Scatter Search

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Chapter 1

Scatter Search

1.1 Description

The main goal is to implement a hash table. In this case, open scattering and closed scattering can be used, also using different scattering techniques (Module, Sum, Pseudorandom) and different exploration techniques (linear, quadratic, double scattering, redispersion). Hash table is a data structure used to store and retrieve values associated with a key. It works through a hash function that takes a key as input and produces an address in the table where the corresponding value is stored.

This program was developed in C++, for more information the documentation is in the /doc directory

1.2 Usage

To compile the program, the *make* command is used in the main directory and the executable of the program is located in the /bin/main directory.

1.3 Author

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Chapter 2

Hierarchical Index

2.1 Class Hierarchy

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

Chapter 3

Class Index

3.1 Class List

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

Chapter 4

File Index

4.1 File List

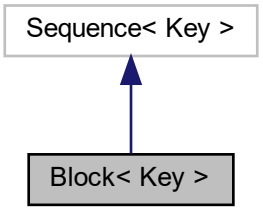
Here is a list of all documented files with brief descriptions:

Chapter 5

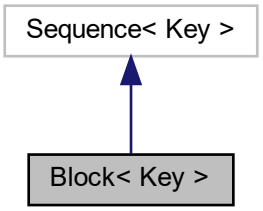
Class Documentation

5.1 Block< Key > Class Template Reference

Inheritance diagram for Block< Key >:



Collaboration diagram for Block< Key >:



Public Member Functions

- Block ()

  Construct a new Block< Key>:: Block object.
- Block (const unsigned)

  Construct a new Block< Key>:: Block object.
- bool Search (const Key &) const override

  Search a key in the block.
- bool Insert (const Key &) override

  Insert a key in the block.
- bool IsFull () const override

  Check if the block is full.
- std::ostream & Write (std::ostream &) const override

  Write the block in the output stream.

5.1.1 Constructor & Destructor Documentation

5.1.1.1 Block() [1/2]

```
template<class Key >
Block< Key >::Block
```

Construct a new Block< Key>:: Block object.

Template Parameters

Key	

5.1.1.2 Block() [2/2]

```
template<class Key >
Block< Key >::Block (
            const unsigned size )
```

Construct a new Block< Key>:: Block object.

Template Parameters

Key	

Parameters

size	

5.1.2 Member Function Documentation

5.1.2.1 Insert()

```
template<class Key >
bool Block< Key >::Insert (
            const Key & k )  [override], [virtual]
```

Insert a key in the block.

Template Parameters

Key	

Parameters

k	

Returns

true

false

Implements Sequence< Key >.

5.1.2.2 IsFull()

```
template<class Key >
bool Block< Key >::IsFull  [override], [virtual]
```

Check if the block is full.

Template Parameters

Key	

Returns

true

false

Implements Sequence< Key >.

5.1.2.3 Search()

```
template<class Key >
bool Block< Key >::Search (
            const Key & k ) const  [override], [virtual]
```

Search a key in the block.

Template Parameters

Key	

Parameters

k	

Returns

true

false

Implements Sequence< Key >.

5.1.2.4 Write()

```
template<class Key >
std::ostream & Block< Key >::Write (
            std::ostream & os ) const  [override], [virtual]
```

Write the block in the output stream.

Template Parameters

Key	

Parameters

os	

Returns

std::ostream&

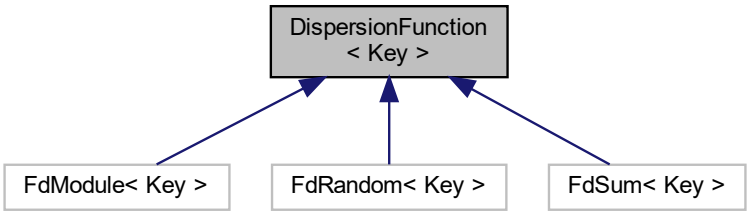
Implements Sequence< Key >.

