uses Berkeley DB mutex mechanisms.

You can call these functions to do portable synchronization for your code.

**Class**

dbstl_global_functions
free_mutex

**Function Details**

```c
void free_mutex(db_mutex_t mtx)
```

Free a mutex, and return immediately.

**Parameters**

mtx

The mutex handle to free.

**Return Value**

0 if succeed, non-zero otherwise, call db_strerror to get message.

**Group: Mutex API based on Berkeley DB mutex.**

These functions are in-process mutex support which uses Berkeley DB mutex mechanisms.

You can call these functions to do portable synchronization for your code.

**Class**

dbstl_global_functions
**dbstl_startup**

**Function Details**

```c
void dbstl_startup()
```

If there are multiple threads within a process that make use of dbstl, then this function should be called in a single thread mutually exclusively before any use of dbstl in a process; Otherwise, you don't need to call it, but are allowed to call it anyway.

**Class**

`dbstl_global_functions`
dbstl_exit

Function Details

```c
void dbstl_exit()
```

This function releases memory allocated by dbstl on the heap, and closes all Berkeley DB handles in the right order.

You can call `dbstl_exit()` before the process exits to release any memory allocated by dbstl that has to persist during the entire process lifetime.

Class

`dbstl_global_functions`
**dbstl_thread_exit**

**Function Details**

```cpp
void dbstl_thread_exit()
```

This function closes all Berkeley DB handles in the right order, if other threads do not use them.

You can call this function before a thread exits to close unused Berkeley DB handles.

**Class**

`dbstl_global_functions`
**operator==**

**Function Details**

```cpp
gbool operator==(const Dbt &d1, 
const Dbt &d2)
```

Operators to compare two Dbt objects.

**Parameters**

- **d2**
  - Dbt object to compare.

- **d1**
  - Dbt object to compare.

```cpp
gbool operator==((const DBT &d1, 
const DBT &d2)
```

Operators to compare two DBT objects.

**Parameters**

- **d2**
  - DBT object to compare.

- **d1**
  - DBT object to compare.

**Class**

`dbstl_global_functions`
set_global_dbfile_suffix_number

Function Details

```c
void set_global_dbfile_suffix_number(u_int32_t num)
```

If existing random temporary database name generation mechanism is still causing name clashes, users can set this global suffix number which will be append to each temporary database file name and incremented after each append, and by default it is 0.

**Parameters**

**num**

Starting number to append to each temporary db file name.

**Class**

`dbstl_global_functions`
close_db_cursors

Function Details

```c
size_t close_db_cursors(Db *dbp1)
```

Close cursors opened in dbp1.

Parameters

dbp1

The database handle whose active cursors to close.

Return Value

The number of cursors closed by this call.

Class

dbstl_global_functions
Chapter 2. Dbstl Container Classes

A dbstl container is very much like a C++ STL container.

It stores a collection of data items, or key/data pairs. Each container is backed by a Berkeley
DB database created in an explicit database environment or an internal private environment;
And the database itself can be created explicitly with all kinds of configurations, or by dbstl
internally. For each type of container, some specific type of database and/or configurations
must be used or specified to the database and its environment. dbstl will check the database
and environment conform to the requirement. When users don't have a chance to specify a
container's backing database and environment, like in copy constructors, dbstl will create
proper databases and/or environment for it. There are two helper functions to make it easier
to create/open an environment or database, they are dbstl::open_db() and dbstl::open_env()
;

See Also

dbstl::open_db() dbstl::open_env() db_vector db_map db_multimap db_set db_multiset

Public Members

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Group

None
Chapter 3. Db_container

This class is the base class for all db container classes, you don’t directly use this class, but all container classes inherit from this class, so you need to know the methods that can be accessed via concrete container classes.

This class is also used to support auto commit transactions. Autocommit is enabled when DB_AUTO_COMMIT is set to the database or database environment handle and the environment is transactional.

Inside dbstl, there are transactions begun and committed/aborted if the backing database and/or environment requires auto commit, and there are cursors opened internally, and you can set the flags used by the transaction and cursor functions via set functions of this class.

All dbstl containers are fully multi-threaded, you should not need any synchronization to use them in the correct way, but this class is not thread safe, access to its members are not protected by any mutex because the data members of this class are supposed to be set before they are used, and remain read only afterwards. If this is not the case, you must synchronize the access.

Public Members

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Dbstl Container Classes  (page 29)
get_db_open_flags

Function Details

```
 u_int32_t get_db_open_flags() const
```

Get the backing database's open flags.

**Return Value**

The backing database's open flags.

**Group: Get and set functions for data members.**

Note that these functions are not thread safe, because all data members of `db_container` are supposed to be set on container construction and initialization, and remain read only afterwards.

**Class**

`db_container`
get_db_set_flags

Function Details

u_int32_t get_db_set_flags() const

Get the backing database's flags that are set via Db::set_flags() function.

Return Value

Flags set to this container's database handle.

Group: Get and set functions for data members.

Note that these functions are not thread safe, because all data members of db_container are supposed to be set on container construction and initialization, and remain read only afterwards.

Class

db_container
get_db_handle

Function Details

Db* get_db_handle() const

Get the backing database's handle.

Return Value

The backing database handle of this container.

Group: Get and set functions for data members.

Note that these functions are not thread safe, because all data members of db_container are supposed to be set on container construction and initialization, and remain read only afterwards.

Class

db_container
get_db_env_handle

Function Details

```
DbEnv* get_db_env_handle() const
```

Get the backing database environment's handle.

Return Value

The backing database environment handle of this container.

Group: Get and set functions for data members.

Note that these functions are not thread safe, because all data members of db_container are supposed to be set on container construction and initialization, and remain read only afterwards.

Class

db_container
set_db_handle

**Function Details**

```c
void set_db_handle(Db *dbp,
                   DbEnv *newenv=NULL)
```

Set the underlying database's handle, and optionally environment handle if the environment has also changed.

That is, users can change the container object's underlying database while the object is alive. dbstl will verify that the handles set conforms to the concrete container's requirement to Berkeley DB database/environment handles.

**Parameters**

*dbp*

The database handle to set.

*newenv*

The database environment handle to set.

**Group: Get and set functions for data members.**

Note that these functions are not thread safe, because all data members of `db_container` are supposed to be set on container construction and initialization, and remain read only afterwards.

**Class**

`db_container`
**set_all_flags**

**Function Details**

```c
void set_all_flags(u_int32_t txn_begin_flags, u_int32_t commit_flags,
                   u_int32_t cursor_open_flags)
```

Set the flags required by the Berkeley DB functions `DbEnv::txn_begin()`, `DbTxn::commit()` and `DbEnv::cursor()`.

These flags will be set to this container’s auto commit member functions when auto commit transaction is used, except that `cursor_oflags` is set to the `Dbc::cursor` when creating an iterator for this container. By default the three flags are all zero. You can also set the values of the flags individually by using the appropriate set functions in this class. The corresponding get functions return the flags actually used.

**Parameters**

**commit_flags**

Flags to be set to `DbTxn::commit()`.

**cursor_open_flags**

Flags to be set to `Db::cursor()`.

**txn_begin_flags**

Flags to be set to `DbEnv::txn_begin()`.

**Group: Get and set functions for data members.**

Note that these functions are not thread safe, because all data members of `db_container` are supposed to be set on container construction and initialization, and remain read only afterwards.

**Class**

`db_container`
set_txn_begin_flags

Function Details

```c
void set_txn_begin_flags(u_int32_t flag)
```

Set flag of DbEnv::txn_begin() call.

Parameters

**flag**

Flags to be set to DbEnv::txn_begin().

Group: Get and set functions for data members.

Note that these functions are not thread safe, because all data members of `db_container` are supposed to be set on container construction and initialization, and remain read only afterwards.

Class

db_container
get_txn_begin_flags

Function Details

```c
u_int32_t get_txn_begin_flags() const
```

Get flag of DbEnv::txn_begin() call.

Return Value

Flags to be set to DbEnv::txn_begin().

Group: Get and set functions for data members.

Note that these functions are not thread safe, because all data members of db_container
are supposed to be set on container construction and initialization, and remain read only
afterwards.

Class

db_container
**set_commit_flags**

**Function Details**

```cpp
void set_commit_flags(u_int32_t flag)
```

Set flag of DbTxn::commit() call.

**Parameters**

*flag*

Flags to be set to DbTxn::commit().

**Group: Get and set functions for data members.**

Note that these functions are not thread safe, because all data members of `db_container` are supposed to be set on container construction and initialization, and remain read only afterwards.

**Class**

`db_container`
get_commit_flags

Function Details

```cpp
u_int32_t get_commit_flags() const
```

Get flag of DbTxn::commit() call.

Return Value

Flags to be set to DbTxn::commit().

Group: Get and set functions for data members.

Note that these functions are not thread safe, because all data members of `db_container` are supposed to be set on container construction and initialization, and remain read only afterwards.

Class

`db_container`
get_cursor_open_flags

**Function Details**

```cpp
u_int32_t get_cursor_open_flags() const
```

Get flag of `Db::cursor()` call.

**Return Value**

Flags to be set to `Db::cursor()`.

**Group: Get and set functions for data members.**

Note that these functions are not thread safe, because all data members of `db_container` are supposed to be set on container construction and initialization, and remain read only afterwards.

**Class**

`db_container`
**set_cursor_open_flags**

**Function Details**

```cpp
void set_cursor_open_flags(u_int32_t flag)
```

Set flag of Db::cursor() call.

**Parameters**

**flag**

Flags to be set to Db::cursor().

**Group: Get and set functions for data members.**

Note that these functions are not thread safe, because all data members of `db_container` are supposed to be set on container construction and initialization, and remain read only afterwards.

**Class**

`db_container`
**db_container**

**Function Details**

- **db_container()**
  Default constructor.

- **db_container(const db_container &dbctnr)**
  Copy constructor.
  The new container will be backed by another database within the same environment unless dbctnr's backing database is in its own internal private environment. The name of the database is coined based on current time and thread id and some random number. If this is still causing naming clashes, you can set a suffix number via "set_global_dbfile_suffix_number" function; And following db file will suffix this number in the file name for additional randomness. And the suffix will be incremented after each such use. You can change the file name via DbEnv::rename. If dbctnr is using an anonymous database, the newly constructed container will also use an anonymous one.

**Parameters**

- **dbctnr**
  The container to initialize this container.

- **db_container(Db *dbp, DbEnv *envp)**
  This constructor is not directly called by the user, but invoked by constructors of concrete container classes.
  The statement about the parameters applies to constructors of all container classes.

**Parameters**

- **dbp**
  Database handle. dbp is supposed to be opened inside envp. Each dbstl container is backed by a Berkeley DB database, so dbstl will create an internal anonymous database if dbp is NULL.

- **envp**
  Environment handle. And envp can also be NULL, meaning the dbp handle may be created in its internal private environment.
Class

db_container
~db_container

**Function Details**

```cpp
virtual ~db_container()
```

The backing database is not closed in this function.

It is closed when current thread exits and the database is no longer referenced by any other container instances in this process. In order to make the reference counting work alright, you must call `register_db(Db*)` and `register_db_env(DbEnv*)` correctly.

**See Also**

`register_db(Db*)` `register_db_env(DbEnv*)`

**Class**

`db_container`
Chapter 4. Db_vector

The db_vector class has the union set of public member functions as std::vector, std::deque and std::list, and each method has identical default semantics to that in the std equivalent containers.

The difference is that the data is maintained using a Berkeley DB database as well as some Berkeley DB related extensions.

See Also

db_container db_container(Db*, DbEnv*) db_container(const db_container&)  

Class Template Parameters

T

The type of data to store.

value_type_sub

If T is a class/struct type, do not specify anything for this parameter; Otherwise, specify ElementHolder<T> to it. Database(dbp) and environment(penv) handle requirement(applies for all constructors of this class template): dbp must meet the following requirement: 1. dbp must be a DB_RECNO type of database handle. 2. DB_THREAD must be set to dbp's open flags. 3. An optional flag DB_RENUMBER is required if the container object is supposed to be a std::vector or std::deque equivalent; Not required if it is a std::list equivalent. But dbstl will not check whether DB_RENUMBER is set to this database handle. Setting DB_RENUMBER will cause the index values of all elements in the underlying database to be maintained consecutive and in order, which involves potentially a lot of work because many indices may be updated. See the db_container(Db*, DbEnv*) for more information about the two parameters.

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**Group**

Dbstl Container Classes  (page 29)
begin

Function Details

```cpp
iterator begin(ReadModifyWriteOption rmw=
    ReadModifyWriteOption::no_read_modify_write(), bool readonly=false,
    BulkRetrievalOption bulk_read=BulkRetrievalOption::no_bulk_retrieval(),
    bool directdb_get=true)
```

Create a read-write or read-only iterator.

We allow users to create a readonly iterator here so that they don't have to use a const container to create a const_iterator. But using const_iterator is faster. The flags set via `db_container::set_cursor_oflags()` is used as the cursor open flags.

**Parameters**

**directdb_get**

Whether always read key/data pair from backing db rather than using the value cached in the iterator. The current key/data pair is cached in the iterator and always kept updated on iterator movement, but in some extreme conditions, errors can happen if you use cached key/data pairs without always refreshing them from database. By default we are always reading from database when we are accessing the data the iterator sits on, except when we are doing bulk retrievals. But your application can gain extra performance promotion if you can set this flag to false.

**readonly**

Whether the iterator is created as a readonly iterator. Read only iterators can not update its underlying key/data pair.

**bulk_read**

Whether read database key/data pairs in bulk, by specifying DB_MULTIPLE_KEY flag to underlying cursor's Dbc::get function. Only readonly iterators can do bulk retrieval, if iterator is not read only, this parameter is ignored. Bulk retrieval can accelerate reading speed because each database read operation will read many key/data pairs, thus saved many database read operations. The default bulk buffer size is 32KB, you can set your desired bulk buffer size by specifying `BulkRetrievalOpt::bulk_retrieval(your_bulk_buffer_size);` If you don't want bulk retrieval, set `BulkRetrievalOpt::no_bulk_retrieval()` as the real parameter.

**rmw**

Whether this iterator will open a Berkeley DB cursor with DB_RMW flag set. If the iterator is used to read a key/data pair, then update it and store back to db, it is good to set the DB_RMW flag, by specifying `RMWItrOpt::read_modify_write()` If you don't want to set the DB_RMW flag, specify `RMWItrOpt::no_read_modify_write()`, which is the default behavior.
Return Value
The created iterator.

See Also

db_container::set_cursor_oflags();

```cpp
class const_iterator begin(BulkRetrievalOption bulkretrieval=
    (BulkRetrievalOption::no_bulk_retrieval()),
    bool directdb_get=true) const
```

Create a const iterator.

The created iterator can only be used to read its referenced data element. Can only be called when using a const reference to the container object. The parameters have identical meanings and usage to those of the other non-const begin function.

Parameters

directdb_get

Same as that of begin(ReadModifyWrite, bool, BulkRetrievalOption, bool);

bulkretrieval

Same as that of begin(ReadModifyWrite, bool, BulkRetrievalOption, bool);

Return Value
The created const iterator.

See Also

begin(ReadModifyWrite, bool, BulkRetrievalOption, bool);

Class

db_vector
Function Details

iterator end()

Create an open boundary iterator.

Return Value

Returns an invalid iterator denoting the position after the last valid element of the container.

const_iterator end() const

Create an open boundary iterator.

Return Value

Returns an invalid const iterator denoting the position after the last valid element of the container.

Class

db_vector
**rbegin**

**Function Details**

```cpp
reverse_iterator rbegin(ReadModifyWriteOption rmw=
    ReadModifyWriteOption::no_read_modify_write(), bool readonly=false,
    BulkRetrievalOption bulk_read=BulkRetrievalOption::no_bulk_retrieval(),
    bool directdb_get=true)
```

Create a reverse iterator.

This function creates a reverse iterator initialized to sit on the last element in the underlying database, and can be used to read/write. The meaning and usage of its parameters are identical to the above begin function.

**Parameters**

- **directdb_get**
  
  Same as that of begin(ReadModifyWrite, bool, BulkRetrievalOption, bool);

- **bulk_read**
  
  Same as that of begin(ReadModifyWrite, bool, BulkRetrievalOption, bool);

- **rmw**
  
  Same as that of begin(ReadModifyWrite, bool, BulkRetrievalOption, bool);

- **readonly**
  
  Same as that of begin(ReadModifyWrite, bool, BulkRetrievalOption, bool);

**Return Value**

The created iterator.

**See Also**

begin(ReadModifyWrite, bool, BulkRetrievalOption, bool);

```cpp
const_reverse_iterator rbegin(BulkRetrievalOption bulkretrieval=
    BulkRetrievalOption(BulkRetrievalOption::no_bulk_retrieval()),
    bool directdb_get=true) const
```

Create a const reverse iterator.

This function creates a const reverse iterator initialized to sit on the last element in the backing database, and can only read the element, it is only available to const `db_vector` containers. The meaning and usage of its parameters are identical as above.
Parameters

directdb_get

Same as that of begin(ReadModifyWrite, bool, BulkRetrievalOption, bool);

bulkretrieval

Same as that of begin(ReadModifyWrite, bool, BulkRetrievalOption, bool);

Return Value

The created iterator.

See Also

begin(ReadModifyWrite, bool, BulkRetrievalOption, bool);

Class

db_vector
rend

Function Details

reverse_iterator rend()

Create an open boundary iterator.

Return Value

Returns an invalid iterator denoting the position before the first valid element of the container.

const_reverse_iterator rend() const

Create an open boundary iterator.

Return Value

Returns an invalid const iterator denoting the position before the first valid element of the container.

Class

db_vector
max_size

Function Details

```cpp
size_type max_size() const
```

Get max size.

The returned size is not the actual limit of database. See the Berkeley DB limits to get real max size.

Return Value

A meaningless huge number.

Group: Huge return

These two functions return $2^{30}$, denoting a huge number that does not overflow, because dbstl does not have to manage memory space.

But the return value is not the real limit, see the Berkeley DB database limits for the limits.

Class

`db_vector`
capacity

Function Details

```cpp
size_type capacity() const
```

Get capacity.

Group: Huge return

These two functions return $2^{30}$, denoting a huge number that does not overflow, because dbstl does not have to manage memory space.

But the return value is not the real limit, see the Berkeley DB database limits for the limits.

Class

db_vector
operator[]

Function Details

reference operator[](index_type n)

Index operator, can act as both a left value and a right value.

Parameters

n

The valid index of the vector.

Return Value

The reference to the element at specified position.

const_reference operator[](index_type n) const

Read only index operator.

Only used as a right value, no need for assignment capability. The return value can’t be used to update the element.

Parameters

n

The valid index of the vector.

Group: Element access functions.

The operator[] and at() only come from std::vector and std::deque. If you are using db_vector as std::list, you don’t have to set DB_RENUMBER flag to the backing database handle, and you get better performance, but at the same time you can’t use these functions.

Otherwise if you have set the DB_RENUMBER flag to the backing database handle, you can use this function though it is an std::list equivalent.

Class

db_vector
at

**Function Details**

```cpp
reference at(index_type n)
```

Index function.

**Parameters**

n

The valid index of the vector.

**Return Value**

The reference to the element at specified position, can act as both a left value and a right value.

**See Also**


```cpp
const_reference at(index_type n) const
```

Read only index function.

Only used as a right value, no need for assignment capability. The return value can't be used to update the element.

**Parameters**

n

The valid index of the vector.

**Return Value**

The const reference to the element at specified position.

**See Also**


**Group: Element access functions.**

The operator[] and at() only come from std::vector and std::deque. If you are using db_vector as std::list, you don't have to set DB_RENUMBER flag to the backing database handle, and you get better performance, but at the same time you can't use these functions.
Otherwise if you have set the DB_RENUMBER flag to the backing database handle, you can use this function though it is an std::list equivalent.

Class

db_vector
front

Function Details

```cpp
reference front()
```

Return a reference to the first element.

Return Value

Return a reference to the first element.

See Also

http://www.cplusplus.com/reference/vector/vector/front/

```cpp
const_reference front() const
```

Return a const reference to the first element.

The return value can't be used to update the element.

Return Value

Return a const reference to the first element.

See Also

http://www.cplusplus.com/reference/vector/vector/front/

Group: Element access functions.

The operator[] and at() only come from std::vector and std::deque, If you are using db_vector as std::list, you don't have to set DB_RENUMBER flag to the backing database handle, and you get better performance, but at the same time you can't use these functions.

Otherwise if you have set the DB_RENUMBER flag to the backing database handle, you can use this function though it is an std::list equivalent.

Class

db_vector
back

**Function Details**

```cpp
reference back()
```

Return a reference to the last element.

**Return Value**

Return a reference to the last element.

**See Also**


```cpp
const_reference back() const
```

Return a reference to the last element.

The return value can't be used to update the element.

**Return Value**

Return a reference to the last element.

