Generic Containers

0.1

Generated by Doxygen 1.7.1

Thu Dec 2 2010 00:50:09

Contents

Chapter 1

Class Index

1.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

Chapter 2

Class Index

2.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

Chapter 3

File Index

3.1 File List

Here is a list of all files with brief descriptions:

Chapter 4

Class Documentation

4.1 GenericContainer< T >::ContainerNode Class Reference

Represents the node of a doubly-linked list.

Public Attributes

- T element

  The copy of the element inserted in the container.

- ContainerNode ∗ next

  A link to the next element in the linked list.

- ContainerNode ∗ previous

  A link to the previous element in the linked list.

4.1.1 Detailed Description

template<class T> class GenericContainer< T >::ContainerNode

Represents the node of a doubly-linked list. This is a private class that can only be accessed by the container and that has the elements and links between the nodes in the linked list

4.1.2 Member Data Documentation

4.1.2.1 template<class T > T GenericContainer< T >::ContainerNode::element

The copy of the element inserted in the container.

This is the only copy of the element in the container.

4.1.2.2 template<class T > ContainerNode∗ GenericContainer< T >::ContainerNode::next

A link to the next element in the linked list.

This is NULL if it's the tail of the list

4.1.2.3 template<class T > ContainerNode∗ GenericContainer< T >::ContainerNode::previous

A link to the previous element in the linked list.

This is NULL if it's the tail of the list

The documentation for this class was generated from the following file:

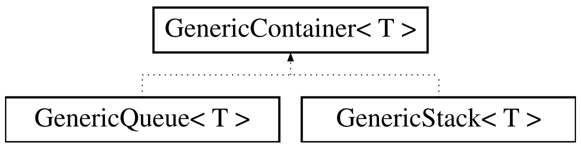
- /home/ferreira/dev-github/random/last.fm/src/GenericContainer.h

4.2 GenericContainer< T > Class Template Reference

A container for generic objects.

`#include <GenericContainer.h>`

Inheritance diagram for GenericContainer< T >:



Classes

- class ContainerNode

  Represents the node of a doubly-linked list.

Public Member Functions

- GenericContainer ()

  Create a GenericContainer.

- ∼GenericContainer ()

  Destroy a GenericContainer.

- bool is_empty () const

  Check if the Container is empty.

- int size () const

  Get number of elements in the container.

- bool exists (const T &element)

  Check if an element exists in the container.

- void insert (const T &element, int position) throw (std::out_of_range)

Insert an element at a specified position of the container.

- void remove (int position) throw (std::out_of_range)

  Remove the element at a specified position of the container.

- bool remove_element (const T &element)

  Remove the first occurence of an element.

- T get_element (int position) throw (std::out_of_range)

  Retrieve the element at a certain position of the container.

Private Attributes

- int n_elements

  The number of elements in the container.

- ContainerNode ∗ head

  A pointer to the first element of the linked list.

- ContainerNode ∗ tail

  A pointer to the last element of the linked list.

- ThreadSafe mutex

  A object to support safe race conditions.

4.2.1 Detailed Description

template<class T> class GenericContainer< T >

A container for generic objects. This class implements a container for generic objects using doubly-linked lists.

A copy of the elements inserted is kept in memory.

If this is linked with ThreadSafe.cpp, it becomes thread safe and supports concurrent reading of the elements of the container. When writing, it makes sure that no other thread is reading or writing concurrently

4.2.2 Constructor & Destructor Documentation

4.2.2.1 template<class T > GenericContainer< T >::GenericContainer ( )

Create a GenericContainer.

Initialization of internal variables

4.2.2.2 template<class T > GenericContainer< T >::∼GenericContainer ( )

Destroy a GenericContainer.

Frees objects alocated in the container

4.2.3 Member Function Documentation

4.2.3.1 template<class T > bool GenericContainer< T >::exists (const T & *element*)

Check if an element exists in the container.