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

- include/Block.h

5.2 DispersionFunction< Key > Class Template Reference

Inheritance diagram for DispersionFunction< Key >:



Public Member Functions

- virtual unsigned operator() (const Key &) const =0

5.2.1 Member Function Documentation

5.2.1.1 operator()()

```
template<class Key >
virtual unsigned DispersionFunction< Key >::operator() (
            const Key &  ) const  [pure virtual]
```

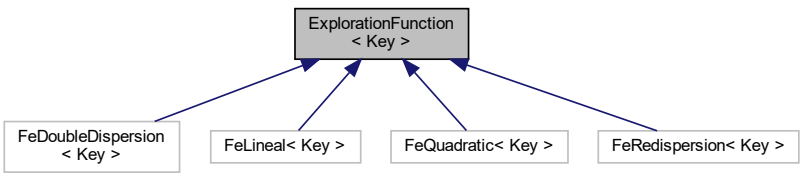
Implemented in FdModule< Key >, FdRandom< Key >, and FdSum< Key >.

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

- include/DispersionFunction.h

5.3 ExplorationFunction< Key > Class Template Reference

Inheritance diagram for ExplorationFunction< Key >:



Public Member Functions

- virtual unsigned operator() (const Key &, unsigned) const =0

5.3.1 Member Function Documentation

5.3.1.1 operator()()

```
template<class Key >
virtual unsigned ExplorationFunction< Key >::operator() (
            const Key & ,
            unsigned  ) const  [pure virtual]
```

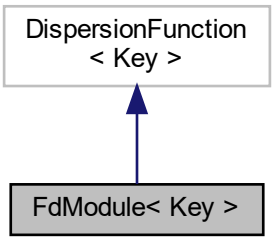
Implemented in FeDoubleDispersion< Key >, FeLineal< Key >, FeQuadratic< Key >, and FeRedispersion< Key >.

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

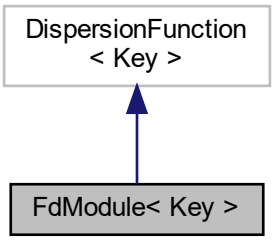
- include/ExplorationFunction.h

5.4 FdModule< Key > Class Template Reference

Inheritance diagram for FdModule< Key >:



Collaboration diagram for FdModule< Key >:



Public Member Functions

- FdModule (const unsigned)

  Construct a new Fd Module< Key>:: Fd Module object.
- unsigned operator() (const Key &) const override

  It is the operator() that performs the module function.

5.4.1 Constructor & Destructor Documentation

5.4.1.1 FdModule()

```
template<class Key >
FdModule< Key >::FdModule (
            const unsigned n )
```

Construct a new Fd Module< Key>:: Fd Module object.

Template Parameters

Key	

Parameters

n	

5.4.2 Member Function Documentation

5.4.2.1 operator()()

```
template<class Key >
unsigned FdModule< Key >::operator() (
            const Key & k ) const  [override], [virtual]
```

It is the operator() that performs the module function.

Template Parameters

Key	

Parameters

k	

Returns

unsigned

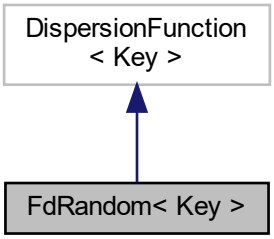
Implements DispersionFunction< Key >.

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

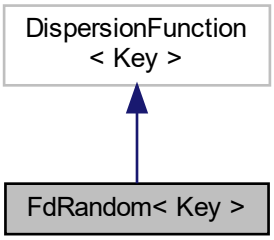
- include/FdModule.h

5.5 FdRandom< Key > Class Template Reference

Inheritance diagram for FdRandom< Key >:



Collaboration diagram for FdRandom< Key >:



Public Member Functions

- FdRandom (const unsigned)

  Construct a new Fd Random< Key>:: Fd Random object.
- unsigned operator() (const Key &) const override

  It is the operator() that performs the pseudorandom function.

5.5.1 Constructor & Destructor Documentation

5.5.1.1 FdRandom()

```
template<class Key >
FdRandom< Key >::FdRandom (
            const unsigned n )
```

Construct a new Fd Random< Key>:: Fd Random object.