**See Also**


**Group: Element access functions.**

The operator[] and at() only come from std::vector and std::deque, If you are using db_vector as std::list, you don't have to set DB_RENUMBER flag to the backing database handle, and you get better performance, but at the same time you can't use these functions.

Otherwise if you have set the DB_RENUMBER flag to the backing database handle, you can use this function though it is an std::list equivalent.

**Class**

db_vector
**operator==**

**Function Details**

```cpp
bool operator==(const db_vector< T2, T3 > &v2) const
```

Container equality comparison operator.

This function supports auto-commit.

**Parameters**

- **v2**

  The vector to compare against.

**Return Value**

Compare two vectors, return true if they have identical sequences of elements, otherwise return false.

```cpp
bool operator==(const self &v2) const
```

Container equality comparison operator.

This function supports auto-commit.

**Return Value**

Compare two vectors, return true if they have identical elements, otherwise return false.

**Group: Compare functions.**


**Class**

- `db_vector`
operator!=

**Function Details**

```cpp
bool operator!=(const db_vector< T2, T3 >& v2) const
```

Container in-equality comparison operator.

This function supports auto-commit.

**Parameters**

v2

The vector to compare against.

**Return Value**

Returns false if elements in each slot of both containers equal; Returns true otherwise.

```cpp
bool operator!=(const self& v2) const
```

Container in-equality comparison operator.

This function supports auto-commit.

**Parameters**

v2

The vector to compare against.

**Return Value**

Returns false if elements in each slot of both containers equal; Returns true otherwise.

**Group: Compare functions.**


**Class**

db_vector
**operator<**

**Function Details**

```cpp
bool operator<(const self &v2) const
```

Container less than comparison operator.

This function supports auto-commit.

**Parameters**

v2

The container to compare against.

**Return Value**

Compare two vectors, return true if this is less than v2, otherwise return false.

**Group: Compare functions.**


**Class**

db_vector
assign

Function Details

void assign(InputIterator first, InputIterator last, bool b_truncate=true)

Assign a range [first, last) to this container.

Parameters

b_truncate

See its member group doc for details.

last

The range open boundary.

first

The range closed boundary.

void assign(const_iterator first, const_iterator last, bool b_truncate=true)

Assign a range [first, last) to this container.

Parameters

b_truncate

See its member group doc for details.

last

The range open boundary.

first

The range closed boundary.

void assign(size_type n, const T &u, bool b_truncate=true)

Assign n number of elements of value u into this container.
Parameters

b_truncate

See its member group doc for details. This function supports auto-commit.

u

The value of elements to insert.

n

The number of elements in this container after the call.

Group: Assign functions

See the function documentation for the correct usage of b_truncate parameter.

The following four member functions have default parameter b_truncate, because they require all key/data pairs in the database be deleted before the real operation, and by default we use Db::truncate to truncate the database rather than delete the key/data pairs one by one, but Db::truncate requires no open cursors on the database handle, and the four member functions will close any open cursors of backing database handle in current thread, but can do nothing to cursors of other threads opened from the same database handle. So you must make sure there are no open cursors of the database handle in any other threads. On the other hand, users can specify "false" to the b_truncate parameter and thus the key/data pairs will be deleted one by one. Other than that, they have identical behaviors as their counterparts in std::vector.


Class

db_vector
push_front

Function Details

```cpp
void push_front(const T &x)
```

Push an element x into the vector from front.

**Parameters**

x

The element to push into this vector. This function supports auto-commit.

**Group: Functions specific to deque and list**

These functions come from std::list and std::deque, and have identical behaviors to their counterparts in std::list/stddeque.


**Class**

db_vector
**pop_front**

**Function Details**

```cpp
void pop_front()
```

Pop out the front element from the vector.

This function supports auto-commit.

**Group: Functions specific to deque and list**

These functions come from std::list and std::deque, and have identical behaviors to their counterparts in std::list/stddeque.

http://www.cplusplus.com/reference/deque/deque/push_front/

**Class**

`db_vector`
insert

Function Details

```
iterator insert(iterator pos, 
    const T &x)
```

Insert x before position pos.

**Parameters**

- **x**
  The element to insert.

- **pos**
  The position before which to insert.

```
void insert(iterator pos, size_type n, 
    const T &x)
```

Insert n number of elements x before position pos.

**Parameters**

- **x**
  The element to insert.

- **pos**
  The position before which to insert.

- **n**
  The number of elements to insert.

```
void insert(iterator pos, InputIterator first, 
    InputIterator last)
```

Range insertion.

Insert elements in range [first, last) into this vector before position pos.

**Parameters**

- **last**
  The open boundary of the range.
pos
   The position before which to insert.

first
   The closed boundary of the range.

```cpp
void insert(iterator pos, const_iterator first,
            const_iterator last)
```

Range insertion.
Insert elements in range [first, last) into this vector before position pos.

**Parameters**

last
   The open boundary of the range.

pos
   The position before which to insert.

first
   The closed boundary of the range.

**Group: Insert functions**
The iterator pos in the functions must be a read-write iterator, can’t be read only.


**Class**

`db_vector`
erase

Function Details

iterator erase(iterator pos)

Erase element at position pos.

Parameters

pos

The valid position in the container's range to erase.

Return Value

The next position after the erased element.

iterator erase(iterator first, iterator last)

Erase elements in range [first, last).

Parameters

last

The open boundary of the range.

first

The closed boundary of the range.

Return Value

The next position after the erased elements.

Group: Erase functions

The iterator pos in the functions must be a read-write iterator, can't be read only.


Class

db_vector
remove

Function Details

```cpp
void remove(const T &value)
```

Remove all elements whose values are "value" from the list.
This function supports auto-commit.

Parameters

value

The target value to remove.

See Also

http://www.cplusplus.com/reference/list/list/remove/

Group: std::list specific functions

http://www.cplusplus.com/reference/list/list/

Class

db_vector
remove_if

Function Details

```cpp
void remove_if(Predicate pred)
```

Remove all elements making "pred" return true.

This function supports auto-commit.

**Parameters**

**pred**

The binary predicate judging elements in this list.

**See Also**

http://www.cplusplus.com/reference/list/list/remove_if/

**Group: std::list specific functions**

http://www.cplusplus.com/reference/list/list/

**Class**

db_vector
merge

Function Details

```cpp
void merge(self &x)
```

Merge content with another container.
This function supports auto-commit.

Parameters

- `x`
The other list to merge with.

See Also

http://www.cplusplus.com/reference/list/list/merge/

```cpp
void merge(self &x, Compare comp)
```

Merge content with another container.
This function supports auto-commit.

Parameters

- `x`
The other list to merge with.
- `comp`
The compare function to determine insertion position.

See Also

http://www.cplusplus.com/reference/list/list/merge/

Group: std::list specific functions

http://www.cplusplus.com/reference/list/list/

Class

`db_vector`
**unique**

**Function Details**

```cpp
void unique()
```

Remove consecutive duplicate values from this list.

This function supports auto-commit.

**See Also**

http://www.cplusplus.com/reference/list/list/unique/

```cpp
void unique(BinaryPredicate binary_pred)
```

Remove consecutive duplicate values from this list.

This function supports auto-commit.

**Parameters**

**binary_pred**

The compare predicate to determine uniqueness.

**See Also**

http://www.cplusplus.com/reference/list/list/unique/

**Group: std::list specific functions**

http://www.cplusplus.com/reference/list/list/

**Class**

`db_vector`
sort

**Function Details**

```c
void sort()
```

Sort this list.

This function supports auto-commit.

**See Also**

http://www.cplusplus.com/reference/list/list/sort/

```c
void sort(Compare comp)
```

Sort this list.

This function supports auto-commit.

**Parameters**

**comp**

The compare operator to determine element order.

**See Also**

http://www.cplusplus.com/reference/list/list/sort/

**Group: std::list specific functions**

http://www.cplusplus.com/reference/list/list/

**Class**

*db_vector*
reverse

**Function Details**

```cpp
void reverse()
```

Reverse this list.

This function supports auto-commit.

**See Also**


**Group: std::list specific functions**


**Class**

db_vector
splice

Function Details

```cpp
void splice(iterator position, 
            self &x)
```

Moves elements from list x into this list.

Moves all elements in list x into this list container at the specified position, effectively inserting the specified elements into the container and removing them from x. This function supports auto-commit.

**Parameters**

**position**

Position within the container where the elements of x are inserted.

**x**

The other list container to splice from.

**See Also**

http://www.cplusplus.com/reference/list/list/splice/

```cpp
void splice(iterator position, self &x, 
            iterator i)
```

Moves elements from list x into this list.

Moves elements at position i of list x into this list container at the specified position, effectively inserting the specified elements into the container and removing them from x. This function supports auto-commit.

**Parameters**

**i**

The position of element in x to move into this list.

**position**

Position within the container where the elements of x are inserted.

**x**

The other list container to splice from.
**See Also**


```c
void splice(iterator position, self &x, iterator first, iterator last)
```

Moves elements from list x into this list.

Moves elements in range [first, last) of list x into this list container at the specified position, effectively inserting the specified elements into the container and removing them from x. This function supports auto-commit.

**Parameters**

**position**

Position within the container where the elements of x are inserted.

**first**

The range's closed boundary.

**last**

The range's open boundary.

**x**

The other list container to splice from.

**See Also**


**Group: std::list specific functions**


**Class**

`db_vector`
size

**Function Details**

```cpp
size_type size() const
```

Return the number of elements in this container.

**See Also**


**Class**

db_vector
empty

Function Details

bool empty() const

Returns whether this container is empty.

Return Value

True if empty, false otherwise.

Class

db_vector
**db_vector**

**Function Details**

```
void db_vector(Db *dbp=NULL, DbEnv *penv=NULL)
```

Constructor.

Note that we do not need an allocator in db-stl container, but we need backing up Db* and DbEnv*, and we have to verify that the passed in bdb handles are valid for use by the container class. See class detail for handle requirement.

**Parameters**

- **dbp**
  The same as that of `db_container(Db*, DbEnv*)`;

- **penv**
  The same as that of `db_container(Db*, DbEnv*)`;

**See Also**

- `db_container(Db*, DbEnv*)`;

```
void db_vector(size_type n, const T &val=T(), Db *dbp=NULL, DbEnv *penv=NULL)
```

Constructor.

This function supports auto-commit. Insert n elements of T type into the database, the value of the elements is the default value or user set value. See class detail for handle requirement.

**Parameters**

- **dbp**
  The same as that of `db_container(Db*, DbEnv*)`;

- **penv**
  The same as that of `db_container(Db*, DbEnv*)`;

- **val**
  The value of elements to insert.
n
The number of elements to insert.

See Also
db_vector(Db*, DbEnv*) ; db_container(Db*, DbEnv*) ;
db_vector(const self &x)

Copy constructor.

This function supports auto-commit. Insert all elements in x into this container.

See Also
db_container(const db_container&)  
db_vector(Db *dbp, DbEnv *penv, InputIterator first,  
            InputIterator last)

Insert a range of elements into this container.

The range is [first, last), which contains elements that can be converted to type T 
automatically. See class detail for handle requirement.

Parameters
dbp
The same as that of db_container(Db*, DbEnv*) ;

first
Range closed boundary.

last
Range open boundary.

penv
The same as that of db_container(Db*, DbEnv*) ;

See Also
db_vector(Db*, DbEnv*) ;
db_vector(const_iterator first, const_iterator last, Db *dbp=NULL,
Range constructor.

This function supports auto-commit. Insert the range of elements in [first, last) into this container. See class detail for handle requirement.

**Parameters**

**dbp**

The same as that of `db_container(Db*, DbEnv*)`;

**first**

Range closed boundary.

**last**

Range open boundary.

**penv**

The same as that of `db_container(Db*, DbEnv*)`;

**See Also**

`db_vector(Db*, DbEnv*)`;

**Class**

`db_vector`
~db_vector

Function Details

virtual ~db_vector()

Class

db_vector
**operator=**

**Function Details**

```cpp
const self& operator=(const self &x)
```

Container assignment operator.

This function supports auto-commit. This `db_vector` is assumed to be valid for use, only copy content of `x` into this container.

**Parameters**

`x`

The right value container.

**Return Value**

The container `x`'s reference.

**Class**

`db_vector`
### resize

#### Function Details

```cpp
void resize(size_type n,
            T t=T())
```

Resize this container to specified size n, insert values t if need to enlarge the container.

This function supports auto-commit.

**Parameters**

- **t**
  - The value to insert when enlarging the container.

- **n**
  - The number of elements in this container after the call.

**See Also**


**Class**

db_vector
reserve

Function Details

```cpp
void reserve(size_type)
```

Reserve space.

The vector is backed by Berkeley DB, we always have enough space. This function does nothing, because dbstl does not have to manage memory space.

Class

db_vector
push_back

Function Details

void push_back(const T &x)

Push back an element into the vector.

This function supports auto-commit.

Parameters

x

The value of element to push into this vector.

See Also


Class

db_vector
pop_back

Function Details

```cpp
void pop_back()
```

Pop out last element from the vector.

This function supports auto-commit.

See Also


Class

db_vector
swap

Function Details

```c
void swap(self &vec)
```

Swap content with another vector `vec`.

Parameters

`vec`

The other vector to swap content with. This function supports auto-commit.

See Also

http://www.cplusplus.com/reference/vector/vector/swap/

Class

db_vector
clear

Function Details

```cpp
void clear(bool b_truncate=true)
```

Remove all elements of the vector, make it an empty vector.

This function supports auto-commit.

Parameters

**b_truncate**

Same as that of `db_vector::assign()`.

See Also

http://www.cplusplus.com/reference/vector/vector/clear/

Class

`db_vector`
Chapter 5.  Db_map

**db_map** has identical methods to std::map and the semantics for each method is identical to its std::map counterpart, except that it stores data into underlying Berkeley DB btree or hash database.

Passing a database handle of btree or hash type creates a **db_map** equivalent to std::map and std::hashmap respectively. Database(dbp) and environment(penv) handle requirement(applies to all constructors in this class template): 0. The dbp is opened inside the penv environment. Either one of the two handles can be NULL. If dbp is NULL, an anonymous database is created by dbstl. 1. Database type of dbp should be DB_BTREE or DB_HASH. 2. No DB_DUP or DB_DUPSORT flag set in dbp. 3. No DB_RECNUM flag set in dbp. 4. No DB_TRUNCATE specified in dbp's database open flags. 5. DB_THREAD must be set if you are sharing the dbp across multiple threads directly, or indirectly by sharing the container object across multiple threads.

**See Also**

db_container db_container(Db*, DbEnv*) db_container(const db_container&)  

**Class Template Parameters**

**kdt**  
The key data type.

**ddt**  
The data data type. **db_map** stores key/data pairs.

**value_type_sub**  
Do not specify anything if ddt type is a class/struct type; Otherwise, specify ElementHolder<ddt> to it.

**iterator_t**  
Never specify anything to this type parameter. It is only used internally.

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**Group**

Dbstl Container Classes  (page 29)
db_map

Function Details

```cpp
db_map(Db *dbp=NULL,
       DbEnv *envp=NULL)
```

Create a std::map/hash_map equivalent associative container.

See the handle requirement in class details to pass correct database/environment handles.

**Parameters**

*dbp*  
The database handle.

*envp*  
The database environment handle.

**See Also**

db_container(Db*, DbEnv*)

```cpp
db_map(Db *dbp, DbEnv *envp, InputIterator first,
       InputIterator last)
```

Iteration constructor.

Iterates between first and last, setting a copy of each of the sequence of elements as the content of the container object. Create a std::map/hash_map equivalent associative container. Insert a range of elements into the database. The range is [first, last), which contains elements that can be converted to type ddt automatically. See the handle requirement in class details to pass correct database/environment handles. This function supports auto-commit.

**Parameters**

*dbp*  
The database handle.

*envp*  
The database environment handle.

*last*  
The open boundary of the range.
**first**

The closed boundary of the range.

**See Also**

`db_container(Db*, DbEnv*)`

```cpp
db_map(const db_map< kdt, ddt, value_type_sub, iterator > &x)
```

Copy constructor.

Create an database and insert all key/data pairs in x into this container. x's data members are not copied. This function supports auto-commit.

**Parameters**

`x`

The other container to initialize this container.

**See Also**

`db_container(const db_container&)`

**Class**

`db_map`
~db_map

**Function Details**

```
virtual ~db_map()
```

**Class**

`db_map`
**insert**

**Function Details**

```cpp
insert(const value_type &x)
```

Insert a single key/data pair if the key is not in the container.

**Parameters**

`x`

The key/data pair to insert.

**Return Value**

A pair P, if insert OK, i.e. the inserted key wasn't in the container, P.first will be the iterator sitting on the inserted key/data pair, and P.second is true; otherwise P.first is an invalid iterator and P.second is false.

```cpp
iterator insert(iterator position,
    const value_type &x)
```

Insert with hint position.

We ignore the hint position because Berkeley DB knows better where to insert.

**Parameters**

`position`

The hint position.

`x`

The key/data pair to insert.

**Return Value**

The iterator sitting on the inserted key/data pair, or an invalid iterator if the key was already in the container.

```cpp
void insert(const db_map_base_iterator< kdt, realddt, ddt > &first,
    const db_map_base_iterator< kdt, realddt, ddt > &last)
```

Range insertion.
Insert a range \([\text{first}, \text{last})\) of key/data pairs into this container.

**Parameters**

**last**

The open boundary of the range.

**first**

The closed boundary of the range.

\[
\text{void insert(InputIterator first, InputIterator last)}
\]

Range insertion.

Insert a range \([\text{first}, \text{last})\) of key/data pairs into this container.

**Parameters**

**last**

The open boundary of the range.

**first**

The closed boundary of the range.

**Group: Insert Functions**

They have similar usage as their C++ STL equivalents.

Note that when secondary index is enabled, each `db_container` can create a `db_multimap` secondary container, but the insert function is not functional for secondary containers.

http://www.cplusplus.com/reference/map/map/insert/

**Class**

`db_map`
begin

Function Details

begin(ReadModifyWriteOption rmw=ReadModifyWriteOption::no_read_modify_write(), bool readonly=false, BulkRetrievalOption bulkretrieval=BulkRetrievalOption::no_bulk_retrieval(), bool directdb_get=true)

Begin a read-write or readonly iterator which sits on the first key/data pair of the database.

Parameters

directdb_get
Same as that of db_vector::begin(ReadModifyWrite, bool, BulkRetrievalOption, bool);

readonly
Same as that of db_vector::begin(ReadModifyWrite, bool, BulkRetrievalOption, bool);

rmw
Same as that of db_vector::begin(ReadModifyWrite, bool, BulkRetrievalOption, bool);

bulkretrieval
Same as that of db_vector::begin(ReadModifyWrite, bool, BulkRetrievalOption, bool);

Return Value
The created iterator.

See Also
db_vector::begin (ReadModifyWriteOption , bool, BulkRetrievalOption , bool)

begin(BulkRetrievalOption bulkretrieval=BulkRetrievalOption::no_bulk_retrieval(), bool directdb_get=true) const

Begin a read-only iterator.

Parameters

directdb_get
Same as that of begin(ReadModifyWrite, bool, BulkRetrievalOption, bool);
bulkretrieval

Same as that of begin(ReadModifyWrite, bool, BulkRetrievalOption, bool);

**Return Value**

The created const iterator.

**See Also**

`db_vector::begin (ReadModifyWrite, bool, BulkRetrievalOption, bool);`

**Group: Iterator Functions**

The parameters in begin functions of this group have identical meaning to those in `db_vector::begin`, refer to those functions for details.

`db_vector::begin()`

**Class**

`db_map`
end

Function Details

iterator end()

Create an open boundary iterator.

Return Value

Returns an invalid iterator denoting the position after the last valid element of the container.

See Also

db_vector::end()

const_iterator end() const

Create an open boundary iterator.

Return Value

Returns an invalid const iterator denoting the position after the last valid element of the container.

See Also

db_vector::end() const

Group: Iterator Functions

The parameters in begin functions of this group have identical meaning to those in db_vector::begin, refer to those functions for details.

db_vector::begin()

Class

db_map
rbegin

Function Details

\[
\begin{align*}
\text{reverse_iterator} & \quad \text{rbegin(ReadModifyWriteOption rmw=}
\text{ReadModifyWriteOption::no_read_modify_write(), bool read_only=false,}
\text{BulkRetrievalOption bulkretrieval=}
\text{BulkRetrievalOption::no_bulk_retrieval(),}
\text{bool directdb_get=true)}
\end{align*}
\]

Begin a read-write or readonly reverse iterator which sits on the first key/data pair of the database.

**Parameters**

*directdb_get*

Same as that of `db_vector::begin(ReadModifyWrite, bool, BulkRetrievalOption, bool)`;

*read_only*

Same as that of `db_vector::begin(ReadModifyWrite, bool, BulkRetrievalOption, bool)`;

*rmw*

Same as that of `db_vector::begin(ReadModifyWrite, bool, BulkRetrievalOption, bool)`;

*bulkretrieval*

Same as that of `db_vector::begin(ReadModifyWrite, bool, BulkRetrievalOption, bool)`;

**Return Value**

The created iterator.