This method takes O(n) time for a random position

Returns

True if the element exists in the container, False otherwise

4.2.3.2 template<class T > T GenericContainer< T >::get_element (int *position*) throw (std::out_of_range)

Retrieve the element at a certain position of the container.

When asked to remove an element out of bounds gives an assert error.

Parameters

position The position of the element to return

Returns

The element at the specified position

4.2.3.3 template<class T > void GenericContainer< T >::insert (const T & *element*, int *position* = `0`) throw (std::out_of_range)

Insert an element at a specified position of the container.

Insert an element in the container at a specified position. A Copy of the element is performed

Positions start counting from 0. The element is inserted at the first position if none other is specified.

When asked to insert an element out of bounds gives an assert error.

This method takes O(n) time for a random position This method takes O(1) time for inserting at left of the linked list

Parameters

element The element to insert in the container

position The position where to insert the element

4.2.3.4 template<class T > bool GenericContainer< T >::is_empty ( ) const

Check if the Container is empty.

This method takes O(1) time

Returns

True if the container is empty, False otherwise

4.2.3.5 template<class T > void GenericContainer< T >::remove (int *position* = `0`) throw (std::out_of_range)

Remove the element at a specified position of the container.

Positions start counting from 0.

When asked to remove an element out of bounds gives an assert error.

This method takes O(n) time for a random position This method takes O(1) time for removing at left of the linked list

Parameters

position The position where the element to remove is

4.2.3.6 template<class T > bool GenericContainer< T >::remove_element (const T & *element*)

Remove the first occurence of an element.

Parameters

element The element to remove

Returns

True if removed an element, False otherwise

4.2.3.7 template<class T > int GenericContainer< T >::size ( ) const

Get number of elements in the container.

This method takes O(1) time

Returns

Number of elements in the container

4.2.4 Member Data Documentation

4.2.4.1 template<class T > ContainerNode∗ GenericContainer< T >::head `[private]`

A pointer to the first element of the linked list.

This first element is a dummy element and it is always created. This is done to avoid special cases when inserting/removing from the endpoints of the list

4.2.4.2 template<class T > ThreadSafe GenericContainer< T >::mutex `[private]`

A object to support safe race conditions.

If the code is linked with threadunsafe, there are no actions being performed. If theading is enabled, it allows concurrent reading of the list and locks reading and writing (inserting/removing) when writing

4.2.4.3 template<class T > int GenericContainer< T >::n_elements `[private]`

The number of elements in the container.

4.2.4.4 template<class T > ContainerNode∗ GenericContainer< T >::tail `[private]`

A pointer to the last element of the linked list.

This last element is a dummy element and it is always created. This is done to avoid special cases when inserting/removing from the endpoints of the list

The documentation for this class was generated from the following file:

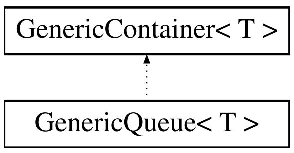
- /home/ferreira/dev-github/random/last.fm/src/GenericContainer.h

4.3 GenericQueue< T > Class Template Reference

A queue for generic objects.

`#include <GenericQueue.h>`

Inheritance diagram for GenericQueue< T >:



Public Member Functions

- T front (void) throw (std::out_of_range)

  Get element at the front of the queue.

- void pop (void) throw (std::out_of_range)

  Remove element at the front of the queue.

- void push (const T &element)

  Push an element to the back of the queue.

Private Member Functions

- bool is_empty () const

  Check if the Container is empty.

- int size () const

  Get number of elements in the container.

- bool exists (const T &element)

Check if an element exists in the container.

- void insert (const T &element, int position) throw (std::out_of_range)

  Insert an element at a specified position of the container.

- void remove (int position) throw (std::out_of_range)

  Remove the element at a specified position of the container.

- bool remove_element (const T &element)

  Remove the first occurence of an element.

- T get_element (int position) throw (std::out_of_range)

  Retrieve the element at a certain position of the container.