Template Parameters

Key	

Parameters

n	

5.5.2 Member Function Documentation

5.5.2.1 operator()()

```
template<class Key >
unsigned FdRandom< Key >::operator() (
            const Key & k ) const  [override], [virtual]
```

It is the operator() that performs the pseudorandom function.

Template Parameters

Key	

Parameters

k	

Returns

unsigned

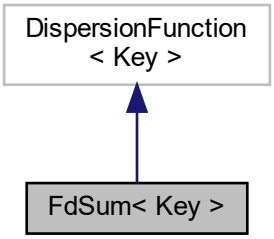
Implements DispersionFunction< Key >.

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

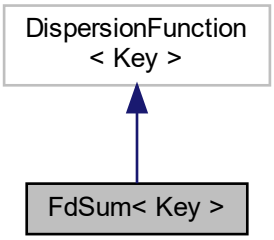
- include/FdRandom.h

5.6 FdSum< Key > Class Template Reference

Inheritance diagram for FdSum< Key >:



Collaboration diagram for FdSum< Key >:



Public Member Functions

- FdSum (const unsigned)

  Construct a new Fd Sum< Key>:: Fd Sum object.
- unsigned operator() (const Key &) const override

  It is the operator() that performs the sum function.

5.6.1 Constructor & Destructor Documentation

5.6.1.1 FdSum()

```
template<class Key >
FdSum< Key >::FdSum (
            const unsigned n )
```

Construct a new Fd Sum< Key>:: Fd Sum object.

Template Parameters

Key	

Parameters

n	

5.6.2 Member Function Documentation

5.6.2.1 operator()()

```
template<class Key >
unsigned FdSum< Key >::operator() (
            const Key & k ) const  [override], [virtual]
```

It is the operator() that performs the sum function.

Template Parameters

Key	

Parameters

k	

Returns

unsigned

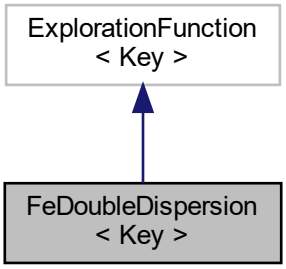
Implements DispersionFunction< Key >.

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

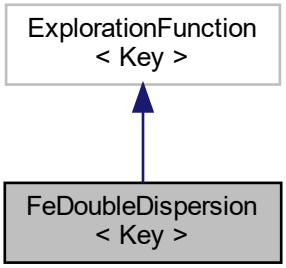
- include/FdSum.h

5.7 FeDoubleDispersion< Key > Class Template Reference

Inheritance diagram for FeDoubleDispersion< Key >:



Collaboration diagram for FeDoubleDispersion< Key >:



Public Member Functions

- FeDoubleDispersion ()

  Construct a new Fe Double Dispersion< Key>:: Fe Double Dispersion object.
- FeDoubleDispersion (DispersionFunction< Key > &)

  Construct a new Fe Double Dispersion< Key>:: Fe Double Dispersion object.
- unsigned operator() (const Key &, unsigned) const override

  It is a method that performs the double hash exploration function.

5.7.1 Constructor & Destructor Documentation

5.7.1.1 FeDoubleDispersion() [1/2]

```
template<class Key >
FeDoubleDispersion< Key >::FeDoubleDispersion
```

Construct a new Fe Double Dispersion< Key>:: Fe Double Dispersion object.

Template Parameters

Key	

5.7.1.2 FeDoubleDispersion() [2/2]

```
template<class Key >
FeDoubleDispersion< Key >::FeDoubleDispersion (
            DispersionFunction< Key > & function )
```

Construct a new Fe Double Dispersion< Key>:: Fe Double Dispersion object.

Template Parameters

Key	

Parameters

function	

5.7.2 Member Function Documentation

5.7.2.1 operator()()

```
template<class Key >
unsigned FeDoubleDispersion< Key >::operator() (
            const Key & k,
            unsigned i ) const  [override], [virtual]
```

It is a method that performs the double hash exploration function.