**See Also**

`db_vector::begin (ReadModifyWriteOption, bool, BulkRetrievalOption, bool)`

`db_vector::begin (ReadModifyWrite, bool, BulkRetrievalOption, bool)`;

\[
\begin{align*}
\text{const_reverse_iterator} & \quad \text{rbegin(BulkRetrievalOption bulkretrieval=}
\text{BulkRetrievalOption::no_bulk_retrieval(),}
\text{bool directdb_get=true) const}
\end{align*}
\]

Begin a read-only reverse iterator.

**Parameters**

*directdb_get*

Same as that of `begin(ReadModifyWrite, bool, BulkRetrievalOption, bool)`;
bulkretrieval

Same as that of begin(ReadModifyWrite, bool, BulkRetrievalOption, bool);

**Return Value**

The created const iterator.

**See Also**

db_vector::begin (ReadModifyWrite, bool, BulkRetrievalOption, bool);

**Group: Iterator Functions**

The parameters in begin functions of this group have identical meaning to those in db_vector::begin, refer to those functions for details.

db_vector::begin()

**Class**

db_map
rend

Function Details

reverse_iterator rend()

Create an open boundary iterator.

Return Value

Returns an invalid iterator denoting the position before the first valid element of the container.

See Also

db_vector::rend()

const_reverse_iterator rend() const

Create an open boundary iterator.

Return Value

Returns an invalid const iterator denoting the position before the first valid element of the container.

See Also

db_vector::rend() const

Group: Iterator Functions

The parameters in begin functions of this group have identical meaning to those in db_vector::begin, refer to those functions for details.

db_vector::begin()

Class

db_map
**is_hash**

**Function Details**

```cpp
bool is_hash() const
```

Get container category.

Determines whether this container object is a std::map<> equivalent (when returns false) or that of hash_map<> class (when returns true). This method is not in stl, but it may be called by users because some operations are not supported by both type(map/hash_map) of containers, you need to call this function to distinguish the two types. dbstl will not stop you from calling the wrong methods of this class.

**Return Value**

Returns true if this container is a hash container based on a Berkeley DB hash database; returns false if it is based on a Berkeley DB btree database.

**Group: Metadata Functions**

These functions return metadata about the container.

**Class**

db_map
bucket_count

Function Details

```cpp
class db_map
{
public:
    size_type bucket_count() const;
};
```

Only for std::hash_map, return number of hash bucket in use.
This function supports auto-commit.

Return Value

The number of hash buckets of the database.

Group: Metadata Functions

These functions return metadata about the container.

Class

db_map
size

**Function Details**

```cpp
size_type size(bool accurate=true) const
```

This function supports auto-commit.

**Parameters**

**accurate**

This function uses database's statistics to get the number of key/data pairs. The statistics mechanism will either scan the whole database to find the accurate number or use the number of last accurate scanning, and thus much faster. If there are millions of key/data pairs, the scanning can take some while, so in that case you may want to set the "accurate" parameter to false.

**Return Value**

Return the number of key/data pairs in the container.

**Group: Metadata Functions**

These functions return metadata about the container.

**Class**

db_map
max_size

Function Details

```cpp
size_type max_size() const
```

Get max size.

The returned size is not the actual limit of database. See the Berkeley DB limits to get real max size.

Return Value

A meaningless huge number.

See Also

`db_vector::max_size()`

Group: Metadata Functions

These functions return metadata about the container.

Class

`db_map`
empty

**Function Details**

```cpp
bool empty() const
```

Returns whether this container is empty.

This function supports auto-commit.

**Return Value**

True if empty, false otherwise.

**Group: Metadata Functions**

These functions return metadata about the container.

**Class**

db_map
erase

**Function Details**

```cpp
void erase(iterator pos)
```

Erase a key/data pair at specified position.

**Parameters**

**pos**
An valid iterator of this container to erase.

```cpp
size_type erase(const key_type &x)
```

Erase elements by key.

All key/data pairs with specified key x will be removed from underlying database. This function supports auto-commit.

**Parameters**

**x**
The key to remove from the container.

**Return Value**

The number of key/data pairs removed.

```cpp
void erase(iterator first,
           iterator last)
```

Range erase.

Erase all key/data pairs within the valid range [first, last).

**Parameters**

**last**
The open boundary of the range.

**first**
The closed boundary of the range.
Group: Erase Functions

http://www.cplusplus.com/reference/map/map/erase/

Class

db_map
find

Function Details

const_iterator find(const key_type &x) const

Find the key/data pair with specified key x.

Parameters

x

The target key to find.

Return Value

The valid const iterator sitting on the key x, or an invalid one.

See Also

http://www.cplusplus.com/reference/map/map/find/

iterator find(const key_type &x,
    bool readonly=false)

Find the key/data pair with specified key x.

Parameters

x

The target key to find.

readonly

Whether the returned iterator is readonly.

Return Value

The valid iterator sitting on the key x, or an invalid one.

See Also

http://www.cplusplus.com/reference/map/map/find/

Group: Searching Functions

The following functions are returning iterators, and they by default return read-write iterators.
If you intend to use the returned iterator only to read, you should call the const version of each function using a const reference to this container. Using const iterators can potentially promote concurrency a lot. You can also set the readonly parameter to each non-const version of the functions to true if you don't use the returned iterator to write, which also promotes concurrency and overall performance.

**Class**

db_map
lower_bound

**Function Details**

```cpp
const_iterator lower_bound(const key_type &x) const
```

Find the greatest key less than or equal to \( x \).

**Parameters**

- \( x \)
  - The target key to find.

**Return Value**

The valid const iterator sitting on the key, or an invalid one.

**See Also**


```cpp
iterator lower_bound(const key_type &x,
                      bool readonly=false)
```

Find the greatest key less than or equal to \( x \).

**Parameters**

- \( x \)
  - The target key to find.
- \( \text{readonly} \)
  - Whether the returned iterator is readonly.

**Return Value**

The valid iterator sitting on the key, or an invalid one.

**See Also**


**Group: Searching Functions**

The following functions are returning iterators, and they by default return read-write iterators.
If you intend to use the returned iterator only to read, you should call the const version of each function using a const reference to this container. Using const iterators can potentially promote concurrency a lot. You can also set the readonly parameter to each non-const version of the functions to true if you don't use the returned iterator to write, which also promotes concurrency and overall performance.

**Class**

db_map
equal_range

Function Details

equal_range(const key_type &x) const

Find the range within which all keys equal to specified key x.

Parameters

x

The target key to find.

Return Value

The range \([\text{first}, \text{last})\).

See Also

http://www.cplusplus.com/reference/map/map/equal_range/

equal_range(const key_type &x,
            bool readonly=false)

Find the range within which all keys equal to specified key x.

Parameters

x

The target key to find.

readonly

Whether the returned iterator is readonly.

Return Value

The range \([\text{first}, \text{last})\).

See Also

http://www.cplusplus.com/reference/map/map/equal_range/

Group: Searching Functions

The following functions are returning iterators, and they by default return read-write iterators.
If you intend to use the returned iterator only to read, you should call the const version of each function using a const reference to this container. Using const iterators can potentially promote concurrency a lot. You can also set the readonly parameter to each non-const version of the functions to true if you don't use the returned iterator to write, which also promotes concurrency and overall performance.

Class

db_map
count

**Function Details**

```cpp
size_type count(const key_type &x) const
```

Count the number of key/data pairs having specified key x.

**Parameters**

- x

  The key to count.

**Return Value**

The number of key/data pairs having x as key within the container.

**See Also**


**Group: Searching Functions**

The following functions are returning iterators, and they by default return read-write iterators.

If you intend to use the returned iterator only to read, you should call the const version of each function using a const reference to this container. Using const iterators can potentially promote concurrency a lot. You can also set the readonly parameter to each non-const version of the functions to true if you don't use the returned iterator to write, which also promotes concurrency and overall performance.

**Class**

- db_map
**upper_bound**

**Function Details**

```cpp
const_iterator upper_bound(const key_type &x) const
```

Find the least key greater than x.

**Parameters**

x

The target key to find.

**Return Value**

The valid iterator sitting on the key, or an invalid one.

**See Also**

http://www.cplusplus.com/reference/map/map/upper_bound/

```cpp
iterator upper_bound(const key_type &x,
                      bool readonly=false)
```

Find the least key greater than x.

**Parameters**

x

The target key to find.

readonly

Whether the returned iterator is readonly.

**Return Value**

The valid iterator sitting on the key, or an invalid one.

**See Also**

http://www.cplusplus.com/reference/map/map/upper_bound/

**Group: Searching Functions**

The following functions are returning iterators, and they by default return read-write iterators.
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Class

db_map
key_eq

Function Details

```cpp
key_equal key_eq() const
```

Function to get key compare functor.

Used when this container is a hash_map, hash_multimap, hash_set or hash_multiset equivalent.

Return Value

`key_equal` type of compare functor.

See Also

http://www.sgi.com/tech/stl/hash_map.html

Class

db_map
hash_funct

Function Details

hasher hash_funct() const

Function to get hash key generating functor.

Used when this container is a hash_map, hash_multimap, hash_set or hash_multiset equivalent.

Return Value

The hash key generating functor.

See Also

http://www.sgi.com/tech/stl/hash_map.html

Class

db_map
**value_comp**

**Function Details**

```cpp
class value_compare
{
public:
    explicit value_compare() = default;
    value_compare(const value_compare&) = default;
    value_compare(value_compare&&) = default;
    ~value_compare() = default;

    template<typename _Key, typename _T1, typename _T2, typename _Compare>
    value_compare(const _Compare& __comp, std::false_type) :
        _comp(__comp) {}

private:
    _Compare _comp;
} ;
```

Function to get value compare functor.

Used when this container is a std::map, std::multimap, std::set or std::multiset equivalent.

**Return Value**

The value compare functor.

**See Also**

http://www.cplusplus.com/reference/map/map/value_comp/

**Class**

db_map
**key_comp**

**Function Details**

```cpp
key_compare key_comp() const
```

Function to get key compare functor.
Used when this container is a std::map, std::multimap, std::set or std::multiset equivalent.

**Return Value**

The key compare functor.

**See Also**

http://www.cplusplus.com/reference/map/map/key_comp/

**Class**

db_map
operator=

**Function Details**

```c++
const self& operator=(const self &x)
```

Container content assignment operator.

This function supports auto-commit.

**Parameters**

`x`

The other container whose key/data pairs will be inserted into this container. Old content in this containers are discarded.

**See Also**


**Class**

`db_map`
**operator[]**

**Function Details**

```
data_type_wrap operator[](const key_type &x)
```

Retrieve data element by key.

This function returns an reference to the underlying data element of the specified key `x`. The returned object can be used to read or write the data element of the key/data pair. Do use a `data_type_wrap` of `db_map` or `value_type::second_type` (they are the same) type of variable to hold the return value of this function.

**Parameters**

`x`

The target key to get value from.

**Return Value**

Data element reference.

```
const ddt operator[](const key_type &x) const
```

Retrieve data element by key.

This function returns the value of the underlying data element of specified key `x`. You can only read the element, but unable to update the element via the return value of this function. And you need to use the container's const reference to call this method.

**Parameters**

`x`

The target key to get value from.

**Return Value**

Data element, read only, can't be used to modify it.

**Class**

`db_map`
**swap**

**Function Details**

```c
void swap(db_map< kdt, ddt, value_type_sub > &mp,
          bool b_truncate=true)
```

Swap content with container `mp`.

This function supports auto-commit.

**Parameters**

**b_truncate**

See `db_vector::swap()` for details.

**mp**

The container to swap content with.

**See Also**

http://www.cplusplus.com/reference/map/map/swap/ db_vector::clear()

**Class**

`db_map`
**clear**

**Function Details**

```cpp
void clear(bool b_truncate=true)
```

Clear contents in this container.

This function supports auto-commit.

**Parameters**

**b_truncate**

See `db_vector::clear(bool)` for details.

**See Also**

`db_vector::clear(bool)`

**Class**

`db_map`
**operator==**

**Function Details**

```cpp
bool operator==(const db_map< kdt, ddt, value_type_sub > &m2) const
```

Map content equality comparison operator.

This function does not rely on key order. For a set of keys S1 in this container and another set of keys S2 of container m2, if set S1 contains S2 and S2 contains S1 (S1 equals to S2) and each data element of a key K in S1 from this container equals the data element of K in m2, the two db_map<> containers equal. Otherwise they are not equal.

**Parameters**

**m2**

The other container to compare against.

**Return Value**

Returns true if they have equal content, false otherwise.

**Class**

`db_map`
operator!=

Function Details

bool operator!=(const db_map< kdt, ddt, value_type_sub > &m2) const

Container unequality comparison operator.

Parameters

m2

The container to compare against.

Return Value

Returns false if equal, true otherwise.

Class

db_map
Chapter 6. Db_multimap

This class is the combination of std::multimap and hash_multimap.

By setting database handles as DB_BTREE or DB_HASH type respectively, you will be using an equivalent of std::multimap or hash_multimap respectively. Database(dbp) and environment(penv) handle requirement: The dbp handle must meet the following requirement: 1. Database type should be DB_BTREE or DB_HASH. 2. Either DB_DUP or DB_DUPSORT flag must be set. Note that so far Berkeley DB does not allow DB_DUPSORT be set and the database is storing identical key/data pairs, i.e. we can't store two (1, 2), (1, 2) pairs into a database D with DB_DUPSORT flag set, but only can do so with DB_DUP flag set; But we can store a (1, 2) pair and a (1, 3) pair into D with DB_DUPSORT flag set. So if your data set allows DB_DUPSORT flag, you should set it to gain a lot of performance promotion. 3. No DB_RECNUM flag set. 4. No DB_TRUNCATE specified in database open flags. 5. DB_THREAD must be set if you are sharing the database handle across multiple threads directly, or indirectly by sharing the container object across multiple threads.

See Also

db_container db_map

Class Template Parameters

kdt
The key data type.

ddt
The data data type. db_multimap stores key/data pairs.

value_type_sub
Do not specify anything if ddt type is a class/struct type; Otherwise, specify ElementHolder<ddt> to it.

iterator_t
Never specify anything to this type parameter. It is only used internally.

Public Members

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**Group**

Dbstl Container Classes  (page 29)
**insert**

**Function Details**

```cpp
void insert(InputIterator first,
            InputIterator last)
```

Range insertion.
Insert a range \([first, last)\) of key/data pairs into this container.

**Parameters**

- **last**
  The open boundary of the range.

- **first**
  The closed boundary of the range.

```cpp
void insert(const_iterator &first,
            const_iterator &last)
```

Range insertion.
Insert a range \([first, last)\) of key/data pairs into this container.

**Parameters**

- **last**
  The open boundary of the range.

- **first**
  The closed boundary of the range.

```cpp
iterator insert(const value_type &x)
```

Insert a single key/data pair if the key is not in the container.

**Parameters**

- **x**
  The key/data pair to insert.
Return Value

A pair $P$, if insert OK, i.e. the inserted key wasn't in the container, $P$.first will be the iterator sitting on the inserted key/data pair, and $P$.second is true; otherwise $P$.first is an invalid iterator and $P$.second is false.

Group: Insert Functions

http://www.cplusplus.com/reference/map/multimap/insert/

Class

db_multimap
**erase**

**Function Details**

```cpp
size_type erase(const key_type &x)
```

Erase elements by key.

All key/data pairs with specified key `x` will be removed from underlying database. This function supports auto-commit.

**Parameters**

`x`

The key to remove from the container.

**Return Value**

The number of key/data pairs removed.

```cpp
void erase(iterator pos)
```

Erase a key/data pair at specified position.

**Parameters**

`pos`

An valid iterator of this container to erase.

```cpp
void erase(iterator first, 
    iterator last)
```

Range erase.

Erase all key/data pairs within the valid range `[first, last)`,

**Parameters**

`last`

The open boundary of the range.

`first`

The closed boundary of the range.
Group: Erase Functions

http://www.cplusplus.com/reference/map/multimap/erase/

Class

db_multimap
equal_range

Function Details

```
equal_range(const key_type &x) const
```

Find the range within which all keys equal to specified key x.

**Parameters**

x

The target key to find.

**Return Value**

The range [first, last).

**See Also**

http://www.cplusplus.com/reference/map/multimap/equal_range/

```
equal_range(const key_type &x,
            bool readonly=false)
```

Find the range within which all keys equal to specified key x.

**Parameters**

x

The target key to find.

readonly

Whether the returned iterator is readonly.

**Return Value**

The range [first, last).

**See Also**

http://www.cplusplus.com/reference/map/multimap/equal_range/

**Group: Searching Functions**

See of db_map's searching functions group for details about iterator, function version and parameters.
db_map

Class

db_multimap
**equal_range_N**

*Function Details*

```cpp
equal_range_N(const key_type &x,
   size_t &nelem) const
```

Find equal range and number of key/data pairs in the range.

This function also returns the number of elements within the returned range via the out parameter `nelem`.

**Parameters**

- **x**
  
  The target key to find.

- **nelem**
  
  The output parameter to take back the number of key/data pair in the returned range.

**See Also**

http://www.cplusplus.com/reference/map/multimap/equal_range/

```cpp
equal_range_N(const key_type &x, size_t &nelem,
   bool readonly=false)
```

Find equal range and number of key/data pairs in the range.

This function also returns the number of elements within the returned range via the out parameter `nelem`.

**Parameters**

- **x**
  
  The target key to find.

- **nelem**
  
  The output parameter to take back the number of key/data pair in the returned range.

- **readonly**
  
  Whether the returned iterator is readonly.

**See Also**

http://www.cplusplus.com/reference/map/multimap/equal_range/
Group: Searching Functions

See of db_map's searching functions group for details about iterator, function version and parameters.

db_map

Class

db_multimap
count

Function Details

```
size_type count(const key_type &x) const
```

Count the number of key/data pairs having specified key x.

Parameters

x

The key to count.

Return Value

The number of key/data pairs having x as key within the container.

See Also

http://www.cplusplus.com/reference/map/multimap/count/

Group: Searching Functions

See of db_map's searching functions group for details about iterator, function version and parameters.

db_map

Class

db_multimap
upper_bound

**Function Details**

```cpp
const_iterator upper_bound(const key_type &x) const
```

Find the least key greater than x.

**Parameters**

- `x`
  - The target key to find.

**Return Value**

The valid iterator sitting on the key, or an invalid one.

**See Also**


```cpp
iterator upper_bound(const key_type &x, 
                      bool readonly=false)
```

Find the least key greater than x.

**Parameters**

- `x`
  - The target key to find.
- `readonly`
  - Whether the returned iterator is readonly.

**Return Value**

The valid iterator sitting on the key, or an invalid one.

**See Also**


**Group: Searching Functions**

See of db_map's searching functions group for details about iterator, function version and parameters.
db_map

Class

db_multimap
db_multimap

Function Details

```cpp
db_multimap(Db *dbp=NULL,  
DbEnv *envp=NULL)
```

Constructor.

See class detail for handle requirement.

**Parameters**

**dbp**

The database handle.

**envp**

The database environment handle.

**See Also**

db_map::db_map(Db*, DbEnv*)  
db_vector::db_vector(Db*, DbEnv*)

```cpp
db_multimap(Db *dbp, DbEnv *envp, InputIterator first,  
InputIterator last)
```

Iteration constructor.

Iterates between first and last, setting a copy of each of the sequence of elements as the content of the container object. This function supports auto-commit. See class detail for handle requirement.

**Parameters**

**dbp**

The database handle.

**envp**

The database environment handle.

**last**

The open boundary of the range.

**first**

The closed boundary of the range.
Copy constructor.

Create an database and insert all key/data pairs in x into this container. x's data members are not copied. This function supports auto-commit.

**Parameters**

x

The other container to initialize this container.

**See Also**

db_container(const db_container&) db_map(const db_map&)

**Class**

db_multimap
~db_multimap

**Function Details**

```
virtual ~db_multimap()
```

**Class**

`db_multimap`
operator=

**Function Details**

```c
const self& operator=(const self &x)
```

Container content assignment operator.
This function supports auto-commit.

**Parameters**

- **x**

The other container whose key/data pairs will be inserted into this container. Old content in this containers are discarded.

**See Also**

http://www.cplusplus.com/reference/map/multimap/operator=/

**Class**

db_multimap
**swap**

**Function Details**

```cpp
void swap(db_multimap< kdt, ddt, value_type_sub > &mp,
          bool b_truncate=true)
```

Swap content with another multimap container.

This function supports auto-commit.

**Parameters**

**b_truncate**

See `db_map::swap()` for details.

**mp**

The other container to swap content with.

**See Also**

`db_vector::clear()`

**Class**

`db_multimap`
**operator==**

**Function Details**

```cpp
bool operator==(const db_multimap< kdt, ddt, value_type_sub > &m2) const
```

Returns whether the two containers have identical content.