4.3.1 Detailed Description

template<class T> class GenericQueue< T >

A queue for generic objects. This class implements a queue for generic objects using the doubly-linked list in Generic Container.

If this is linked with ThreadSafe.cpp, it becomes thread safe and supports concurrent reading of the elements of the container. When writing, it makes sure that no other thread is reading or writing concurrently

4.3.2 Member Function Documentation

4.3.2.1 template<class T > bool GenericContainer< T >::exists (const T & *element*) `[inherited]`

Check if an element exists in the container.

This method takes O(n) time for a random position

Returns

True if the element exists in the container, False otherwise

4.3.2.2 template<class T > T GenericQueue< T >::front (void) throw (std::out_of_range)

Get element at the front of the queue.

This method reuses the get_element method implemented in GenericContainer This method takes O(1) time

Returns

Returns a copy of the element at the front of the queue

4.3.2.3 template<class T > T GenericContainer< T >::get_element (int *position*) throw (std::out_of_range) `[inherited]`

Retrieve the element at a certain position of the container.

When asked to remove an element out of bounds gives an assert error.

Parameters

position The position of the element to return

Returns

The element at the specified position

4.3.2.4 template<class T > void GenericContainer< T >::insert (const T & *element*, int *position* = `0`) throw (std::out_of_range) `[inherited]`

Insert an element at a specified position of the container.

Insert an element in the container at a specified position. A Copy of the element is performed

Positions start counting from 0. The element is inserted at the first position if none other is specified.

When asked to insert an element out of bounds gives an assert error.

This method takes O(n) time for a random position This method takes O(1) time for inserting at left of the linked list

Parameters

element	The element to insert in the container
position	The position where to insert the element

4.3.2.5 template<class T > bool GenericContainer< T >::is_empty ( ) const `[inherited]`

Check if the Container is empty.

This method takes O(1) time

Returns

True if the container is empty, False otherwise

4.3.2.6 template<class T > void GenericQueue< T >::pop (void) throw (std::out_of_range)

Remove element at the front of the queue.

This method reuses the remove method implemented in GenericContainer

This method takes O(1) time

4.3.2.7 template<class T > void GenericQueue< T >::push (const T & *element*)

Push an element to the back of the queue.

This method implement a insert from the back of the linked list method in order to be more efficient.

This method takes O(1) time

4.3.2.8 template<class T > void GenericContainer< T >::remove (int *position* = `0`) throw (std::out_of_range) `[inherited]`

Remove the element at a specified position of the container.

Positions start counting from 0.

When asked to remove an element out of bounds gives an assert error.

This method takes O(n) time for a random position This method takes O(1) time for removing at left of the linked list

Parameters

position The position where the element to remove is

4.3.2.9 template<class T > bool GenericContainer< T >::remove_element (const T & *element*) `[inherited]`

Remove the first occurence of an element.

Parameters

element The element to remove

Returns

True if removed an element, False otherwise

4.3.2.10 template<class T > int GenericContainer< T >::size ( ) const `[inherited]`

Get number of elements in the container.

This method takes O(1) time

Returns

Number of elements in the container

The documentation for this class was generated from the following file:

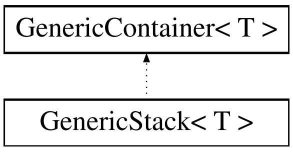
- /home/ferreira/dev-github/random/last.fm/src/GenericQueue.h

4.4 GenericStack< T > Class Template Reference

A stack for generic objects.

```
#include <GenericStack.h>
```

Inheritance diagram for GenericStack< T >:



Public Member Functions

- T top (void) throw (std::out_of_range)

  Get element at the top of the stack.

- void pop (void) throw (std::out_of_range)

  Remove element at the top of the stack.

- void push (T &element)

  Push an element to the top of the stack.

Private Member Functions

- bool is_empty () const

  Check if the Container is empty.

- int size () const

  Get number of elements in the container.

- bool exists (const T &element)

  Check if an element exists in the container.

- void insert (const T &element, int position) throw (std::out_of_range)

  Insert an element at a specified position of the container.