Template Parameters

Key	

Parameters

k	
i	

Returns

unsigned

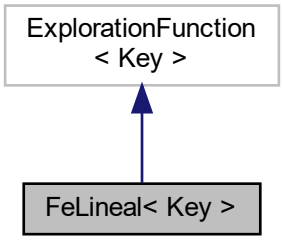
Implements ExplorationFunction< Key >.

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

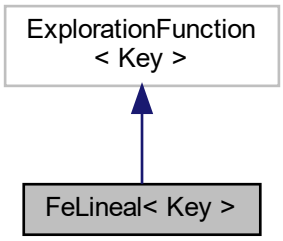
- include/FeDoubleDispersion.h

5.8 FeLineal< Key > Class Template Reference

Inheritance diagram for FeLineal< Key >:



Collaboration diagram for FeLineal< Key >:



Public Member Functions

- FeLineal ()

  Construct a new Fe Lineal< Key>:: Fe Lineal object.
- unsigned operator() (const Key &, unsigned) const override

  It is a method that performs the linear exploration function.

5.8.1 Constructor & Destructor Documentation

5.8.1.1 FeLineal()

```
template<class Key >
FeLineal< Key >::FeLineal
```

Construct a new Fe Lineal< Key>:: Fe Lineal object.

Template Parameters

Key	

5.8.2 Member Function Documentation

5.8.2.1 operator()()

```
template<class Key >
unsigned FeLineal< Key >::operator() (
            const Key & k,
            unsigned i ) const  [override], [virtual]
```

It is a method that performs the linear exploration function.

Template Parameters

Key	

Parameters

k	
i	

Returns

unsigned

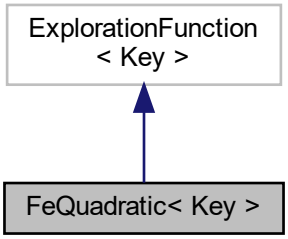
Implements ExplorationFunction< Key >.

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

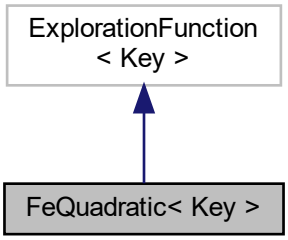
- include/FeLineal.h

5.9 FeQuadratic< Key > Class Template Reference

Inheritance diagram for FeQuadratic< Key >:



Collaboration diagram for FeQuadratic< Key >:



Public Member Functions

- FeQuadratic ()

  Construct a new Fe Quadratic< Key>:: Fe Quadratic object.
- unsigned operator() (const Key &, unsigned) const override

  It is a method that performs the quadratic exploration function.

5.9.1 Constructor & Destructor Documentation

5.9.1.1 FeQuadratic()

```
template<class Key >
FeQuadratic< Key >::FeQuadratic
```

Construct a new Fe Quadratic< Key>:: Fe Quadratic object.

Template Parameters

Key	

5.9.2 Member Function Documentation

5.9.2.1 operator()()

```
template<class Key >
unsigned FeQuadratic< Key >::operator() (
            const Key & k,
            unsigned i ) const  [override], [virtual]
```

It is a method that performs the quadratic exploration function.

Template Parameters

Key	

Parameters

k	
i	

Returns

unsigned

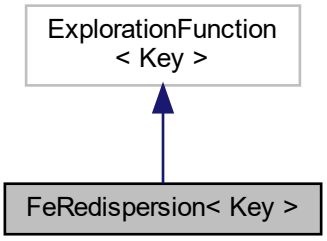
Implements ExplorationFunction< Key >.

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

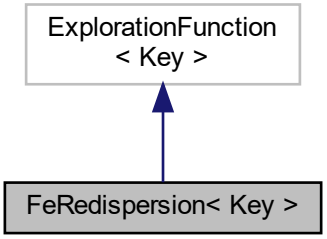
- include/FeQuadratic.h

5.10 FeRedispersion< Key > Class Template Reference

Inheritance diagram for FeRedispersion< Key >:



Collaboration diagram for FeRedispersion< Key >:



Public Member Functions

- FeRedispersion ()

  Construct a new Fe Redispersion< Key>:: Fe Redispersion object.
- unsigned operator() (const Key &, unsigned) const override

  It is a method that performs the redispersion exploration function.