This function does not rely on key order. For a set of keys S1 in this container and another set of keys S2 of container m2, if set S1 contains S2 and S2 contains S1 (S1 equals to S2) and each set of data elements of any key K in S1 from this container equals the set of data elements of K in m2, the two db_multimap<> containers equal. Otherwise they are not equal. Data element set comparison does not rely on order either.

**Parameters**

m2

The other container to compare against.

**Return Value**

Returns true if they are equal, false otherwise.

**Class**

`db_multimap`
operator!=

**Function Details**

```cpp
bool operator!=(const db_multimap< kdt, ddt, value_type_sub > &m2) const
```

Container unequality comparison operator.

**Parameters**

- `m2`
  
The container to compare against.

**Return Value**

Returns false if equal, true otherwise.

**Class**

`db_multimap`
Chapter 7. Db_set

This class is the combination of std::set and hash_set.

By setting database handles of DB_BTREE or DB_HASH type, you will be using the equivalent of std::set or hash_set. This container stores the key in the key element of a key/data pair in the underlying database, but doesn't store anything in the data element. Database and environment handle requirement: The same as that of db_map.

See Also

db_map db_container

Class Template Parameters

kdt

The key data type.

value_type_sub

If kdt is a class/struct type, do not specify anything in this parameter; Otherwise specify ElementHolder<kdt>.

Public Members

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<td>value_comp</td>
<td>Get value comparison functor.</td>
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Group

Dbstl Container Classes (page 29)
db_set

Function Details

```c
db_set(Db *dbp=NULL,
       DbEnv *envp=NULL)
```

Create a std::set/hash_set equivalent associative container.
See the handle requirement in class details to pass correct database/environment handles.

**Parameters**

**dbp**

The database handle.

**envp**

The database environment handle.

**See Also**

`db_map(Db*, DbEnv*) db_container(Db*, DbEnv*)`

```c
db_set(Db *dbp, DbEnv *envp, InputIterator first,
       InputIterator last)
```

Iteration constructor.
Iterates between first and last, copying each of the elements in the range into this container.
Create a std::set/hash_set equivalent associative container. Insert a range of elements into the database. The range is [first, last), which contains elements that can be converted to type ddt automatically. This function supports auto-commit. See the handle requirement in class details to pass correct database/environment handles.

**Parameters**

**dbp**

The database handle.

**envp**

The database environment handle.

**last**

The open boundary of the range.
**first**

The closed boundary of the range.

**See Also**

`db_map(Db*, DbEnv*, InputIterator, InputIterator)`

`db_set(const self &x)`

Copy constructor.

Create a database and insert all key/data pairs in x into this container. x's data members are not copied. This function supports auto-commit.

**Parameters**

`x`

The source container to initialize this container.

**See Also**

`db_map(const db_map&) db_container(const db_container&)`

**Class**

`db_set`
~db_set

Function Details

virtual ~db_set()

Class

db_set
**insert**

**Function Details**

```cpp
insert(const value_type &x)
```

Insert a single key/data pair if the key is not in the container.

**Parameters**

`x`

The key/data pair to insert.

**Return Value**

A pair `P`, if insert OK, i.e. the inserted key wasn’t in the container, `P.first` will be the iterator positioned on the inserted key/data pair, and `P.second` is true; otherwise `P.first` is an invalid iterator equal to that returned by `end()` and `P.second` is false.

```cpp
void insert(const_iterator &first, const_iterator &last)
```

Range insertion.

Insert a range `[first, last)` of key/data pairs into this container.

**Parameters**

`last`

The open boundary of the range.

`first`

The closed boundary of the range.

```cpp
void insert(iterator &first, iterator &last)
```

Range insertion.

Insert a range `[first, last)` of key/data pairs into this container.

**Parameters**

`last`

The open boundary of the range.
first

The closed boundary of the range.

```
iterator insert(iterator position,
               const value_type &x)
```

Insert with hint position.

We ignore the hint position because Berkeley DB knows better where to insert.

**Parameters**

position

The hint position.

x

The key/data pair to insert.

**Return Value**

The iterator positioned on the inserted key/data pair, or an invalid iterator if the key was already in the container.

```
void insert(InputIterator first,
            InputIterator last)
```

Range insertion.

Insert a range [first, last) of key/data pairs into this container.

**Parameters**

last

The open boundary of the range.

first

The closed boundary of the range.

**Group: Insert Functions**


**Class**

db_set


**operator=**

*Function Details*

```cpp
const self& operator=(const self &x)
```

Container content assignment operator.

This function supports auto-commit.

**Parameters**

`x`

The source container whose key/data pairs will be inserted into the target container. Old content in the target container is discarded.

**Return Value**

The container `x`'s reference.

**See Also**


**Class**

db_set
value_comp

Function Details

```
value_compare value_comp() const
```

Get value comparison functor.

**Return Value**

The value comparison functor.

**See Also**


**Class**

db_set
**swap**

**Function Details**

```cpp
void swap(db_set< kdt, value_type_sub > &mp,
          bool b_truncate=true)
```

Swap content with another container.

This function supports auto-commit.

**Parameters**

*b_truncate*

See `db_vector::swap` 's `b_truncate` parameter for details.

*mp*

The container to swap content with.

**See Also**

db_map::swap() db_vector::clear()

**Class**

db_set
**operator==**

**Function Details**

```cpp
bool operator==(const db_set< kdt,
    value_type_sub > &m2) const
```

Set content equality comparison operator.

Return if the two containers have identical content. This function does not rely on key order. Two sets A and B are equal if and only if A contains B and B contains A.

**Parameters**

**m2**

The container to compare against.

**Return Value**

Returns true if the two containers are equal, false otherwise.

**Class**

`db_set`
**operator!=**

**Function Details**

```cpp
bool operator!=(const db_set< kdt,
    value_type_sub > &m2) const
```

Inequality comparison operator.

**Class**

`db_set`
Chapter 8.  Db_multiset

This class is the combination of std::multiset and hash_multiset.

By setting database handles of DB_BTREE or DB_HASH type respectively, you will be using the equivalent of std::multiset or hash_multiset respectively. This container stores the key in the key element of a key/data pair in the underlying database, but doesn't store anything in the data element. Database and environment handle requirement: The requirement to these handles is the same as that to db_multimap.

See Also

db_multimap db_map db_container db_set

Class Template Parameters

kdt
The key data type.

value_type_sub
If kdt is a class/struct type, do not specify anything in this parameter; Otherwise specify ElementHolder<kdt>.

Public Members

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Group

Dbstl Container Classes  (page 29)
db_multiset

Function Details

```c
db_multiset(Db *dbp=NULL,
DbEnv *envp=NULL)
```

Create a std::multiset/hash_multiset equivalent associative container.

See the handle requirement in class details to pass correct database/environment handles.

**Parameters**

**dbp**

The database handle.

**envp**

The database environment handle.

**See Also**

db_multimap(Db*, DbEnv*)

```c
db_multiset(Db *dbp, DbEnv *envp, InputIterator first,
InputIterator last)
```

Iteration constructor.

Iterates between first and last, copying each of the elements in the range into this container. Create a std::multi/hash_multiset equivalent associative container. Insert a range of elements into the database. The range is [first, last), which contains elements that can be converted to type ddt automatically. This function supports auto-commit. See the handle requirement in class details to pass correct database/environment handles.

**Parameters**

**dbp**

The database handle.

**envp**

The database environment handle.

**last**

The open boundary of the range.
first
The closed boundary of the range.

See Also

**db_multimap(Db*, DbEnv*, InputIterator, InputIterator)**

**db_multiset(const self &x)**
Copy constructor.
Create a database and insert all key/data pairs in x into this container. x's data members are not copied. This function supports auto-commit.

Parameters

x
The source container to initialize this container.

See Also

**db_multimap(const db_multimap&)**  **db_container(const db_container&)**

Class

**db_multiset**
~db_multiset

Function Details

virtual ~db_multiset()

Class

db_multiset
**insert**

**Function Details**

```cpp
iterator insert(const value_type &x)
```

Insert a single key if the key is not in the container.

**Parameters**

- `x`

  The key to insert.

**Return Value**

An iterator positioned on the newly inserted key. If the key `x` already exists, an invalid iterator equal to that returned by `end()` function is returned.

```cpp
iterator insert(iterator position,
               const value_type &x)
```

Insert a single key with hint if the key is not in the container.

The hint position is ignored because Berkeley DB controls where to insert the key.

**Parameters**

- `x`

  The key to insert.

- `position`

  The hint insert position, ignored.

**Return Value**

An iterator positioned on the newly inserted key. If the key `x` already exists, an invalid iterator equal to that returned by `end()` function is returned.

```cpp
void insert(InputIterator first,
            InputIterator last)
```

Range insertion.

Insert a range `[first, last)` of key/data pairs into this container.
Parameters

last

The open boundary of the range.

first

The closed boundary of the range.

```cpp
void insert(db_set_iterator< kdt, value_type_sub > &first,
           db_set_iterator< kdt, value_type_sub > &last)
```

Range insertion.

Insert a range [first, last) of key/data pairs into this container.

Parameters

last

The open boundary of the range.

first

The closed boundary of the range.

```cpp
void insert(db_set_base_iterator< kdt > &first,
           db_set_base_iterator< kdt > &last)
```

Range insertion.

Insert a range [first, last) of key/data pairs into this container.

Parameters

last

The open boundary of the range.

first

The closed boundary of the range.

Group: Insert Functions

Class

db_multiset
erase

Function Details

```cpp
size_type erase(const key_type &x)
```

Erase elements by key.

All key/data pairs with specified key x will be removed from the underlying database. This function supports auto-commit.

**Parameters**

**x**

The key to remove from the container.

**Return Value**

The number of key/data pairs removed.

```cpp
void erase(iterator pos)
```

Erase a key/data pair at specified position.

**Parameters**

**pos**

A valid iterator of this container to erase.

```cpp
void erase(iterator first, iterator last)
```

Range erase.

Erase all key/data pairs within the valid range [first, last).

**Parameters**

**last**

The open boundary of the range.

**first**

The closed boundary of the range.
**Group: Erase Functions**

http://www.cplusplus.com/reference/set/multiset/erase/

**Class**

db_multiset
operator=

**Function Details**

```cpp
const self& operator=(const self &x)
```

Container content assignment operator.

This function supports auto-commit.

**Parameters**

`x`

The source container whose key/data pairs will be inserted into the target container. Old content in the target container is discarded.

**Return Value**

The container x's reference.

**See Also**


**Class**

db_multiset
**swap**

**Function Details**

```c++
void swap(db_multiset< kdt, value_type_sub > &mp,
          bool b_truncate=true)
```

Swap content with another container.

This function supports auto-commit.

**Parameters**

**b_truncate**

See `db_multimap::swap()` for details.

**mp**

The container to swap content with.

**See Also**

`db_map::swap()` `db_vector::clear()`

**Class**

`db_multiset`
operator==

Function Details

```cpp
bool operator==(const self &m2) const
```

Container content equality compare operator.

This function does not rely on key order. Two sets A and B are equal if and only if for each and every key K having n occurrences in A, K has n occurrences in B, and for each and every key K' having N occurrences in B, K' has n occurrences in A.

Parameters

m2

The container to compare against.

Return Value

Returns true if the two containers are equal, false otherwise.

Class

db_multiset
operator!=

**Function Details**

```cpp
bool operator!=(const self &m2) const
```

Inequality comparison operator.

**Class**

db_multiset
Chapter 9. Dbstl Iterator Classes

Common information for all dbstl iterators:

1. Each instance of a dbstl iterator uniquely owns a Berkeley DB cursor, so that the key/data pair it currently sits on is always valid before it moves elsewhere. It also caches the current key/data pair values in order for member functions like operator* / operator-> to work properly, but caching is not compatible with standard C++ Stl behavior --- the C++ standard requires the iterator refer to a shared piece of memory where the data is stored, thus two iterators of the same container sitting on the same element should point to the same memory location, which is false for dbstl iterators.

2. There are some functions common to each child class of this class which have identical behaviors, so we will document them here.

This class is the base class for all dbstl iterators, there is no much to say about this class itself, and users are not supposed to directly use this class at all. So we will talk about some common functions of dbstl iterators in this section.

See Also

db_vector_base_iterator db_vector_iterator db_map_base_iterator db_map_iterator
db_set_base_iterator db_set_iterator

Public Members

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<td>db_map_iterator</td>
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Iterator classes for db_map and db_multimap. Iterator classes for db_map and db_multimap.

Iterator classes for db_set and db_multiset. Iterator classes for db_set and db_multiset.

Iterator classes for db_vector. Iterator classes for db_vector.

Group

None
Chapter 10. Db_base_iterator

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Group

Dbstl Iterator Classes (page 176)
refresh

Function Details

```c
int refresh(bool from_db=true)
```

Read data from underlying database via its cursor, and update its cached value.

Parameters

from_db

Whether retrieve data from database rather than using the cached data in this iterator.

Return Value

0 if succeeded. Otherwise an DbstlException exception will be thrown.

Class

db_base_iterator
close_cursor

**Function Details**

```cpp
void close_cursor() const
```

Close its cursor.

If you are sure the iterator is no longer used, call this function so that its underlying cursor is closed before this iterator is destructed, potentially increase performance and concurrency. Note that the cursor is definitely closed at iterator destruction if you don't close it explicitly.

**Class**

`db_base_iterator`
**set_bulk_buffer**

*Function Details*

```cpp
bool set_bulk_buffer(u_int32_t sz)
```

Call this function to modify bulk buffer size.

Bulk retrieval is enabled when creating an iterator, so users later can only modify the bulk buffer size to another value, but can't enable/disable bulk read while an iterator is already alive.

**Parameters**

`sz`

The new buffer size in bytes.

**Return Value**

ture if succeeded, false otherwise.

**Class**

db_base_iterator
get_bulk_bufsize

**Function Details**

```c
u_int32_t get_bulk bufsize()
```

Return current bulk buffer size.

Returns 0 if bulk retrieval is not enabled.

**Class**

db_base_iterator
db_base_iterator

Function Details

- `db_base_iterator()`

Default constructor.

- `db_base_iterator(db_container *powner, bool directdbget, bool b_read_only, u_int32_t bulk, bool rmw)`

Constructor.

- `db_base_iterator(const db_base_iterator &bi)`

Copy constructor. Copy all members of this class.

Class

- `db_base_iterator`
operator=

Function Details

const self& operator=(const self &bi)

Iterator assignment operator.

Iterator assignment will cause the underlying cursor of the right iterator to be duplicated to the left iterator after its previous cursor is closed, to make sure each iterator owns one unique cursor. The key/data cached in the right iterator is copied to the left iterator. Consequently, the left iterator points to the same key/data pair in the database as the the right value after the assignment, and have identical cached key/data pair.

Parameters

bi

The other iterator to assign with.

Return Value

The iterator bi’s reference.

Class

db_base_iterator
~db_base_iterator

Function Details

virtual ~db_base_iterator()

Destructor.

Class

db_base_iterator
get_bulk_retrieval

Function Details

```cpp
u_int32_t get_bulk_retrieval() const
```

Get bulk buffer size.

Return bulk buffer size. If the size is 0, bulk retrieval is not enabled.

Class

db_base_iterator
**is_rmw**

**Function Details**

```cpp
bool is_rmw() const
```

Get DB_RMW setting.

Return true if the iterator's cursor has DB_RMW flag set, false otherwise. DB_RMW flag causes a write lock to be acquired when reading a key/data pair, so that the transaction won't block later when writing back the updated value in a read-modify-write operation cycle.

**Class**

`db_base_iterator`
is_directdb_get

Function Details

```cpp
bool is_directdb_get() const
```

Get direct database get setting.

Return true if every operation to retrieve the key/data pair the iterator points to will read from database rather than using the cached value, false otherwise.

Class

db_base_iterator
Chapter 11. Iterator Classes for db_vector

db_vector has two iterator classes --- db_vector_base_iterator and db_vector_iterator.

The differences between the two classes are that the db_vector_base_iterator can only be used to read its referenced value, so it is intended as db_vector’s const iterator; While the other class allows both read and write access. If your access pattern is readonly, it is strongly recommended that you use the const iterator because it is faster and more efficient. The two classes have identical behaviors to std::vector::const_iterator and std::vector::iterator respectively. Note that the common public member function behaviors are described in the db_base_iterator section.

See Also

db_base_iterator

Public Members

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Dbstl Iterator Classes (page 176)
Chapter 12. Db_vector_base_iterator

This class is the const iterator class for db_vector, and it is inherited by the db_vector_iterator class, which is the iterator class for db_vector.

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Iterator Classes for db_vector (page 188)
**db_vector_base_iterator**

**Function Details**

- `db_vector_base_iterator(const db_vector_base_iterator< T > &vi)`
- `db_vector_base_iterator(db_container *powner, u_int32_t b_bulk_retrieval=0, bool rmw=false, bool directdbget=true, bool readonly=false)`
- `db_vector_base_iterator()`

**Group: Constructors and destructor**

Do not construct iterators explicitly using these constructors, but call `db_vector::begin() const` to get an valid iterator.

`db_vector::begin() const`

**Class**

- `db_vector_base_iterator`
~db_vector_base_iterator

Function Details

virtual ~db_vector_base_iterator()

Group: Constructors and destructor

Do not construct iterators explicitly using these constructors, but call db_vector::begin() const to get a valid iterator.

db_vector::begin() const

Class

db_vector_base_iterator
operator==

**Function Details**

```cpp
bool operator==(const self &itr) const
```

Equality comparison operator.

Invalid iterators are equal; Valid iterators sitting on the same key/data pair equal; Otherwise not equal.

**Parameters**

`itr`

The iterator to compare against.

**Return Value**

True if this iterator equals to `itr`; False otherwise.

**Group: Iterator comparison operators**

The way to compare two iterators is to compare the index values of the two elements they point to.

The iterator sitting on an element with less index is regarded to be smaller. And the invalid iterator sitting after last element is greater than any other iterators, because it is assumed to have an index equal to last element’s index plus one; The invalid iterator sitting before first element is less than any other iterators because it is assumed to have an index -1.

**Class**

db_vector_base_iterator
operator!=

Function Details

```cpp
bool operator!=(const self &itr) const
```

Unequal compare, identical to !operator(==itr).

Parameters

**itr**

The iterator to compare against.

Return Value

False if this iterator equals to itr; True otherwise.

Group: Iterator comparison operators

The way to compare two iterators is to compare the index values of the two elements they point to.

The iterator sitting on an element with less index is regarded to be smaller. And the invalid iterator sitting after last element is greater than any other iterators, because it is assumed to have an index equal to last element’s index plus one; The invalid iterator sitting before first element is less than any other iterators because it is assumed to have an index -1.

Class

`db_vector_base_iterator`
operator<

Function Details

```cpp
bool operator<(const self &itr) const
```

Less than comparison operator.

Parameters

itr

The iterator to compare against.

Return Value

True if this iterator is less than itr.

Group: Iterator comparison operators

The way to compare two iterators is to compare the index values of the two elements they point to.

The iterator sitting on an element with less index is regarded to be smaller. And the invalid iterator sitting after last element is greater than any other iterators, because it is assumed to have an index equal to last element’s index plus one; The invalid iterator sitting before first element is less than any other iterators because it is assumed to have an index -1.

Class

db_vector_base_iterator
operator\textless{}=\

**Function Details**

```cpp
bool operator\textless{}=(const self &itr) const
```

Less equal comparison operator.

**Parameters**

itr

The iterator to compare against.

**Return Value**

True if this iterator is less than or equal to itr.

**Group: Iterator comparison operators**

The way to compare two iterators is to compare the index values of the two elements they point to.

The iterator sitting on an element with less index is regarded to be smaller. And the invalid iterator sitting after last element is greater than any other iterators, because it is assumed to have an index equal to last element’s index plus one; The invalid iterator sitting before first element is less than any other iterators because it is assumed to have an index -1.

**Class**

db_vector_base_iterator
### operator\(\geq\)

**Function Details**

```cpp
bool operator\(\geq\)(const self &itr) const
```

Greater equal comparison operator.

**Parameters**

itr

The iterator to compare against.

**Return Value**

True if this iterator is greater than or equal to itr.

**Group: Iterator comparison operators**

The way to compare two iterators is to compare the index values of the two elements they point to.

The iterator sitting on an element with less index is regarded to be smaller. And the invalid iterator sitting after last element is greater than any other iterators, because it is assumed to have an index equal to last element's index plus one; The invalid iterator sitting before first element is less than any other iterators because it is assumed to have an index -1.