- void remove (int position) throw (std::out_of_range)

  Remove the element at a specified position of the container.

- bool remove_element (const T &element)

  Remove the first occurence of an element.

- T get_element (int position) throw (std::out_of_range)

  Retrieve the element at a certain position of the container.

4.4.1 Detailed Description

template<class T> class GenericStack< T >

A stack for generic objects. This class implements a stack for generic objects using the doubly-linked list in Generic Container.

If this is linked with ThreadSafe.cpp, it becomes thread safe and supports concurrent reading of the elements of the container. When writing, it makes sure that no other thread is reading or writing concurrently

4.4.2 Member Function Documentation

4.4.2.1 template<class T > bool GenericContainer< T >::exists (const T & *element*) `[inherited]`

Check if an element exists in the container.

This method takes O(n) time for a random position

Returns

True if the element exists in the container, False otherwise

4.4.2.2 template<class T > T GenericContainer< T >::get_element (int *position*) throw (std::out_of_range) `[inherited]`

Retrieve the element at a certain position of the container.

When asked to remove an element out of bounds gives an assert error.

Parameters

position The position of the element to return

Returns

The element at the specified position

4.4.2.3 template<class T > void GenericContainer< T >::insert (const T & *element*, int *position* = `0`) throw (std::out_of_range) `[inherited]`

Insert an element at a specified position of the container.

Insert an element in the container at a specified position. A Copy of the element is performed

Positions start counting from 0. The element is inserted at the first position if none other is specified.

When asked to insert an element out of bounds gives an assert error.

This method takes O(n) time for a random position This method takes O(1) time for inserting at left of the linked list

Parameters

element The element to insert in the container

position The position where to insert the element

4.4.2.4 template<class T > bool GenericContainer< T >::is_empty ( ) const `[inherited]`

Check if the Container is empty.

This method takes O(1) time

Returns

True if the container is empty, False otherwise

4.4.2.5 template<class T > void GenericStack< T >::pop (void) throw (std::out_of_range)

Remove element at the top of the stack.

This method reuses the get_element method implemented in GenericContainer This method takes O(1) time

4.4.2.6 template<class T > void GenericStack< T >::push (T & *element*)

Push an element to the top of the stack.

This method reuses the get_element method implemented in GenericContainer

This method takes O(1) time

4.4.2.7 template<class T > void GenericContainer< T >::remove (int *position* = `0`) throw (std::out_of_range) `[inherited]`

Remove the element at a specified position of the container.

Positions start counting from 0.

When asked to remove an element out of bounds gives an assert error.

This method takes O(n) time for a random position This method takes O(1) time for removing at left of the linked list

Parameters

position The position where the element to remove is

4.4.2.8 template<class T > bool GenericContainer< T >::remove_element (const T & *element*) `[inherited]`

Remove the first occurence of an element.

Parameters

element The element to remove

Returns

True if removed an element, False otherwise

4.4.2.9 template<class T > int GenericContainer< T >::size ( ) const [inherited]

Get number of elements in the container.

This method takes O(1) time

Returns

Number of elements in the container

4.4.2.10 template<class T > T GenericStack< T >::top (void) throw (std::out_of_range)

Get element at the top of the stack.

This method reuses the get_element method implemented in GenericContainer This method takes O(1) time

Returns

Returns a copy of the element at the front of the queue

The documentation for this class was generated from the following file:

- /home/ferreira/dev-github/random/last.fm/src/GenericStack.h

4.5 ThreadSafe Class Reference

Provides thread safeness to containers.

```
#include <ThreadSafe.h>
```

Public Member Functions

- ThreadSafe ()

  Constuctor of the thread safe class.

- void lock_write ()

  Locks the container for writing.

- void unlock_write ()

  Unlocks the container for writing.

- void lock_readwrite ()

  Locks the container for Reading and Writing.

- void unlock_readwrite ()

  Unlocks the container for Reading and Writing.