5.10.1 Constructor & Destructor Documentation

5.10.1.1 FeRedispersion()

```
template<class Key >
FeRedispersion< Key >::FeRedispersion
```

Construct a new Fe Redispersion< Key>:: Fe Redispersion object.

Template Parameters

Key	

5.10.2 Member Function Documentation

5.10.2.1 operator()()

```
template<class Key >
unsigned FeRedispersion< Key >::operator() (
            const Key & k,
            unsigned i ) const  [override], [virtual]
```

It is a method that performs the redispersion exploration function.

Template Parameters

Key	

Parameters

k	
i	

Returns

unsigned

Implements ExplorationFunction< Key >.

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

- include/FeRedispersion.h

5.11 HashTable< Key > Class Template Reference

Public Member Functions

- HashTable ()

  Construct a new Hash Table< Key>:: Hash Table object.
- HashTable (unsigned, DispersionFunction< Key > *, ExplorationFunction< Key > *=nullptr, unsigned=0)

  Construct a new Hash Table< Key>:: Hash Table object.
- ~HashTable ()

Destroy the Hash Table< Key>:: Hash Table object.

- bool Insert (const Key &) const

  Insert a key in the hash table.

- bool Search (const Key &) const

  Search a key in the hash table.

- std::ostream & Write (std::ostream &) const

  Write the hash table.

Friends

- std::ostream & **operator** (std::ostream &, const HashTable< Key > &)

5.11.1 Constructor & Destructor Documentation

5.11.1.1 HashTable() [1/2]

```
template<class Key >
HashTable< Key >::HashTable
```

Construct a new Hash Table< Key>:: Hash Table object.

Template Parameters

Key	

5.11.1.2 HashTable() [2/2]

```
template<class Key >
HashTable< Key >::HashTable (
            unsigned table_size,
            DispersionFunction< Key > * fd,
            ExplorationFunction< Key > * fe = nullptr,
            unsigned block_size = 0 )
```

Construct a new Hash Table< Key>:: Hash Table object.

Template Parameters

Key	

Parameters

table_size	

Parameters

fd	
fe	
block_size	

5.11.1.3 ~HashTable()

```
template<class Key >
HashTable< Key >::~HashTable
```

Destroy the Hash Table< Key>:: Hash Table object.

Template Parameters

Key	

5.11.2 Member Function Documentation

5.11.2.1 Insert()

```
template<class Key >
bool HashTable< Key >::Insert (
            const Key & k ) const
```

Insert a key in the hash table.

Template Parameters

Key	

Parameters

k	

Returns

true

false

5.11.2.2 Search()

```
template<class Key >
bool HashTable< Key >::Search (
             const Key & k ) const
```

Search a key in the hash table.

Template Parameters

Key	

Parameters

k	

Returns

true

false

5.11.2.3 Write()

```
template<class Key >
std::ostream & HashTable< Key >::Write (
             std::ostream & os ) const
```

Write the hash table.

Template Parameters

Key	

Parameters

os	

Returns

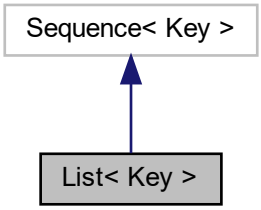
std::ostream&

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

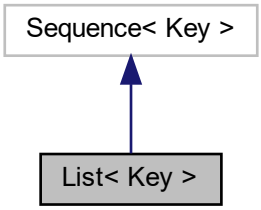
- include/HashTable.h

5.12 List< Key > Class Template Reference

Inheritance diagram for List< Key >:



Collaboration diagram for List< Key >:



Public Member Functions

- List ()
  Construct a new List< Key >:: List object.
- bool Search (const Key &) const override
  Search a key in the list.
- bool Insert (const Key &) override
  Insert a key in the list.
- bool IsFull () const override
  Check if the list is full.
- std::ostream & Write (std::ostream &) const override
  Write the list in the output stream.