**Class**

`db_vector_base_iterator`
**`operator>`**

**Function Details**

```cpp
greater comparison operator.

**Parameters**

itr

The iterator to compare against.

**Return Value**

True if this iterator is greater than itr.

**Group: Iterator comparison operators**

The way to compare two iterators is to compare the index values of the two elements they point to.

The iterator sitting on an element with less index is regarded to be smaller. And the invalid iterator sitting after last element is greater than any other iterators, because it is assumed to have an index equal to last element's index plus one; The invalid iterator sitting before first element is less than any other iterators because it is assumed to have an index -1.

**Class**

db_vector_base_iterator
operator++

Function Details

```cpp
self& operator++()
```

Pre-increment.

Move the iterator one element backward, so that the element it sits on has a bigger index. Use `++iter` rather than `iter++` where possible to avoid two useless iterator copy constructions.

**Return Value**

This iterator after incremented.

```cpp
self operator++(int)
```

Post-increment.

Move the iterator one element backward, so that the element it sits on has a bigger index. Use `++iter` rather than `iter++` where possible to avoid two useless iterator copy constructions.

**Return Value**

A new iterator not incremented.

**Group: Iterator movement operators.**

When we talk about iterator movement, we think the container is a uni-directional range, represented by `[begin, end)`, and this is true no matter we are using iterators or reverse iterators.

When an iterator is moved closer to “begin”, we say it is moved forward, otherwise we say it is moved backward.

**Class**

`db_vector_base_iterator`
**operator--**

**Function Details**

```cpp
self& operator--()
```

Pre-decrement.

*Move the iterator one element backward, so that the element it sits on has a smaller index. Use --iter rather than iter-- where possible to avoid two useless iterator copy constructions.*

**Return Value**

This iterator after decremented.

```cpp
self operator--(int)
```

Post-decrement.

*Move the iterator one element backward, so that the element it sits on has a smaller index. Use --iter rather than iter-- where possible to avoid two useless iterator copy constructions.*

**Return Value**

A new iterator not decremented.

**Group: Iterator movement operators.**

When we talk about iterator movement, we think the container is a uni-directional range, represented by [begin, end), and this is true no matter we are using iterators or reverse iterators.

When an iterator is moved closer to “begin”, we say it is moved forward, otherwise we say it is moved backward.

**Class**

db_vector_base_iterator
operator=

**Function Details**

```
const self& operator=(const self &itr)
```

Assignment operator.

This iterator will point to the same key/data pair as itr, and have the same configurations as itr.

**Parameters**

itr

The right value of the assignment.

**Return Value**

This iterator's reference.

**See Also**

`db_base_iterator::operator=`

**Group: Iterator movement operators.**

When we talk about iterator movement, we think the container is a uni-directional range, represented by [begin, end), and this is true no matter we are using iterators or reverse iterators.

When an iterator is moved closer to “begin”, we say it is moved forward, otherwise we say it is moved backward.

**Class**

`db_vector_base_iterator`
operator+

**Function Details**

```cpp
self operator+(difference_type n) const
```

Iterator movement operator.

Return another iterator by moving this iterator forward by n elements.

**Parameters**

n

The amount and direction of movement. If negative, will move forward by $|n|$ element.

**Return Value**

The new iterator at new position.

**Group: Iterator movement operators.**

When we talk about iterator movement, we think the container is a uni-directional range, represented by `[begin, end)`, and this is true no matter we are using iterators or reverse iterators.

When an iterator is moved closer to "begin", we say it is moved forward, otherwise we say it is moved backward.

**Class**

db_vector_base_iterator
operator+=

Function Details

```cpp
const self& operator+=(difference_type n)
```

Move this iterator backward by n elements.

Parameters

n

The amount and direction of movement. If negative, will move forward by |n| element.

Return Value

Reference to this iterator at new position.

Group: Iterator movement operators.

When we talk about iterator movement, we think the container is a uni-directional range, represented by [begin, end), and this is true no matter we are using iterators or reverse iterators.

When an iterator is moved closer to “begin”, we say it is moved forward, otherwise we say it is moved backward.

Class

db_vector_base_iterator
**operator-**

**Function Details**

```cpp
self operator-(difference_type n) const
```

Iterator movement operator.

Return another iterator by moving this iterator backward by \( n \) elements.

**Parameters**

\( n \)

The amount and direction of movement. If negative, will move backward by \(|n|\) element.

**Return Value**

The new iterator at new position.

```cpp
difference_type operator-(const self &itr) const
```

Iterator distance operator.

Return the index difference of this iterator and \( \text{itr} \), so if this iterator sits on an element with a smaller index, this call will return a negative number.

**Parameters**

\( \text{itr} \)

The other iterator to substract. \( \text{itr} \) can be the invalid iterator after last element or before first element, their index will be regarded as last element's index + 1 and -1 respectively.

**Return Value**

The index difference.

**Group: Iterator movement operators.**

When we talk about iterator movement, we think the container is a uni-directional range, represented by \([\text{begin}, \text{end})\), and this is true no matter we are using iterators or reverse iterators.

When an iterator is moved closer to “begin”, we say it is moved forward, otherwise we say it is moved backward.

**Class**

\( \text{db_vector_base_iterator} \)
operator-=

**Function Details**

```cpp
const self& operator-=(difference_type n)
```

Move this iterator forward by n elements.

**Parameters**

n

The amount and direction of movement. If negative, will move backward by |n| element.

**Return Value**

Reference to this iterator at new position.

**Group: Iterator movement operators.**

When we talk about iterator movement, we think the container is a uni-directional range, represented by [begin, end), and this is true no matter we are using iterators or reverse iterators.

When an iterator is moved closer to “begin”, we say it is moved forward, otherwise we say it is moved backward.

**Class**

`db_vector_base_iterator`
operator *

Function Details

reference operator *() const

Dereference operator.

Return the reference to the cached data element, which is an ElementRef<T> object if T is a class type or an ElementHolder<T> object if T is a C++ primitive data type. The returned value can only be used to read its referenced element.

Return Value

The reference to the element this iterator points to.

Class

db_vector_base_iterator
operator->

Function Details

```
pointer operator->() const
```

Arrow operator.

Return the pointer to the cached data element, which is an ElementRef<T> object if T is a class type or an ElementHolder<T> object if T is a C++ primitive data type. The returned value can only be used to read its referenced element.

Return Value

The address of the referenced object.

Class

db_vector_base_iterator
**operator[]**

**Function Details**

```cpp
value_type_wrap operator[](difference_type _Off) const
```

Iterator index operator.

If _Off not in a valid range, the returned value will be invalid. Note that you should use a `value_type_wrap` type to hold the returned value.

**Parameters**

_-Off_

The valid index relative to this iterator.

**Return Value**

Return the element which is at position *this + _Off*. The returned value can only be used to read its referenced element.

**Class**

db_vector_base_iterator
get_current_index

Function Details

```cpp
index_type get_current_index() const
```

Get current index of within the vector.

Return the iterators current element's index (0 based). Requires this iterator to be a valid iterator, not end_itr_.

Return Value

Current index of the iterator.

Class

db_vector_base_iterator
move_to

Function Details

```cpp
void move_to(index_type n) const
```

Iterator movement function.

Move this iterator to the index "n". If n is not in the valid range, this iterator will be an invalid iterator equal to end() iterator.

Parameters

n

target element's index.

See Also

db_vector::end();

Class

db_vector_base_iterator
refresh

**Function Details**

```
virtual int refresh(bool from_db=true)
```

Refresh iterator cached value.

**Parameters**

**from_db**

If not doing direct database get and this parameter is true, we will retrieve data directly from db.

**See Also**

db_base_iterator::refresh(bool).

**Class**

`db_vector_base_iterator`
close_cursor

Function Details

```cpp
void close_cursor() const
```

Close underlying Berkeley DB cursor of this iterator.

See Also

`db_base_iterator::close_cursor() const`

Class

`db_vector_base_iterator`
set_bulk_buffer

**Function Details**

```cpp
bool set_bulk_buffer(u_int32_t sz)
```

Modify bulk buffer size.

Bulk read is enabled when creating an iterator, so you later can only modify the bulk buffer size to another value, but can't enable/disable bulk read while an iterator is already alive.

**Parameters**

`sz`

The new size of the bulk read buffer of this iterator.

**Return Value**

Returns true if succeeded, false otherwise.

**See Also**

`db_base_iterator::set_bulk_buffer(u_int32_t sz)`

**Class**

`db_vector_base_iterator`
get_bulk_bufsize

Function Details

u_int32_t get_bulk_bufsize()

Get bulk retrieval buffer size in bytes.

Return Value

Return current bulk buffer size, or 0 if bulk retrieval is not enabled.

See Also

db_base_iterator::get_bulk_bufsize()

Class

db_vector_base_iterator
Chapter 13. Db_vector_iterator

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Iterator Classes for db_vector (page 188)
**db_vector_iterator**

**Function Details**

- `db_vector_iterator(const db_vector_iterator< T, value_type_sub > &vi)`
- `db_vector_iterator(db_container *powner, u_int32_t b_bulk_retrieval=0, bool brmw=false, bool directdbget=true, bool b_read_only=false)`
- `db_vector_iterator()`
- `db_vector_iterator(const db_vector_base_iterator< T > &obj)`

**Group: Constructors and destructor**

Do not construct iterators explicitly using these constructors, but call `db_vector::begin` to get an valid iterator.

- `db_vector::begin`

**Class**

- `db_vector_iterator`
~db_vector_iterator

Function Details

virtual ~db_vector_iterator()

Group: Constructors and destructor

Do not construct iterators explicitly using these constructors, but call db_vector::begin to get an valid iterator.

db_vector::begin

Class

db_vector_iterator
operator++

Function Details

self& operator++()

Pre-increment.

Return Value

This iterator after incremented.

See Also

db_vector_base_iterator::operator++()

self operator++(int)

Post-increment.

Return Value

A new iterator not incremented.

See Also

db_vector_base_iterator::operator++(int)

Group: Iterator movement operators.

These functions have identical behaviors and semantics as those of db_vector_base_iterator, so please refer to equivalent in that class.

Class

db_vector_iterator
operator--

Function Details

self& operator--()

Pre-decrement.

Return Value
This iterator after decremented.

See Also
db_vector_base_iterator::operator--()

self operator--(int)

Post-decrement.

Return Value
A new iterator not decremented.

See Also
db_vector_base_iterator::operator--(int)

Group: Iterator movement operators.
These functions have identical behaviors and semantics as those of db_vector_base_iterator, so please refer to equivalent in that class.

Class
db_vector_iterator
operator=

**Function Details**

```cpp
const self& operator=(const self &itr)
```

Assignment operator.

This iterator will point to the same key/data pair as itr, and have the same configurations as itr.

**Parameters**

itr

The right value of the assignment.

**Return Value**

This iterator’s reference.

**See Also**

`db_base_iterator::operator=(const self&)`

**Group: Iterator movement operators.**

These functions have identical behaviors and semantics as those of `db_vector_base_iterator`, so please refer to equivalent in that class.

**Class**

`db_vector_iterator`
operator+

Function Details

```
self operator+(difference_type n) const
```

Iterator movement operator.

Return another iterator by moving this iterator backward by n elements.

Parameters

\( n \)

The amount and direction of movement. If negative, will move forward by \( |n| \) element.

Return Value

The new iterator at new position.

See Also

```
db_vector_base_iterator::operator+(difference_type n) const
```

Group: Iterator movement operators.

These functions have identical behaviors and semantics as those of `db_vector_base_iterator`, so please refer to equivalent in that class.

Class

`db_vector_iterator`
operator+=

Function Details

const self& operator+=(difference_type n)

Move this iterator backward by n elements.

Parameters

n

The amount and direction of movement. If negative, will move forward by |n| element.

Return Value

Reference to this iterator at new position.

See Also

db_vector_base_iterator::operator+=(difference_type n)

Group: Iterator movement operators.

These functions have identical behaviors and semantics as those of db_vector_base_iterator, so please refer to equivalent in that class.

Class

db_vector_iterator
operator-  

**Function Details**

```cpp
self operator-(difference_type n) const
```

Iterator movement operator.

Return another iterator by moving this iterator forward by n elements.

**Parameters**

`n`

The amount and direction of movement. If negative, will move backward by `|n|` element.

**Return Value**

The new iterator at new position.

**See Also**

db_vector_base_iterator::operator-(difference_type n) const

difference_type operator-(const self &itr) const

Iterator distance operator.

Return the index difference of this iterator and itr, so if this iterator sits on an element with a smaller index, this call will return a negative number.

**Parameters**

`itr`

The other iterator to substract. `itr` can be the invalid iterator after last element or before first element, their index will be regarded as last element's index + 1 and -1 respectively.

**Return Value**

The index difference.

**See Also**

db_vector_base_iterator::operator-(const self& itr) const

**Group: Iterator movement operators.**

These functions have identical behaviors and semantics as those of `db_vector_base_iterator`, so please refer to equivalent in that class.
Class

db_vector_iterator
operator-=

**Function Details**

```cpp
class db::db_vector_iterator
{
public:

  // Move this iterator forward by n elements.
  void operator-=(difference_type n);
};
```

Move this iterator forward by n elements.

**Parameters**

*n*

The amount and direction of movement. If negative, will move backward by |n| element.

**Return Value**

Reference to this iterator at new position.

**See Also**

*db_vector_base_iterator::operator-=(difference_type n)*

**Group: Iterator movement operators.**

These functions have identical behaviors and semantics as those of *db_vector_base_iterator*, so please refer to equivalent in that class.

**Class**

*db_vector_iterator*
**operator ***

**Function Details**

```cpp
reference operator *() const
```

Dereference operator.

Return the reference to the cached data element, which is an ElementRef<T> object if T is a class type or an ElementHolder<T> object if T is a C++ primitive data type. The returned value can be used to read or update its referenced element.

**Return Value**

The reference to the element this iterator points to.

**Class**

`db_vector_iterator`
**operator->**

**Function Details**

```cpp
pointer operator->() const
```

Arrow operator.

Return the pointer to the cached data element, which is an ElementRef<T> object if T is a class type or an ElementHolder<T> object if T is a C++ primitive data type. The returned value can be used to read or update its referenced element.

**Return Value**

The address of the referenced object.

**Class**

`db_vector_iterator`
**operator[]**

**Function Details**

```cpp
value_type_wrap operator[](difference_type _Off) const
```

Iterator index operator.

If `_Off` not in a valid range, the returned value will be invalid. Note that you should use a `value_type_wrap` type to hold the returned value.

**Parameters**

`_Off`

The valid index relative to this iterator.

**Return Value**

Return the element which is at position `*this + _Off`, which is an ElementRef<T> object if T is a class type or an ElementHolder<T> object if T is a C++ primitive data type. The returned value can be used to read or update its referenced element.

**Class**

`db_vector_iterator`
**refresh**

**Function Details**

```cpp
virtual int refresh(bool from_db=true)
```

Refresh iterator cached value.

**Parameters**

**from_db**

If not doing direct database get and this parameter is true, we will retrieve data directly from db.

**See Also**

`db_base_iterator::refresh(bool)`

**Class**

`db_vector_iterator`
Chapter 14. Iterator Classes for db_map and db_multimap

db_map has two iterator class templates -- db_map_base_iterator and db_map_iterator.

They are the const iterator class and iterator class for db_map and db_multimap. db_map_iterator inherits from db_map_base_iterator.

The two classes have identical behaviors to std::map::const_iterator and std::map::iterator respectively. Note that the common public member function behaviors are described in the db_base_iterator section.

The differences between the two classes are that the db_map_base_iterator can only be used to read its referenced value, while db_map_iterator allows both read and write access. If your access pattern is readonly, it is strongly recommended that you use the const iterator because it is faster and more efficient.

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Iterator Classes for db_map and db_multimap (page 229)
db_map_base_iterator

Function Details

```
db_map_base_iterator(const self &vi)
```

Copy constructor.

**Parameters**

- **vi**

The other iterator of the same type to initialize this.

```
db_map_base_iterator(const base &vi)
```

Base copy constructor.

**Parameters**

- **vi**

Initialize from a base class iterator.

```
db_map_base_iterator(db_container *powner, u_int32_t b_bulk_retrieval=0,
    bool rmw=false, bool directdbget=true,
    bool readonly=false)
```

Constructor.

**Parameters**

- **b_bulk_retrieval**

  The bulk read buffer size. 0 means bulk read disabled.

- **directdbget**

  Whether do direct database get rather than using key/data values cached in the iterator whenever read.

- **readonly**

  Whether open a read only cursor. Only effective when using Berkeley DB Concurrent Data Store.

- **powner**

  The container which creates this iterator.
rmw

Whether set DB_RMW flag in underlying cursor.

db_map_base_iterator()

Default constructor, do not create the cursor for now.

**Group: Constructors and destructor**

Do not create iterators directly using these constructors, but call `db_map::begin` or `db_multimap::begin` to get instances of this class.

`db_map::begin()` `db_multimap::begin()`

**Class**

`db_map_base_iterator`
~db_map_base_iterator

Function Details

virtual ~db_map_base_iterator()

Destructor.

Group: Constructors and destructor

Do not create iterators directly using these constructors, but call db_map::begin or db_multimap::begin to get instances of this class.

db_map::begin() db_multimap::begin()

Class

db_map_base_iterator
**operator**

**Function Details**

```cpp
self& operator++()
```

Pre-increment.

**Return Value**

This iterator after incremented.

```cpp
self operator++(int)
```

Post-increment.

**Return Value**

Another iterator having the old value of this iterator.

**Group: Iterator increment movement functions.**

The two functions moves the iterator one element backward, so that the element it sits on has a bigger key.

The btree/hash key comparison routine determines which key is greater. Use ++iter rather than iter++ where possible to avoid two useless iterator copy constructions.

**Class**

`db_map_base_iterator`
**operator--**

**Function Details**

```cpp
self& operator--()
```

Pre-decrement.

**Return Value**

This iterator after decremented.

```cpp
self operator--(int)
```

Post-decrement.

**Return Value**

Another iterator having the old value of this iterator.

**Group: Iterator decrement movement functions.**

The two functions moves the iterator one element forward, so that the element it sits on has a smaller key.

The btree/hash key comparison routine determines which key is greater. Use --iter rather than iter-- where possible to avoid two useless iterator copy constructions.

**Class**

`db_map_base_iterator`
operator==

**Function Details**

```cpp
bool operator==(const self &itr) const
```

Equal comparison operator.

**Parameters**

itr

The iterator to compare against.

**Return Value**

Returns true if equal, false otherwise.

**Group: Compare operators.**

Only equal comparison is supported.

**Class**

db_map_base_iterator
operator!=

Function Details

```cpp
bool operator!=(const self &itr) const
```

Unequal comparison operator.

**Parameters**

itr

The iterator to compare against.

**Return Value**

Returns false if equal, true otherwise.

**See Also**

```cpp
bool operator==(const self&itr) const
```

**Group: Compare operators.**

Only equal comparison is supported.

**Class**

db_map_base_iterator
operator *

**Function Details**

```cpp
reference operator *() const
```

Dereference operator.

Return the reference to the cached data element, which is a pair<Key_type, T>. You can only read its referenced data via this iterator but cannot update it.

**Return Value**

Current data element reference object, i.e. `ElementHolder` or `ElementRef` object.

**Class**

`db_map_base_iterator`
operator->

Function Details

```cpp
pointer operator->() const
```

Arrow operator.

Return the pointer to the cached data element, which is an `pair<Key_type, T>`. You can only read its referenced data via this iterator but can not update it.

Return Value

Current data element reference object's address, i.e. address of `ElementHolder` or `ElementRef` object.

Class

db_map_base_iterator
refresh

**Function Details**

```cpp
virtual int refresh(bool from_db=true) const
```

Refresh iterator cached value.

**Parameters**

*from_db*

If not doing direct database get and this parameter is true, we will retrieve data directly from db.

**See Also**

db_base_iterator::refresh(bool)

**Class**

db_map_base_iterator
close_cursor

Function Details

```cpp
void close_cursor() const
```

Close underlying Berkeley DB cursor of this iterator.

See Also

db_base_iterator::close_cursor() const

Class

db_map_base_iterator
move_to

Function Details

```cpp
int move_to(const kdt &k,
            int flag=DB_SET) const
```

Iterator movement function.

Move this iterator to the specified key k, by default moves exactly to k, and update cached data element, you can also specify DB_SET_RANGE, to move to the biggest key smaller than k. The btree/hash key comparison routine determines which key is bigger. When the iterator is on a multiple container, move_to will move itself to the first key/data pair of the identical keys.

Parameters

**k**

The target key value to move to.

**flag**

Flags available: DB_SET(default) or DB_SET_RANGE. DB_SET will move this iterator exactly at k; DB_SET_RANGE moves this iterator to k or the smallest key greater than k. If fail to find such a key, this iterator will become invalid.

Return Value

0 if succeed; non-0 otherwise, and this iterator becomes invalid. Call db_strerror with the return value to get the error message.

Class

db_map_base_iterator
## set_bulk_buffer

### Function Details

```
bool set_bulk_buffer(u_int32_t sz)
```

Modify bulk buffer size.

Bulk read is enabled when creating an iterator, so users later can only modify the bulk buffer size to another value, but can't enable/disable bulk read while an iterator is already alive.

### Parameters

**sz**

The new size of the bulk read buffer of this iterator.

### Return Value

Returns true if succeeded, false otherwise.

### See Also

`db_base_iterator::set_bulk_buffer(u_int32_t)`

### Class

`db_map_base_iterator`
get_bulk_bufsize

Function Details

```c
u_int32_t get_bulk_bufsize()
```

Get bulk retrieval buffer size in bytes.

Return Value

Return current bulk buffer size or 0 if bulk retrieval is not enabled.

See Also

db_base_iterator::get_bulk_bufsize()

Class

db_map_base_iterator
**operator=**

**Function Details**

```cpp
const self& operator=(const self &itr)
```

Assignment operator.

This iterator will point to the same key/data pair as itr, and have the same configurations as itr.

**Parameters**

*itr*

The right value of assignment.

**Return Value**

The reference of itr.

**See Also**

*db_base_iterator::operator=(const self&)*

**Class**

*db_map_base_iterator*
Chapter 16. Db_map_iterator

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Dbstl Iterator Classes  (page 176)
**db_map_iterator**

**Function Details**

```cpp
db_map_iterator(const db_map_iterator< kdt, ddt, value_type_sub > &vi)
```

Copy constructor.

**Parameters**

*vi*

The other iterator of the same type to initialize this.