Private Attributes

- pthread_mutex_t write_mutex

  Mutex for writing (insert/remove).

- pthread_mutex_t logic_mutex

  Mutex for internal synch logic.

- int read_counter

  Number of threads reading the container.

4.5.1 Detailed Description

Provides thread safeness to containers. This class implements methods that provide thread safeness to containers.

It alows that many threads are used at the same time. If a method that modifies the container is used, i.e. insert/remove, it guaranties that no other thread is reading or writing Read operations. i.e. get_element, can be used concurrently

If this is linked with ThreadSafe.cpp, it enables thread safeness and supports concurrent reading of the elements of the container.

4.5.2 Constructor & Destructor Documentation

4.5.2.1 ThreadSafe::ThreadSafe ( )

Constuctor of the thread safe class.

Initializes the class that provides safe race conditions

4.5.3 Member Function Documentation

4.5.3.1 void ThreadSafe::lock_readwrite ( )

Locks the container for Reading and Writing.

Waits until there are no threads reading the container. Locks the container for writing if there are no threads reading at the moment

4.5.3.2 void ThreadSafe::lock_write ( )

Locks the container for writing.

Waits until there are no threads writing in the container. Locks the container for writing without doing so for reading. Keeps count of how many threads are reading the container at the moment

4.5.3.3 void ThreadSafe::unlock_readwrite ( )

Unlocks the container for Reading and Writing.

Unlocks the container for reading and writing

4.5.3.4 void ThreadSafe::unlock_write ( )

Unlocks the container for writing.

Unlocks the container for writing if there are no threads reading at the moment Keeps count of how many threads are reading the container at the moment

4.5.4 Member Data Documentation

4.5.4.1 pthread_mutex_t ThreadSafe::logic_mutex `[private]`

Mutex for internal synch logic.

This mutex makes sure that operations in the synchorinzation methods are atomic

4.5.4.2 int ThreadSafe::read_counter `[private]`

Number of threads reading the container.

4.5.4.3 pthread_mutex_t ThreadSafe::write_mutex `[private]`

Mutex for writing (insert/remove).

If locked a thread has to wait to write

The documentation for this class was generated from the following files:

- /home/ferreira/dev-github/random/last.fm/src/ThreadSafe.h
- /home/ferreira/dev-github/random/last.fm/src/ThreadSafe.cpp
- /home/ferreira/dev-github/random/last.fm/src/ThreadUnsafe.cpp

Chapter 5

File Documentation

5.1 /home/ferreira/dev-github/random/last.fm/src/GenericContainer.h File Reference

```
#include <utility>
#include <assert.h>
#include <stdexcept>
#include "ThreadSafe.h"
#include <iostream>
```

Classes

- class GenericContainer< T >

  A container for generic objects.

- class GenericContainer< T >::ContainerNode

  Represents the node of a doubly-linked list.

5.2 /home/ferreira/dev-github/random/last.fm/src/GenericQueue.h File Reference

```
#include "GenericContainer.h"
```

Classes

- class GenericQueue< T >

  A queue for generic objects.

5.3 /home/ferreira/dev-github/random/last.fm/src/GenericStack.h File Reference

```
#include "GenericContainer.h"
```

Classes

- class GenericStack< T >

  A stack for generic objects.

5.4 /home/ferreira/dev-github/random/last.fm/src/ThreadSafe.cpp File Reference

```
#include "ThreadSafe.h"
#include <stdlib.h>
#include <iostream>
```

5.5 /home/ferreira/dev-github/random/last.fm/src/ThreadSafe.h File Reference

```
#include <pthread.h>
```

Classes

- class ThreadSafe

  Provides thread safeness to containers.

5.6 /home/ferreira/dev-github/random/last.fm/src/ThreadUnsafe.cpp File Reference

```
#include "ThreadSafe.h"
```

5.7 /home/ferreira/dev-github/random/last.fm/unit-tests/unittestGenericContainer.cpp File Reference

```
#include <assert.h>
#include <stdexcept>
#include "../src/GenericContainer.h"
```

```
#include <iostream>
#include <string>
```

Functions

- void insert_remove_string_test (void)

  test insertion and removal of elements

- void out_of_bounds_test (void)

  Test exceptions thrown for access of out of bounds elements.