```cpp
db_map_iterator(const db_map_base_iterator< kdt, realddt, ddt > &vi)
```

Base copy constructor.

**Parameters**

*vi*

Initialize from a base class iterator.

```cpp
db_map_iterator(db_container *powner, u_int32_t b_bulk_retrieval=0,
    bool brmw=false, bool directdbget=true,
    bool b_read_only=false)
```

Constructor.

**Parameters**

*b_bulk_retrieval*

The bulk read buffer size. 0 means bulk read disabled.

*brmw*

Whether set DB_RMW flag in underlying cursor.

*powner*

The container which creates this iterator.

*directdbget*

Whether do direct database get rather than using key/data values cached in the iterator whenever read.
**b_read_only**

Whether open a read only cursor. Only effective when using Berkeley DB Concurrent Data Store.

```
db_map_iterator()
```

Default constructor, dose not create the cursor for now.

**Group: Constructors and destructor**

Do not create iterators directly using these constructors, but call `db_map::begin` or `db_multimap::begin` to get instances of this class.

```
db_map::begin() db_multimap::begin()
```

**Class**

`db_map_iterator`
~db_map_iterator

Function Details

virtual ~db_map_iterator()

Destructor.

Group: Constructors and destructor

Do not create iterators directly using these constructors, but call db_map::begin or db_multimap::begin to get instances of this class.

db_map::begin() db_multimap::begin()

Class

db_map_iterator
operator++

Function Details

```cpp
self& operator++()
```

Pre-increment.

Return Value

This iterator after incremented.

See Also

db_map_base_iterator::operator++()

```cpp
self operator++(int)
```

Post-increment.

Return Value

Another iterator having the old value of this iterator.

See Also

db_map_base_iterator::operator++(int)

Class

db_map_iterator
operator--

Function Details

```cpp
self& operator--()
```

Pre-decrement.

**Return Value**

This iterator after decremented.

**See Also**

```
db_map_base_iterator::operator--()
```

```cpp
self operator--(int)
```

Post-decrement.

**Return Value**

Another iterator having the old value of this iterator.

**See Also**

```
db_map_base_iterator::operator--(int)
```

**Class**

```
db_map_iterator
```
**operator ***

**Function Details**

```cpp
reference operator *() const
```

Dereference operator.

Return the reference to the cached data element, which is an `pair<Key_type, ElementRef<T> >` object if `T` is a class type or an `pair<Key_type, ElementHolder<T> >` object if `T` is a C++ primitive data type.

**Return Value**

Current data element reference object, i.e. `ElementHolder` or `ElementRef` object.

**Class**

`db_map_iterator`
**operator->**

**Function Details**

```cpp
pointer operator->() const
```

Arrow operator.

Return the pointer to the cached data element, which is an pair<Key_type, ElementRef<T>> object if T is a class type or an pair<Key_type, ElementHolder<T>> object if T is a C++ primitive data type.

**Return Value**

Current data element reference object's address, i.e. address of `ElementHolder` or `ElementRef` object.

**Class**

`db_map_iterator`
**refresh**

**Function Details**

```cpp
virtual int refresh(bool from_db=true) const
```

Refresh iterator cached value.

**Parameters**

**from_db**

If not doing direct database get and this parameter is true, we will retrieve data directly from db.

**See Also**

db_base_iterator::refresh(bool )

**Class**

db_map_iterator
**operator=**

**Function Details**

```cpp
const self& operator=(const self &itr)
```

Assignment operator.

This iterator will point to the same key/data pair as itr, and have the same configurations as itr.

**Parameters**

itr

The right value of assignment.

**Return Value**

The reference of itr.

**See Also**

db_base_iterator::operator=(const self&)

**Class**

db_map_iterator
Chapter 17. Iterator Classes for db_set and db_multiset

`db_set_base_iterator` and `db_set_iterator` are the const iterator and iterator class for `db_set` and `db_multiset`.

They have identical behaviors to `std::set::const_iterator` and `std::set::iterator` respectively.

The difference between the two classes is that the `db_set_base_iterator` can only be used to read its referenced value, while `db_set_iterator` allows both read and write access. If the access pattern is readonly, it is strongly recommended that you use the const iterator because it is faster and more efficient.

The two classes inherit several functions from `db_map_base_iterator` and `db_map_iterator` respectively.

See Also

`db_map_base_iterator` `db_map_iterator`

Public Members

<table>
<thead>
<tr>
<th>Member</th>
<th>Description</th>
</tr>
</thead>
<tbody>
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<td><code>db_set_base_iterator</code></td>
</tr>
<tr>
<td><code>db_set_iterator</code></td>
<td><code>db_set_iterator</code></td>
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</table>

Group

Dbstl Iterator Classes (page 176)
Chapter 18. Db_set_base_iterator

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Group

Iterator Classes for db_set and db_multiset (page 256)
~db_set_base_iterator

Function Details

virtual ~db_set_base_iterator()

Destructor.

Group: Constructors and destructor

Do not use these constructors to create iterators, but call db_set::begin() const or db_multiset::begin() const to create valid iterators.

Class

db_set_base_iterator
**db_set_base_iterator**

**Function Details**

```cpp
db_set_base_iterator(db_container *powner, u_int32_t b_bulk_retrieval=0,
bool brmw=false, bool directdbget=true,
bool b_read_only=false)
```

Constructor.

**Parameters**

**b_bulk_retrieval**

The bulk read buffer size. 0 means bulk read disabled.

**brmw**

Whether set DB_RMW flag in underlying cursor.

**powner**

The container which creates this iterator.

**directdbget**

Whether do direct database get rather than using key/data values cached in the iterator whenever read.

**b_read_only**

Whether open a read only cursor. Only effective when using Berkeley DB Concurrent Data Store.

```cpp
db_set_base_iterator()
```

Default constructor, dose not create the cursor for now.

```cpp
db_set_base_iterator(const db_set_base_iterator &s)
```

Copy constructor.

**Parameters**

**s**

The other iterator of the same type to initialize this.
db_set_base_iterator(const base &bo)

Base copy constructor.

**Parameters**

bo

Initialize from a base class iterator.

**Group: Constructors and destructor**

Do not use these constructors to create iterators, but call db_set::begin() const or db_multiset::begin() const to create valid iterators.

**Class**

db_set_base_iterator
**operator++**

**Function Details**

```cpp
self& operator++()
```

Post-increment.

**Return Value**

This iterator after incremented.

**See Also**

db_map_base_iterator::operator++()

```cpp
self operator++(int)
```

Pre-increment.

**Return Value**

Another iterator having the old value of this iterator.

**See Also**

db_map_base_iterator::operator++(int)

**Group: Iterator movement operators.**

These functions are identical to those of db_map_base_iterator and db_map_iterator and db_set_iterator.

Actually the iterator movement functions in the four classes are the same.

**Class**

db_set_base_iterator
operator--

Function Details

```cpp
self& operator--()
```

Post-decrement.

**Return Value**

This iterator after decremented.

**See Also**

db_map_base_iterator::operator--()

```cpp
self operator--(int)
```

Pre-decrement.

**Return Value**

Another iterator having the old value of this iterator.

**See Also**

db_map_base_iterator::operator--(int)

**Group: Iterator movement operators.**

These functions are identical to those of db_map_base_iterator and db_map_iterator and db_set_iterator.

Actually the iterator movement functions in the four classes are the same.

**Class**

db_set_base_iterator
**operator *\**

**Function Details**

```cpp
reference operator *( )
```

Dereference operator.

Return the reference to the cached data element, which is an object of type T. You can only use the return value to read its referenced data element, can not update it.

**Return Value**

Current data element reference object, i.e. `ElementHolder` or `ElementRef` object.

**Class**

`db_set_base_iterator`
operator->

Function Details

pointer operator->() const

Arrow operator.

Return the pointer to the cached data element, which is an object of type T. You can only use the return value to read its referenced data element, can not update it.

Return Value

Current data element reference object's address, i.e. address of ElementHolder or ElementRef object.

Class

db_set_base_iterator
refresh

Function Details

virtual int refresh(bool from_db=true) const

Refresh iterator cached value.

Parameters

from_db

If not doing direct database get and this parameter is true, we will retrieve data directly from db.

See Also

db_base_iterator::refresh(bool)

Class

db_set_base_iterator
Chapter 19. Db_set_iterator

Public Members

<table>
<thead>
<tr>
<th>Member</th>
<th>Description</th>
</tr>
</thead>
<tbody>
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<td>~db_set_iterator</td>
<td>Destructor.</td>
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<tr>
<td>db_set_iterator</td>
<td>Constructor.</td>
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<tr>
<td>operator++</td>
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<td>operator-&gt;</td>
<td>Arrow operator.</td>
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<tr>
<td>refresh</td>
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</tr>
</tbody>
</table>

Group

Iterator Classes for db_set and db_multiset (page 256)
~db_set_iterator

Function Details

virtual ~db_set_iterator()

Destructor.

Group: Constructors and destructor

Do not use these constructors to create iterators, but call db_set::begin() or db_multiset::begin() to create valid ones.

Class

db_set_iterator
**Function Details**

```cpp
db_set_iterator(db_container *powner, u_int32_t b_bulk_retrieval=0,
                bool brmw=false, bool directdbget=true,
                bool b_read_only=false)
```

Constructor.

**Parameters**

- `b_bulk_retrieval`:
The bulk read buffer size. 0 means bulk read disabled.

- `brmw`:
Whether set DB_RMW flag in underlying cursor.

- `powner`:
The container which creates this iterator.

- `directdbget`:
Whether do direct database get rather than using key/data values cached in the iterator whenever read.

- `b_read_only`:
Whether open a read only cursor. Only effective when using Berkeley DB Concurrent Data Store.

**db_set_iterator()**

Default constructor, dose not create the cursor for now.

```cpp
db_set_iterator(const db_set_iterator &s)
```

Copy constructor.

**Parameters**

- `s`:
The other iterator of the same type to initialize this.
db_set_iterator(const base &bo)

Base copy constructor.

**Parameters**

**bo**

Initialize from a base class iterator.

db_set_iterator(const db_set_base_iterator< kdt > &bs)

Sibling copy constructor.

Note that this class does not derive from db_set_base_iterator but from db_map_iterator.

**Parameters**

**bs**

Initialize from a base class iterator.

**Group: Constructors and destructor**

Do not use these constructors to create iterators, but call db_set::begin() or db_multiset::begin() to create valid ones.

**Class**

db_set_iterator
operator++

Function Details

```cpp
self& operator++()
```

Pre-increment.

Identical to those of `db_map_iterator`.

**Return Value**

This iterator after incremented.

**See Also**

- `db_map_iterator::operator++()`

```cpp
self operator++(int)
```

Post-increment.

**Return Value**

Another iterator having the old value of this iterator.

**See Also**

- `db_map_iterator::operator++(int)`

**Class**

- `db_set_iterator`
operator--

Function Details

```cpp
self& operator--()
```

Pre-decrement.

**Return Value**

This iterator after decremented.

**See Also**

db_map_iterator::operator--()

```cpp
self operator--(int)
```

Post-decrement.

**Return Value**

Another iterator having the old value of this iterator.

**See Also**

db_map_iterator::operator--(int)

**Class**

db_set_iterator
operator *

Function Details

```
reference operator *()
```

Dereference operator.

Return the reference to the cached data element, which is an ElementRef<T> object if T is a
class type or an ElementHolder<T> object if T is a C++ primitive data type.

Return Value

Current data element reference object, i.e. ElementRef or ElementHolder object.

Class

db_set_iterator
operator->

Function Details

```cpp
pointer operator->() const
```

Arrow operator.

Return the pointer to the cached data element, which is an ElementRef<T> object if T is a class type or an ElementHolder<T> object if T is a C++ primitive data type.

Return Value

Current data element reference object's address, i.e. address of ElementRef or ElementHolder object.

Class

db_set_iterator
**refresh**

**Function Details**

```cpp
virtual int refresh(bool from_db=true) const
```

Refresh iterator cached value.

**Parameters**

**from_db**

If not doing direct database get and this parameter is true, we will retrieve data directly from `db`.

**See Also**

db_base_iterator::refresh(bool)

**Class**

db_set_iterator
Chapter 20. Db_reverse_iterator

This class is the reverse class adaptor for all dbstl iterator classes.

It inherits from real iterator classes like db_vector_iterator, db_map_iterator or db_set_iterator. When you call container::rbegin(), you will get an instance of this class.

See Also

db_vector_base_iterator db_vector_iterator db_map_base_iterator db_map_iterator
db_set_base_iterator db_set_iterator

Public Members

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<th>Member</th>
<th>Description</th>
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<td>Move this iterator forward by one element.</td>
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<tr>
<td>db_reverse_iterator (page 286)</td>
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<td>operator= (page 287)</td>
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<td>operator[] (page 288)</td>
<td>Return the reference of the element which can be reached by moving this reverse iterator by Off times backward.</td>
</tr>
</tbody>
</table>

Group

Dbstl Iterator Classes (page 176)
operator++

Function Details

```cpp
self& operator++()
```

Move this iterator forward by one element.

Return Value

The moved iterator at new position.

```cpp
self operator++(int)
```

Move this iterator forward by one element.

Return Value

The original iterator at old position.

Group: Reverse iterator movement functions

When we talk about reverse iterator movement, we think the container is a uni-directional range, represented by [begin, end), and this is true no matter we are using iterators or reverse iterators.

When an iterator is moved closer to “begin”, we say it is moved forward, otherwise we say it is moved backward.

Class

db_reverse_iterator
operator--

Function Details

```cpp
self& operator--()
```

Move this iterator backward by one element.

**Return Value**
The moved iterator at new position.

```cpp
self operator--(int)
```

Move this iterator backward by one element.

**Return Value**
The original iterator at old position.

**Group: Reverse iterator movement functions**

When we talk about reverse iterator movement, we think the container is a uni-directional range, represented by [begin, end), and this is true no matter we are using iterators or reverse iterators.

When an iterator is moved closer to “begin”, we say it is moved forward, otherwise we say it is moved backward.

**Class**

`db_reverse_iterator`
operator+

**Function Details**

```cpp
self operator+(difference_type n) const
```

Iterator shuffle operator.

Return a new iterator by moving this iterator forward by n elements.

**Parameters**

- **n**

  The amount and direction of movement. If negative, will move towards reverse direction.

**Return Value**

A new iterator at new position.

**Group: Operators for random reverse iterators**

Methods below only applies to random iterators.

```
/////
```

Return a new iterator by moving this iterator backward or forward by n elements.

**Class**

db_reverse_iterator
operator-

Function Details

```
self operator-(difference_type n) const
```

Iterator shuffle operator.
Return a new iterator by moving this iterator backward by n elements.

**Parameters**

n
The amount and direction of movement. If negative, will move towards reverse direction.

**Return Value**

A new iterator at new position.

```
difference_type operator-(const self &itr) const
```

Return the negative value of the difference of indices of elements this iterator and itr are sitting on.

**Parameters**

itr
The other reverse iterator.

**Return Value**

itr.index - this->index.

**Group: Operators for random reverse iterators**

Methods below only applies to random iterators.

```
////////
```

Return a new iterator by moving this iterator backward or forward by n elements.

**Class**

db_reverse_iterator
operator+=

**Function Details**

```cpp
class db_reverse_iterator

const self& operator+=(difference_type n)
```

Iterator shuffle operator.

Move this iterator forward by n elements and then return it.

**Parameters**

n

The amount and direction of movement. If negative, will move towards reverse direction.

**Return Value**

This iterator at new position.

**Group: Operators for random reverse iterators**

Move this iterator backward or forward by n elements and then return it.

**Class**

`db_reverse_iterator`
**operator-=**

**Function Details**

```cpp
cost self& operator-=(difference_type n)
```

Iterator shuffle operator.

Move this iterator backward by n elements and then return it.

**Parameters**

n

The amount and direction of movement. If negative, will move towards reverse direction.

**Return Value**

This iterator at new position.

**Group: Operators for random reverse iterators**

Move this iterator backward or forward by n elements and then return it.

**Class**

db_reverse_iterator
operator<

Function Details

```cpp
bool operator<(const self &itr) const
```

Less compare operator.

Group: Operators for random reverse iterators

Reverse iterator comparison against reverse iterator itr, the one sitting on elements with less index is returned to be greater.

Class

db_reverse_iterator
**operator>**

**Function Details**

```cpp
bool operator>(const self &itr) const
```

Greater compare operator.

**Group: Operators for random reverse iterators**

Reverse iterator comparison against reverse iterator itr, the one sitting on elements with less index is returned to be greater.

**Class**

db_reverse_iterator
operator<=

Function Details

```cpp
bool operator<=(const self &itr) const
```

Less equal compare operator.

**Group: Operators for random reverse iterators**

Reverse iterator comparison against reverse iterator itr, the one sitting on elements with less index is returned to be greater.

**Class**

`db_reverse_iterator`
**operator>=**

**Function Details**

```cpp
bool operator>=(const self &itr) const
```

Greater equal compare operator.

**Group: Operators for random reverse iterators**

Reverse iterator comparison against reverse iterator itr, the one sitting on elements with less index is returned to be greater.

**Class**

`db_reverse_iterator`
**db_reverse_iterator**

**Function Details**

- **db_reverse_iterator(const iterator &vi)**
  Constructor. Construct from an iterator of wrapped type.

- **db_reverse_iterator(const self &ritr)**
  Copy constructor.

- **db_reverse_iterator(const db_reverse_iterator< twin_itr_t, iterator > &ritr)**
  Copy constructor.

- **db_reverse_iterator()**
  Default constructor.

**Class**

- **db_reverse_iterator**
operator=

Function Details

const self& operator=(const self &ri)

Assignment operator.

Parameters

ri

The iterator to assign with.

Return Value

The iterator ri.

See Also

db_base_iterator::operator=(const self&)

Class

db_reverse_iterator
operator[]

Function Details

value_type_wrap operator[](difference_type Off) const

Return the reference of the element which can be reached by moving this reverse iterator by Off times backward.

If Off is negative, the movement will be forward.

Class

db_reverse_iterator
Chapter 21. Dbstl Helper Classes

Classes of this module help to achieve various features of dbstl.

**Public Members**

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<td>ReadModifyWriteOption</td>
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<td>DbstlDbt</td>
<td>DbstlDbt</td>
</tr>
<tr>
<td>ElementRef and ElementHolder wrappers</td>
<td>ElementRef and ElementHolder wrappers.</td>
</tr>
</tbody>
</table>

**Group**

None
Chapter 22. ElementRef and ElementHolder Wrappers

An ElementRef and ElementHolder object represents the reference to the data element referenced by an iterator.

Each iterator object has an ElementRef or ElementHolder object that stores the data element that the iterator points to.

The ElementHolder class is used to store primitive types into STL containers.

The ElementRef class is used to store other types into STL containers.

The ElementRef and ElementHolder classes have identical interfaces, and are treated the same by other STL classes. Since the ElementRef class inherits from the template data class, all methods have a _DB_STL_ prefix to avoid name clashes.

An ElementRef or ElementHolder class corresponds to a single iterator instance. An Element object is generally owned by an iterator object. The ownership relationship is swapped in some specific situations, specifically for the dereference and array index operator.

Public Members

<table>
<thead>
<tr>
<th>Member</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ElementRef</td>
<td>ElementRef</td>
</tr>
<tr>
<td>ElementHolder</td>
<td>ElementHolder</td>
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</tbody>
</table>

Group

Dbstl Helper Classes (page 289)
Chapter 23. ElementHolder

A wrapper class for primitive types.

It has identical usage and public interface to the ElementRef class.

See Also

ElementRef.

Public Members

<table>
<thead>
<tr>
<th>Member</th>
<th>Description</th>
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</thead>
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<td>ElementHolder</td>
<td>Constructor.</td>
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<tr>
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<tr>
<td>operator+=</td>
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<td>operator-=</td>
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<tr>
<td>operator *=</td>
<td></td>
</tr>
<tr>
<td>operator /=</td>
<td></td>
</tr>
<tr>
<td>operator %=</td>
<td></td>
</tr>
<tr>
<td>operator &amp;=</td>
<td></td>
</tr>
<tr>
<td>operator</td>
<td>=</td>
</tr>
<tr>
<td>operator ^=</td>
<td></td>
</tr>
<tr>
<td>operator &gt;&gt;=</td>
<td></td>
</tr>
<tr>
<td>operator &lt;&lt;=</td>
<td></td>
</tr>
<tr>
<td>operator++</td>
<td></td>
</tr>
<tr>
<td>operator--</td>
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</tr>
<tr>
<td>operator=</td>
<td></td>
</tr>
<tr>
<td>operator ptype</td>
<td>This operator is a type converter.</td>
</tr>
<tr>
<td>_DB_STL_value</td>
<td>Returns the data element this wrapper object wraps.</td>
</tr>
<tr>
<td>_DB_STL_StoreElement</td>
<td>Function to store the data element.</td>
</tr>
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Group

ElementRef and ElementHolder Wappers (page 290)
**ElementHolder**

**Function Details**

**ElementHolder(iterator_type *pitr=NULL)**

Constructor.

If the pitr parameter is NULL or the default value is used, the object created is a simple wrapper and not connected to a container. If a valid iterator parameter is passed in, the wrapped element will be associated with the matching key/data pair in the underlying container.

**Parameters**

**pitr**

The iterator owning this object.

**ElementHolder(const ptype &dt)**

Constructor.

Initializes an ElementRef wrapper without an iterator. It can only be used to wrap a data element in memory, it can’t access an underlying database.

**Parameters**

**dt**

The base class object to initialize this object.

**ElementHolder(const self &other)**

Copy constructor.

The constructor takes a “deep” copy. The created object will be identical to, but independent from the original object.

**Parameters**

**other**

The object to clone from.

**Class**

ElementHolder
~ElementHolder

Function Details

~ElementHolder()

Destructor.

Class

ElementHolder
operator+=

**Function Details**

```
const self& operator+=(const ElementHolder< T2 > &p2)
```

```
const self& operator+=(const self &p2)
```

**Group: Math operators.**

*ElementHolder* class templates also have all C/C++ self mutating operators for numeric primitive types, including: `+=, -=, *=, /=, %=, <<=, >>=, &=, |=, ^=, ++, --`. These operators should not be used when `ddt` is a sequence pointer type like `char*` or `wchar_t*` or `T*`, otherwise the behavior is undefined.

These methods exist only to override default behavior to store the new updated value, otherwise, the type convert operator could have done all the job. As you know, some of them are not applicable to float or double types or *ElementHolder* wrapper types for float/double types. These operators not only modifies the cached data element, but also stores new value to database if it associates a database key/data pair.

**Class**

*ElementHolder*
operator-=

**Function Details**

<table>
<thead>
<tr>
<th>const self&amp; operator-=(const ElementHolder&lt; T2 &gt; &amp;p2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>const self&amp; operator-=(const self &amp;p2)</td>
</tr>
</tbody>
</table>

**Group: Math operators.**

*ElementHolder* class templates also have all C/C++ self mutating operators for numeric primitive types, including: `+=, -=, *=, /=, +=, -=, <<=, >>=, &=, |=, ^=, ++, --`. These operators should not be used when *ddt* is a sequence pointer type like `char*` or `wchar_t*` or `T*`, otherwise the behavior is undefined.

These methods exist only to override default behavior to store the new updated value, otherwise, the type convert operator could have done all the job. As you know, some of them are not applicable to float or double types or *ElementHolder* wrapper types for float/double types. These operators not only modifies the cached data element, but also stores new value to database if it associates a database key/data pair.

**Class**

*ElementHolder*
**operator *=**

**Function Details**

```cpp
const self& operator *=(const ElementHolder< T2 > &p2)
```

```cpp
const self& operator *=(const self &p2)
```

**Group: Math operators.**

`ElementHolder` class templates also have all C/C++ self mutating operators for numeric primitive types, including: `+=, -=, *=, /=, +=, <<=, >>=, &=, |=, ^=, ++, --`. These operators should not be used when `ddt` is a sequence pointer type like `char*` or `wchar_t*` or `T*`, otherwise the behavior is undefined.

These methods exist only to override default behavior to store the new updated value, otherwise, the type convert operator could have done all the job. As you know, some of them are not applicable to float or double types or `ElementHolder` wrapper types for float/double types. These operators not only modifies the cached data element, but also stores new value to database if it associates a database key/data pair.

**Class**

`ElementHolder`
### operator/=  

#### Function Details

<table>
<thead>
<tr>
<th>Const self&amp; operator/=(const ElementHolder&lt; T2 &gt; &amp;p2)</th>
</tr>
</thead>
</table>

| Const self& operator/=(const self &p2) |

#### Group: Math operators.

<ElementHolder> class templates also have all C/C++ self mutating operators for numeric primitive types, including: +=, -=, *=, /=, =, <<=, >>=, &=, |=, ^=, ++, --. These operators should not be used when ddt is a sequence pointer type like char* or wchar_t* or T*, otherwise the behavior is undefined.

These methods exist only to override default behavior to store the new updated value, otherwise, the type convert operator could have done all the job. As you know, some of them are not applicable to float or double types or <ElementHolder> wrapper types for float/double types. These operators not only modifies the cached data element, but also stores new value to database if it associates a database key/data pair.

#### Class

<ElementHolder>
operator%=

Function Details

```
const self& operator%=(const ElementHolder< T2 > &p2)
```

```
const self& operator%=(const self &p2)
```

Group: Math operators.

`ElementHolder` class templates also have all C/C++ self mutating operators for numeric primitive types, including: `+=, -=, *=, /=, =, <<=, >>=, &=, |=, ^=, ++, --`. These operators should not be used when `ddt` is a sequence pointer type like `char*` or `wchar_t*` or `T*`, otherwise the behavior is undefined.

These methods exist only to override default behavior to store the new updated value, otherwise, the type convert operator could have done all the job. As you know, some of them are not applicable to float or double types or `ElementHolder` wrapper types for float/double types. These operators not only modifies the cached data element, but also stores new value to database if it associates a database key/data pair.

Class

`ElementHolder`
operator &=

Function Details

const self& operator &=(const ElementHolder< T2 > &p2)

const self& operator &=(const self &p2)

Group: Math operators.

ElementHolder class templates also have all C/C++ self mutating operators for numeric primitive types, including: +=, -=, *=, /=, <<=, >>=, &=, |=, ^=, ++, -- These operators should not be used when ddt is a sequence pointer type like char* or wchar_t* or T*, otherwise the behavior is undefined.

These methods exist only to override default behavior to store the new updated value, otherwise, the type convert operator could have done all the job. As you know, some of them are not applicable to float or double types or ElementHolder wrapper types for float/double types. These operators not only modifies the cached data element, but also stores new value to database if it associates a database key/data pair.

Class

ElementHolder
operator|=

Function Details

const self& operator|=(const ElementHolder< T2 > &p2)

const self& operator|=(const self &p2)

Group: Math operators.

ElementHolder class templates also have all C/C++ self mutating operators for numeric
primitive types, including: +=, -=, *=, /=, =, <<=, >>=, &=, |=, ^=, ++, -- These operators
should not be used when ddt is a sequence pointer type like char* or wchar_t* or T*, otherwise
the behavior is undefined.

These methods exist only to override default bahavior to store the new updated value,
otherwise, the type convert operator could have done all the job. As you know, some of them
are not applicable to float or double types or ElementHolder wrapper types for float/double
types. These operators not only modifies the cached data element, but also stores new value
to database if it associates a database key/data pair.

Class

ElementHolder
operator^=  

**Function Details**

- const self& operator^=(const ElementHolder< T2 > &p2)
- const self& operator^=(const self &p2)

**Group: Math operators.**

`ElementHolder` class templates also have all C/C++ self mutating operators for numeric primitive types, including: `+=, -=, *=, /=, <<=, >>=, &=, |=, ^=, ++, --` These operators should not be used when `ddt` is a sequence pointer type like `char*` or `wchar_t*` or `T*`, otherwise the behavior is undefined.

These methods exist only to override default behavior to store the new updated value, otherwise, the type convert operator could have done all the job. As you know, some of them are not applicable to float or double types or `ElementHolder` wrapper types for float/double types. These operators not only modifies the cached data element, but also stores new value to database if it associates a database key/data pair.

**Class**

`ElementHolder`
**operator>>=**

**Function Details**

```cpp
const self& operator>>=(size_t n)
```

**Group: Math operators.**

The `ElementHolder` class templates also have all C/C++ self mutating operators for numeric primitive types, including: `+=, -=, *=, /=, =, <<=, >>=, &=, |=, ^=, ++, --`. These operators should not be used when `ddt` is a sequence pointer type like `char*` or `wchar_t*` or `T*`, otherwise the behavior is undefined.

These methods exist only to override default behavior to store the new updated value, otherwise, the type convert operator could have done all the job. As you know, some of them are not applicable to float or double types or `ElementHolder` wrapper types for float/double types. These operators not only modifies the cached data element, but also stores new value to database if it associates a database key/data pair.

**Class**

`ElementHolder`
operator<<=

Function Details

```cpp
const self& operator<<=(size_t n)
```

Group: Math operators.

*ElementHolder* class templates also have all C/C++ self mutating operators for numeric primitive types, including: +=, -=, *=, /=, %=, <<=, >>=, &=, |=, ^=, ++, --. These operators should not be used when *ddt* is a sequence pointer type like char* or wchar_t* or T*, otherwise the behavior is undefined.

These methods exist only to override default behavior to store the new updated value, otherwise, the type convert operator could have done all the job. As you know, some of them are not applicable to float or double types or *ElementHolder* wrapper types for float/double types. These operators not only modifies the cached data element, but also stores new value to database if it associates a database key/data pair.

Class

*ElementHolder*
**operator++**

**Function Details**

```
self& operator++()

self operator++(int)
```

**Group: Math operators.**

The `ElementHolder` class templates also have all C/C++ self mutating operators for numeric primitive types, including: +=, -=, *=, /=, =, <=, >=, &e, |=, ^=, ++, -- These operators should not be used when ddt is a sequence pointer type like char* or wchar_t* or T*, otherwise the behavior is undefined.

These methods exist only to override default behavior to store the new updated value, otherwise, the type convert operator could have done all the job. As you know, some of them are not applicable to float or double types or `ElementHolder` wrapper types for float/double types. These operators not only modifies the cached data element, but also stores new value to database if it associates a database key/data pair.

**Class**

`ElementHolder`
operator--

**Function Details**

```c++
self& operator--()
```

```c++
self operator--(int)
```

**Group: Math operators.**

*ElementHolder* class templates also have all C/C++ self mutating operators for numeric primitive types, including: \(+, -, *, /, =, =, <=, >=, \&=, |=, ^=, +=, --\) These operators should not be used when *ddt* is a sequence pointer type like *char* or *wchar_t* or *T*, otherwise the behavior is undefined.

These methods exist only to override default behavior to store the new updated value, otherwise, the type convert operator could have done all the job. As you know, some of them are not applicable to float or double types or *ElementHolder* wrapper types for float/double types. These operators not only modifies the cached data element, but also stores new value to database if it associates a database key/data pair.

**Class**

*ElementHolder*
operator=

**Function Details**

- `const ptype& operator=(const ptype &dt2)`
- `const self& operator=(const self &dt2)`

**Group: Math operators.**

`ElementHolder` class templates also have all C/C++ self mutating operators for numeric primitive types, including: `+=, -=, *=, /=, &=, |=, ^=, <<=, >>=, <=, >=, ==, ^=, ++, --`. These operators should not be used when `ddt` is a sequence pointer type like `char*` or `wchar_t*` or `T*`, otherwise the behavior is undefined.

These methods exist only to override default behavior to store the new updated value, otherwise, the type convert operator could have done all the job. As you know, some of them are not applicable to float or double types or `ElementHolder` wrapper types for float/double types. These operators not only modifies the cached data element, but also stores new value to database if it associates a database key/data pair.

**Class**

`ElementHolder`
**operator ptype**

**Function Details**

```cpp
operator ptype() const
```

This operator is a type converter.

Where an automatic type conversion is needed, this function is called to convert this object into the primitive type it wraps.

**Class**

*ElementHolder*
**_DB_STL_value**

**Function Details**

```cpp
const ptype& _DB_STL_value() const
```

Returns the data element this wrapper object wraps.

```cpp
ptype& _DB_STL_value()
```

Returns the data element this wrapper object wraps.

**Class**

*ElementHolder*
**_DB_STL_StoreElement**

**Function Details**

```c
void _DB_STL_StoreElement()
```

Function to store the data element.

The user needs to call this method after modifying the underlying object, so that the version stored in the container can be updated.

When `db_base_iterator`'s `directdb_get_` member is true, this function must be called after modifying the data member and before any subsequent container iterator dereference operations. If this step is not carried out any changes will be lost.

If the data element is changed via `ElementHolder<>::operator=()`, you don't need to call this function.

**Class**

`ElementHolder`
Chapter 24. ElementRef

ElementRef element wrapper for classes and structures.

See Also

ElementHolder

Public Members

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<td>Assignment Operator.</td>
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<tr>
<td>_DB_STL_StoreElement (page 314)</td>
<td>Function to store the data element.</td>
</tr>
<tr>
<td>_DB_STL_value (page 315)</td>
<td>Returns the data element this wrapper object wraps.</td>
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</table>

Group

ElementRef and ElementHolder Wappers  (page 290)
~ElementRef

Function Details

~ElementRef()

Destructor.

Class

ElementRef
ElementRef

Function Details

ElementRef(iterator_type *pitr=NULL)

Constructor.

If the pitr parameter is NULL or the default value is used, the object created is a simple wrapper and not connected to a container. If a valid iterator parameter is passed in, the wrapped element will be associated with the matching key/data pair in the underlying container.

Parameters

pitr

The iterator owning this object.

ElementRef(const ddt &dt)

Constructor.

Initializes an ElementRef wrapper without an iterator. It can only be used to wrap a data element in memory, it can't access an underlying database.

Parameters

dt

The base class object to initialize this object.

ElementRef(const self &other)

Copy constructor.

The constructor takes a “deep” copy. The created object will be identical to, but independent from the original object.

Parameters

other

The object to clone from.

Class

ElementRef
**operator=**

**Function Details**

```cpp
class ddt
{
  const ddt& operator=(const ddt &dt2)
}
```

Assignment Operator.

**Parameters**

- **dt2**
  
  The data value to assign with.

**Return Value**

The object dt2's reference.

```cpp
class self
{
  const self& operator=(const self &me)
}
```

Assignment Operator.

**Parameters**

- **me**
  
  The object to assign with.

**Return Value**

The object me's reference.

**Group: Assignment operators.**

The assignment operators are used to store right-values into the wrapped object, and also to store values into an underlying container.

**Class**

- **ElementRef**
_DB_STL_StoreElement

Function Details

```cpp
void _DB_STL_StoreElement()
```

Function to store the data element.

The user needs to call this method after modifying the underlying object, so that the version stored in the container can be updated.

When `db_base_iterator`'s `directdb_get_` member is true, this function must be called after modifying the data member and before any subsequent container iterator dereference operations. If this step is not carried out any changes will be lost.

If the data element is changed via `ElementHolder<>::operator=()`, you don't need to call this function.

**Class**

`ElementRef`
**_DB_STL_value**

**Function Details**

```cpp
const ddt& _DB_STL_value() const
```

Returns the data element this wrapper object wraps.

```cpp
ddt& _DB_STL_value()
```

Returns the data element this wrapper object wraps.

**Class**

`ElementRef`
You can persist all bytes in a chunk of contiguous memory by constructing an `DbstlDbt` object `A` (use malloc to allocate the required number of bytes for `A.data` and copy the bytes to be stored into `A.data`, set other fields as necessary) and store `A` into a container, e.g. `db_vector<DbstlDbt>`, this stores the bytes rather than the object `A` into the underlying database. The `DbstlDbt` class can help you avoid memory leaks, so it is strongly recommended that you use `DbstlDbt` rather than `Dbt` class.

`DbstlDbt` derives from `Dbt` class, and it does a deep copy on copy construction and assignment --by calling malloc to allocate its own memory and then copying the bytes to it; Conversely the destructor will free the memory on destruction if the data pointer is non-NULL. The destructor assumes the memory is allocated via malloc, hence why you are required to call malloc to allocate memory in order to use `DbstlDbt`.

`DbstlDbt` simply inherits all methods from `Dbt` with no extra new methods except the constructors/destructor and assignment operator, so it is easy to use.

In practice you rarely need to use `DbstlDbt` or `Dbt` because dbstl enables you to store any complex objects or primitive data. Only when you need to store raw bytes, e.g. a bitmap, do you need to use `DbstlDbt`.

Hence, `DbstlDbt` is the right class to use to store any object into Berkeley DB via dbstl without memory leaks.

Don't free the memory referenced by `DbstlDbt` objects, it will be freed when the `DbstlDbt` object is destructed.

Please refer to the two examples using `DbstlDbt` in `TestAssoc::test_arbitrary_object_storage` and `TestAssoc::test_char_star_string_storage` member functions, which illustrate how to correctly use `DbstlDbt` in order to store raw bytes.

This class handles the task of allocating and de-allocating memory internally. Although it can be used to store data which cannot be handled by the `DbstlElemTraits` class, in practice, it is usually more convenient to register callbacks in the `DbstlElemTraits` class for the type you are storing/retrieving using dbstl.

**Public Members**

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<th>Description</th>
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<td>Construct an object with an existing chunk of memory of size1 bytes, refered by data1,..</td>
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<tr>
<td><code>~DbstlDbt</code> (page 319)</td>
<td>The memory will be free'ed by the destructor.</td>
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<td>The memory will be reallocated if neccessary.</td>
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</table>

**Group**

`Dbstl Helper Classes` (page 289)
DbstlDbt

**Function Details**

DbstlDbt(void *data1,
         u_int32_t size1)

Construct an object with an existing chunk of memory of size1 bytes, refered by data1.

DbstlDbt()

DbstlDbt(const DbstlDbt &d)

This copy constructor does a deep copy.

**Class**

DbstlDbt
~DbstlDbt

**Function Details**

~~DbstlDbt()~~

The memory will be free'ed by the destructor.

**Class**

DbstlDbt
operator=

**Function Details**

```cpp
cast DbstlDbt& operator=(const DbstlDbt &d)
```

The memory will be reallocated if neccessary.

**Class**

DbstlDbt
Chapter 26. DbstlElemTraits

This class is used to register callbacks to manipulate an object of a complex type.

These callbacks are used by dbstl at runtime to manipulate the object.

A complex type is a type whose members are not located in a contiguous chunk of memory. For example, the following class A is a complex type because for any instance a of class A, a.b_ points to another object of type B, and dbstl treats the object that a.b_ points to as part of the data of the instance a. Hence, if the user needs to store a.b_ into a dbstl container, the user needs to register an appropriate callback to de-reference and store the object referenced by a.b. Similarly, the user also needs to register callbacks to marshall an array as well as to count the number of elements in such an array.

```cpp
class A { int m; B *p_; }; class B { int n; };
```

The user also needs to register callbacks for i). returning an object’s size in bytes; ii). Marshalling and unmarshalling an object; iii). Copying a complex object and and assigning an object to another object of the same type; iv). Element comparison. v). Compare two sequences of any type of objects; Measuring the length of an object sequence and copy an object sequence.

Several elements located in a contiguous chunk of memory form a sequence. An element of a sequence may be a simple object located at a contiguous memory chunk, or a complex object, i.e. some of its members may contain references (pointers) to another region of memory. It is not necessary to store a special object to denote the end of the sequence. The callback to traverse the constituent elements of the sequence needs to able to determine the end of the sequence.

Marshalling means packing the object’s data members into a contiguous chunk of memory; unmarshalling is the opposite of marshalling. In other words, when you unmarshall an object, its data members are populated with values from a previously marshalled version of the object.

The callbacks need not be set to every type explicitly. dbstl will check if a needed callback function of this type is provided. If one is available, dbstl will use the registered callback. If the appropriate callback is not provided, dbstl will use reasonable defaults to do the job.

For returning the size of an object, the default behavior is to use the sizeof() operator; For marshalling and unmarshalling, dbstl uses memcpy, so the default behavior is sufficient for simple types whose data reside in a contiguous chunk of memory; Dbstl uses uses >, == and < for comparison operations; For char* and wchar_t * strings, dbstl already provides the appropriate callbacks, so you do not need to register them. In general, if the default behavior is adequate, you don’t need to register the corresponding callback.

If you have registered proper callbacks, the DbstlElemTraits<T> can also be used as the char_traits<T> class for std::basic_string<T, char_traits<T>>, and you can enable your class T to form a basic_string<T, DbstlElemTraits<T>>, and use basic_string’s functionality and the algorithms to manipulate it.
## Public Members

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<th>Description</th>
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**Group**

Dbstl Helper Classes (page 289)
**assign**

**Function Details**

```cpp
static void assign(T &left,
                  const T &right)
```

Assign one object to another.