- void multiple_operations_int_test (void)

  Test mixed operations.

- void lots_of_inserts_test (void)

  Test the insertion of elements.

- int main (void)

  Runs the unit tests for GenericContainer.

5.7.1 Function Documentation

5.7.1.1 void insert_remove_string_test (void)

test insertion and removal of elements

5.7.1.2 void lots_of_inserts_test (void)

Test the insertion of elements.

5.7.1.3 int main (void)

Runs the unit tests for GenericContainer.

5.7.1.4 void multiple_operations_int_test (void)

Test mixed operations.

5.7.1.5 void out_of_bounds_test (void)

Test exceptions thrown for access of out of bounds elements.

5.8 /home/ferreira/dev-github/random/last.fm/unit-tests/unittestGenericQueue.cpp File Reference

```
#include <assert.h>
#include <stdexcept>
#include "../src/GenericQueue.h"
#include <iostream>
#include <string>
```

Functions

- void order_test (void)

  Test the order elements come out of the queue.
- int main (void)

  Runs the unit tests for GenericQueue.

5.8.1 Function Documentation

5.8.1.1 int main (void)

Runs the unit tests for GenericQueue.

As the queue heavily reuses code from GenericContainer the only thing left to test is the order of the elements

5.8.1.2 void order_test (void)

Test the order elements come out of the queue.

Make sure of FIFO

5.9 /home/ferreira/dev-github/random/last.fm/unit-tests/unittestGenericStack.cpp File Reference

```
#include <assert.h>
#include <stdexcept>
#include "../src/GenericStack.h"
#include <iostream>
#include <string>
```

Functions

- void order_test (void)

Test the order elements come out of the queue.

- int main (void)

  Runs the unit tests for GenericStack.

5.9.1 Function Documentation

5.9.1.1 int main (void)

Runs the unit tests for GenericStack.

As the stack heavily reuses code from GenericContainer the only thing left to test is the order of the elements

5.9.1.2 void order_test (void)

Test the order elements come out of the queue.

Make sure of LIFO

5.10 /home/ferreira/dev-github/random/last.fm/unit-tests/unittestMultiThreaded.cpp File Reference

```
#include <assert.h>
#include <stdexcept>
#include "../src/GenericContainer.h"
#include <iostream>
#include <pthread.h>
```

Defines

- #define N_THREADS 50
- #define N_INSERTS 1000

Functions

- void ∗ insert_remove_run (void ∗data)

  The thread that insert, accesses and removes elements.

- void test_insert_remove ()

  Test concurrent insertion, access and removal of elements.

- void ∗ insert_access_remove_run (void ∗data)

  The thread that insert and removes elements.

- void test_insert_access_remove ()

Test concurrent insertion and removal of elements.

- int main (void)

  Runs the unit tests for GenericContainer.

5.10.1 Define Documentation

5.10.1.1 #define N_INSERTS 1000

5.10.1.2 #define N_THREADS 50

5.10.2 Function Documentation

5.10.2.1 void∗ insert_access_remove_run (void ∗ *data*)

The thread that insert and removes elements.

5.10.2.2 void∗ insert_remove_run (void ∗ *data*)

The thread that insert, accesses and removes elements.

5.10.2.3 int main (void)

Runs the unit tests for GenericContainer.

As all the multi-threading logic is in the GenericContainer there is no need to test the queue and the stack

5.10.2.4 void test_insert_access_remove ( )

Test concurrent insertion and removal of elements.

Start several threads that insert many elements and then remove the same number of elements inserted

5.10.2.5 void test_insert_remove ( )

Test concurrent insertion, access and removal of elements.

Start several threads that insert many elements then access the same number of elements and then remove the same number of elements inserted

Index