```cpp
static T* assign(T *seq, size_t cnt,
                 T elem)
```

Assign first cnt number of elements of sequence seq with the value of elem.

**Group: Interface compatible with std::string's char_traits.**

Following are char_traits functions, which make this class char_traits compatible, so that it can be used in std::basic_string template, and be manipulated by the C++ STL algorithms.

**Class**

DbstlElemTraits
eq

**Function Details**

```cpp
static bool eq(const T &left,
               const T &right)
```

Check for equality of two objects.

**Group: Interface compatible with std::string's char_traits.**

Following are char_traits function, which make this class char_traits compatible, so that it can be used in std::basic_string template, and be manipulated by the c++ stl algorithms.

**Class**

.DbstlElemTraits
Function Details

```cpp
static bool lt(const T &left,
    const T &right)
```

Less than comparison.

Returns if object left is less than object right.

**Group: Interface compatible with std::string's char_traits.**

Following are char_traits funcitons, which make this class char_traits compatible, so that it can be used in std::basic_string template, and be manipulated by the c++ stl algorithms.

**Class**

DbstlElemTraits
**compare**

**Function Details**

```c
static int compare(const T *seq1, const T *seq2, size_t cnt)
```

Sequence comparison.

Compares the first cnt number of elements in the two sequences seq1 and seq2, returns negative/0/positive if seq1 is less/equal/greater than seq2.

**Group: Interface compatible with std::string's char_traits.**

Following are char_traits functions, which make this class char_traits compatible, so that it can be used in std::basic_string template, and be manipulated by the c++ stl algorithms.

**Class**

DbstElemTraits
length

**Function Details**

```cpp
static size_t length(const T *seq)
```

Returns the number of elements in sequence seq.

Note that seq may or may not end with a trailing ",", it is completely user's responsibility for this decision, though seq[0], seq[1],..., seq[length - 1] are all sequence seq's memory.

**Group: Interface compatible with std::string's char_traits.**

Following are char_traits funcitons, which make this class char_traits compatible, so that it can be used in std::basic_string template, and be manipulated by the c++ stl algorithms.

**Class**

*DbstlElemTraits*
copy

Function Details

```
static T* copy(T *seq1, const T *seq2,
               size_t cnt)
```

Copy first cnt number of elements from seq2 to seq1.

Group: Interface compatible with std::string's char_traits.

Following are char_traits functions, which make this class char_traits compatible, so that it can be used in std::basic_string template, and be manipulated by the c++ stl algorithms.

Class

DbstlElemTraits
find

Function Details

```cpp
static const T* find(const T *seq, size_t cnt, const T &elem)
```

Find within the first cnt elements of sequence seq the position of element equal to elem.

**Group: Interface compatible with std::string's char_traits.**

Following are char_traits functionos, which make this class char_traits compatible, so that it can be used in std::basic_string template, and be manipulated by the c++ stl algorithms.

**Class**

DbstlElemTraits
move

Function Details

```cpp
static T* move(T *seq1, const T *seq2,
               size_t cnt)
```

Sequence movement.

Move first cnt number of elements from seq2 to seq1, seq1 and seq2 may or may not overlap.

**Group: Interface compatible with std::string's char_traits.**

Following are char_traits function, which make this class char_traits compatible, so that it can be used in std::basic_string template, and be manipulated by the c++ stl algorithms.

**Class**

DbstlElemTraits
**to_char_type**

**Function Details**

```cpp
static T to_char_type(const int_type &meta_elem)
```

**Group: Interface compatible with std::string's char_traits.**

Following are char_traits functions, which make this class char_traits compatible, so that it can be used in std::basic_string template, and be manipulated by the c++ stl algorithms.

**Class**

DbstlElemTraits
to_int_type

Function Details

static int_type to_int_type(const T &elem)

Group: Interface compatible with std::string's char_traits.

Following are char_traits functions, which make this class char_traits compatible, so that it can be used in std::basic_string template, and be manipulated by the c++ stl algorithms.

Class

DbstlElemTraits
eq_int_type

**Function Details**

```cpp
static bool eq_int_type(const int_type &left,
const int_type &right)
```

**Group: Interface compatible with std::string's char_traits.**

Following are char_traits functions, which make this class char_traits compatible, so that it can be used in std::basic_string template, and be manipulated by the c++ stl algorithms.

**Class**

DbstlElemTraits
eof

Function Details

static int_type eof()

Group: Interface compatible with std::string's char_traits.

Following are char_traits functions, which make this class char_traits compatible, so that it can be used in std::basic_string template, and be manipulated by the c++ stl algorithms.

Class

DbstlElemTraits
not_eof

Function Details

static int_type not_eof(const int_type &meta_elem)

Group: Interface compatible with std::string's char_traits.

Following are char_traits functions, which make this class char_traits compatible, so that it can be used in std::basic_string template, and be manipulated by the c++ stl algorithms.

Class

DbstlElemTraits
set_restore_function

Function Details

void set_restore_function(ElemRstoreFunct f)

Group: Set/get functions for callback function pointers.
These are the setters and getters for each callback function pointers.

Class

DbstlElemTraits
**get_restore_function**

**Function Details**

```cpp
elemRstoreFunct get_restore_function()
```

**Group: Set/get functions for callback function pointers.**

These are the setters and getters for each callback function pointers.

**Class**

DbstlElemTraits
set_assign_function

Function Details

void set_assign_function(ElemAssignFunct f)

**Group: Set/get functions for callback function pointers.**

These are the setters and getters for each callback function pointers.

**Class**

DbstlElemTraits
**get_assign_function**

**Function Details**

```
ElemAssignFunc get_assign_function()
```

**Group: Set/get functions for callback function pointers.**

These are the setters and getters for each callback function pointers.

**Class**

`DbstlElemTraits`
**get_size_function**

**Function Details**

```
ElemSizeFunct get_size_function()
```

**Group: Set/get functions for callback function pointers.**

These are the setters and getters for each callback function pointers.

**Class**

`DbstlElemTraits`
set_size_function

Function Details

void set_size_function(ElemSizeFunct f)

Group: Set/get functions for callback function pointers.
These are the setters and getters for each callback function pointers.

Class

DbstlElemTraits
get_copy_function

Function Details

ElemCopyFunct get_copy_function()

Group: Set/get functions for callback function pointers.

These are the setters and getters for each callback function pointers.

Class

DbstlElemTraits
set_copy_function

Function Details

```c
void set_copy_function(ElemCopyFunct f)
```

**Group: Set/get functions for callback function pointers.**

These are the setters and getters for each callback function pointers.

**Class**

DbstlElemTraits
set_sequence_len_function

Function Details

```c
void set_sequence_len_function(SequenceLenFunct f)
```

**Group: Set/get functions for callback function pointers.**

These are the setters and getters for each callback function pointers.

**Class**

DbstlElemTraits
get_sequence_len_function

Function Details

SequenceLenFunct get_sequence_len_function()

Group: Set/get functions for callback function pointers.
These are the setters and getters for each callback function pointers.

Class
DbstlElemTraits
get_sequence_copy_function

Function Details

SequenceCopyFunct get_sequence_copy_function()

Group: Set/get functions for callback function pointers.

These are the setters and getters for each callback function pointers.

Class

DbstlElemTraits
set_sequence_copy_function

**Function Details**

```c
void set_sequence_copy_function(SequenceCopyFunct f)
```

**Group: Set/get functions for callback function pointers.**

These are the setters and getters for each callback function pointers.

**Class**

DbstlElemTraits
set_compare_function

Function Details

```cpp
void set_compare_function(ElemCompareFunct f)
```

**Group: Set/get functions for callback function pointers.**

These are the setters and getters for each callback function pointers.

**Class**

DbstlElemTraits
get_compare_function

**Function Details**

```cpp
ElemCompareFunct get_compare_function()
```

**Group: Set/get functions for callback function pointers.**

These are the setters and getters for each callback function pointers.

**Class**

DbstlElemTraits
set_sequence_compare_function

Function Details

```cpp
void set_sequence_compare_function(SequenceCompareFunct f)
```

**Group:** Set/get functions for callback function pointers.

These are the setters and getters for each callback function pointers.

**Class**

*DbstlElemTraits*
get_sequence_compare_function

Function Details

SequenceCompareFunct get_sequence_compare_function()

Group: Set/get functions for callback function pointers.

These are the setters and getters for each callback function pointers.

Class

DbstlElemTraits
set_sequence_n_compare_function

Function Details

```c
void set_sequence_n_compare_function(SequenceNCompareFunct f)
```

Group: Set/get functions for callback function pointers.

These are the setters and getters for each callback function pointers.

Class

DbstlElemTraits
get_sequence_n_compare_function

Function Details

SequenceNCompareFunct get_sequence_n_compare_function()

Group: Set/get functions for callback function pointers.

These are the setters and getters for each callback function pointers.

Class

DbstlElemTraits
instance

Function Details

```cpp
static DbstlElemTraits* instance()
```

Factory method to create a singleton instance of this class.

The created object will be deleted by dbstl upon process exit.

Class

DbstlElemTraits
~DbstlElemTraits

Function Details

~DbstlElemTraits()

Class

DbstlElemTraits
DbstlElemTraits

Function Details

DbstlElemTraits()

Class

DbstlElemTraits
Chapter 27. BulkRetrievalOption

Bulk retrieval configuration helper class.

Used by the begin() function of a container.

Public Members

<table>
<thead>
<tr>
<th>Member</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>BulkRetrievalOption</td>
<td>Equality comparison.</td>
</tr>
<tr>
<td>operator== (page 360)</td>
<td>Assignment operator.</td>
</tr>
<tr>
<td>bulk_buf_size (page 362)</td>
<td>Return the buffer size set to this object.</td>
</tr>
<tr>
<td>bulk_retrieval (page 363)</td>
<td>This function indicates that you need a bulk retrieval iterator, and it can be also used to optionally set the bulk read buffer size.</td>
</tr>
<tr>
<td>no_bulk_retrieval (page 364)</td>
<td>This function indicates that you do not need a bulk retrieval iterator.</td>
</tr>
</tbody>
</table>

Group

Dbstl Helper Classes (page 289)
BulkRetrievalOption

Function Details

BulkRetrievalOption(Option bulk_retrieve1,
   u_int32_t bulk_buf_sz=DBSTL_BULK_BUF_SIZE)

Class

BulkRetrievalOption
**operator==**

**Function Details**

```cpp
bool operator==(const BulkRetrievalOption &bro) const
```

Equality comparison.

**Class**

`BulkRetrievalOption`
operator=

Function Details

void operator=(BulkRetrievalOption::Option opt)

Assignment operator.

Class

BulkRetrievalOption
bulk_buf_size

Function Details

```c
u_int32_t bulk_buf_size()
```

Return the buffer size set to this object.

Class

BulkRetrievalOption


bulk_retrieval

Function Details

```cpp
static BulkRetrievalOption bulk_retrieval(u_int32_t bulk_buf_sz= DBSTL_BULK_BUF_SIZE)
```

This function indicates that you need a bulk retrieval iterator, and it can be also used to optionally set the bulk read buffer size.

Class

BulkRetrievalOption
**no_bulk_retrieval**

**Function Details**

```cpp
static BulkRetrievalOption no_bulk_retrieval()
```

This function indicates that you do not need a bulk retrieval iterator.

**Class**

BulkRetrievalOption
Chapter 28. ReadModifyWriteOption

Read-modify-write cursor configuration helper class.

Used by each begin() function of all containers.

Public Members

<table>
<thead>
<tr>
<th>Member</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>operator= (page 366)</td>
<td>Assignment operator.</td>
</tr>
<tr>
<td>operator== (page 367)</td>
<td>Equality comparison.</td>
</tr>
<tr>
<td>read_modify_write (page 368)</td>
<td>Call this function to tell the container's begin() function that you need a read-modify-write iterator.</td>
</tr>
<tr>
<td>no_read_modify_write (page 369)</td>
<td>Call this function to tell the container's begin() function that you do not need a read-modify-write iterator.</td>
</tr>
</tbody>
</table>

Group

Dbstl Helper Classes  (page 289)
operator=

Function Details

```cpp
void operator=(ReadModifyWriteOption::Option rmw1)
```

Assignment operator.

Class

`ReadModifyWriteOption`
operator==

Function Details

```cpp
bool operator==(const ReadModifyWriteOption &rmw1) const
```

Equality comparison.

Class

`ReadModifyWriteOption`
read_modify_write

Function Details

```cpp
static ReadModifyWriteOption read_modify_write()
```

Call this function to tell the container's begin() function that you need a read-modify-write iterator.

Class

ReadModifyWriteOption
no_read_modify_write

Function Details

```cpp
static ReadModifyWriteOption no_read_modify_write()
```

Call this function to tell the container's begin() function that you do not need a read-modify-write iterator.

This is the default value for the parameter of any container's begin() function.

Class

ReadModifyWriteOption
Chapter 29. Dbstl Exception Classes

dbstl throws several types of exceptions on several kinds of errors, the exception classes form a class hierarchy.

First, there is the DbstlException, which is the base class for all types of dbstl specific concrete exception classes. DbstlException inherits from the class DbException of Berkeley DB C++ API. Since DbException class inherits from C++ STL exception base class std::exception, you can make use of all Berkeley DB C++ and dbstl API exceptions in the same way you use the C++ std::exception class.

Besides exceptions of DbstlException and its subclasses, dbstl may also throw exceptions of DbException and its subclasses, which happens when a Berkeley DB call failed. So you should use the same way you catch Berkeley DB C++ API exceptions when you want to catch exceptions throw by Berkeley DB operations.

When an exception occurs, dbstl initialize an local exception object on the stack and throws the exception object, so you should catch an exception like this:

try { dbstl operations } catch(DbstlException ex){ Exception handling throw ex; // Optionally throw ex again }

Public Members

<table>
<thead>
<tr>
<th>Member</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DbstlException</td>
<td>DbstlException</td>
</tr>
<tr>
<td>NotEnoughMemoryException</td>
<td>NotEnoughMemoryException</td>
</tr>
<tr>
<td>InvalidIteratorException</td>
<td>InvalidIteratorException</td>
</tr>
<tr>
<td>InvalidCursorException</td>
<td>InvalidCursorException</td>
</tr>
<tr>
<td>InvalidDbtException</td>
<td>InvalidDbtException</td>
</tr>
<tr>
<td>FailedAssertionException</td>
<td>FailedAssertionException</td>
</tr>
<tr>
<td>NoSuchKeyException</td>
<td>NoSuchKeyException</td>
</tr>
<tr>
<td>InvalidArgumentException</td>
<td>InvalidArgumentException</td>
</tr>
<tr>
<td>NotSupportedException</td>
<td>NotSupportedException</td>
</tr>
<tr>
<td>InvalidFunctionCall</td>
<td>InvalidFunctionCall</td>
</tr>
</tbody>
</table>

Group

None
Chapter 30. DbstlException

Base class of all dbstl exception classes.

It is derived from Berkeley DB C++ API DbException class to maintain consistency with all Berkeley DB exceptions.

Public Members

<table>
<thead>
<tr>
<th>Member</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>DbstlException (page 372)</td>
<td></td>
</tr>
<tr>
<td>operator= (page 373)</td>
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</tr>
<tr>
<td>~DbstlException (page 374)</td>
<td></td>
</tr>
</tbody>
</table>

Group

Dbstl Exception Classes (page 370)
DbstlException

Function Details

- DbstlException(const char *msg)
- DbstlException(const char *msg, int err)
- DbstlException(const DbstlException &ex)
- DbstlException(int err)
- DbstlException(const char *prefix, const char *msg, int err)

Class

DbstlException
### operator=

**Function Details**

```cpp
const DbstlException& operator=(const DbstlException &exobj)
```

**Class**

DbstlException
~DbstlException

Function Details

virtual ~DbstlException()
Chapter 31. InvalidDbtException

The Dbt object has inconsistent status or has no valid data, it is unable to be used any more.

Public Members

<table>
<thead>
<tr>
<th>Member</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>InvalidDbtException</td>
<td>(page 376)</td>
</tr>
</tbody>
</table>

Group

Dbstl Exception Classes  (page 370)
InvalidDbtException

Function Details

InvalidDbtException()

InvalidDbtException(int error_code)

Class

InvalidDbtException
Chapter 32. FailedAssertionException

The assertions inside dbstl failed.

The code file name and line number will be passed to the exception object of this class.

Public Members

<table>
<thead>
<tr>
<th>Member</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>what (page 378)</td>
<td></td>
</tr>
<tr>
<td>FailedAssertionException (page 379)</td>
<td></td>
</tr>
<tr>
<td>~FailedAssertionException (page 380)</td>
<td></td>
</tr>
</tbody>
</table>

Group

Dbstl Exception Classes  (page 370)
what

**Function Details**

```
virtual const char* what() const
```

**Class**

`FailedAssertionException`
FailedAssertionException

Function Details

FailedAssertionException(const char *fname, size_t lineno, const char *msg)

FailedAssertionException(const FailedAssertionException &ex)

Class

FailedAssertionException
~FailedAssertionException

Function Details

virtual ~FailedAssertionException()

Class

FailedAssertionException
Chapter 33. InvalidCursorException

The cursor has inconsistent status, it is unable to be used any more.

Public Members

<table>
<thead>
<tr>
<th>Member</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>InvalidCursorException</td>
<td>(page 382)</td>
</tr>
</tbody>
</table>

Group

Dbstl Exception Classes  (page 370)
InvalidCursorException

Function Details

InvalidCursorException()

InvalidCursorException(int error_code)

Class

InvalidCursorException
Chapter 34. NoSuchKeyException

There is no such key in the database.

The key can’t not be passed into the exception instance because this class has to be a class template for that to work.

Public Members

<table>
<thead>
<tr>
<th>Member</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>NoSuchKeyException (page 384)</td>
<td></td>
</tr>
</tbody>
</table>

Group

Dbstdl Exception Classes  (page 370)
NoSuchKeyException

Function Details

NoSuchKeyException()

Class

NoSuchKeyException
Chapter 35. NotEnoughMemoryException

Failed to allocate memory because memory is not enough.

Public Members

<table>
<thead>
<tr>
<th>Member</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NotEnoughMemoryException</td>
<td>(page 386)</td>
</tr>
</tbody>
</table>

Group

Dbstl Exception Classes  (page 370)
**NotEnoughMemoryException**

**Function Details**

```
NotEnoughMemoryException(const char *msg,
             size_t sz)
```

```
NotEnoughMemoryException(const NotEnoughMemoryException &ex)
```

**Class**

`NotEnoughMemoryException`
Chapter 36. NotSupportedException

The function called is not supported in this class.

Public Members

<table>
<thead>
<tr>
<th>Member</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>NotSupportedException</td>
<td>(page 388)</td>
</tr>
</tbody>
</table>

Group

Dbstd Exception Classes  (page 370)
NotSupportedException

Function Details

NotSupportedException(const char *str)

Class

NotSupportedException
Chapter 37. InvalidIteratorException

The iterator has inconsistent status, it is unable to be used any more.

Public Members

<table>
<thead>
<tr>
<th>Member</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>InvalidIteratorException</td>
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</tr>
</tbody>
</table>

Group

Dbstl Exception Classes (page 370)
InvalidIteratorException

**Function Details**

<table>
<thead>
<tr>
<th>Function</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>InvalidIteratorException()</td>
<td></td>
</tr>
<tr>
<td>InvalidIteratorException(int error_code)</td>
<td></td>
</tr>
</tbody>
</table>

**Class**

InvalidIteratorException
Chapter 38. InvalidFunctionCall

The function can not be called in this context or in current configurations.

**Public Members**

<table>
<thead>
<tr>
<th>Member</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>InvalidFunctionCall (page 392)</td>
<td></td>
</tr>
</tbody>
</table>

**Group**

Dbssl Exception Classes (page 370)
InvalidFunctionCall

Function Details

InvalidFunctionCall(const char *str)

Class

InvalidFunctionCall
Chapter 39. InvalidArgumentException

Some argument of a function is invalid.

Public Members

<table>
<thead>
<tr>
<th>Member</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>InvalidArgumentException (page 394)</td>
<td></td>
</tr>
</tbody>
</table>

Group

Dbstl Exception Classes (page 370)
InvalidArgumentException

Function Details

InvalidArgumentException(const char *errmsg)

InvalidArgumentException(const char *argtype, const char *arg)

Class

InvalidArgumentException