5.12.1 Constructor & Destructor Documentation

5.12.1.1 List()

```
template<class Key >
List< Key >::List
```

Construct a new List< Key>:: List object.

Template Parameters

Key	

5.12.2 Member Function Documentation

5.12.2.1 Insert()

```
template<class Key >
bool List< Key >::Insert (
            const Key & k )  [override], [virtual]
```

Insert a key in the list.

Template Parameters

Key	

Parameters

k	

Returns

true

false

Implements Sequence< Key >.

5.12.2.2 IsFull()

```
template<class Key >
bool List< Key >::IsFull  [override], [virtual]
```

Check if the list is full.

Template Parameters

Key	

Returns

true

false

Implements Sequence< Key >.

5.12.2.3 Search()

```
template<class Key >
bool List< Key >::Search (
            const Key & k ) const  [override], [virtual]
```

Search a key in the list.

Template Parameters

Key	

Parameters

k	

Returns

true

false

Implements Sequence< Key >.

5.12.2.4 Write()

```
template<class Key >
std::ostream & List< Key >::Write (
            std::ostream & os ) const  [override], [virtual]
```

Write the list in the output stream.

Template Parameters

Key	

Parameters

os	

Returns

std::ostream&

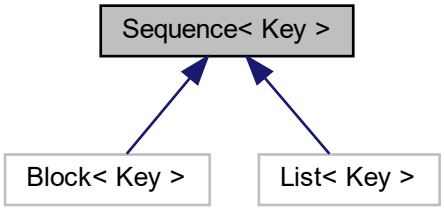
Implements Sequence< Key >.

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

- include/List.h

5.13 Sequence< Key > Class Template Reference

Inheritance diagram for Sequence< Key >:



Public Member Functions

- virtual bool Search (const Key &) const =0
- virtual bool Insert (const Key &)=0
- virtual bool IsFull () const =0
- virtual std::ostream & Write (std::ostream &os) const =0

5.13.1 Member Function Documentation

5.13.1.1 Insert()

```
template<class Key >
virtual bool Sequence< Key >::Insert (
            const Key &  )  [pure virtual]
```

Implemented in Block< Key >, and List< Key >.

5.13.1.2 IsFull()

```
template<class Key >
virtual bool Sequence< Key >::IsFull ( ) const  [pure virtual]
```

Implemented in Block< Key >, and List< Key >.

5.13.1.3 Search()

```
template<class Key >
virtual bool Sequence< Key >::Search (
            const Key &  ) const  [pure virtual]
```

Implemented in Block< Key >, and List< Key >.

5.13.1.4 Write()

```
template<class Key >
virtual std::ostream & Sequence< Key >::Write (
            std::ostream & os ) const  [pure virtual]
```

Implemented in Block< Key >, and List< Key >.

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

- include/Sequence.h

Chapter 6

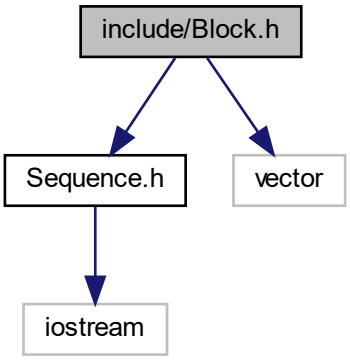
File Documentation

6.1 include/Block.h File Reference

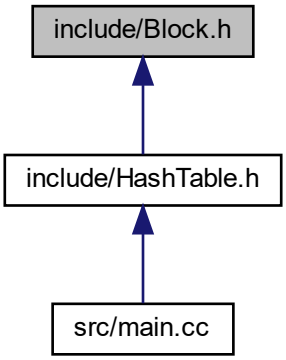
This is a sequence-derived class that contains a vector where the keys will be stored when closed dispersion is used.

```
#include "Sequence.h"
#include <vector>
```

Include dependency graph for Block.h:



This graph shows which files directly or indirectly include this file:



Classes

- class Block< Key >

6.1.1 Detailed Description

This is a sequence-derived class that contains a vector where the keys will be stored when closed dispersion is used.

Author

Fabrizzio Daniell Perilli Martín

Version

0.1

Date

2023-03-12

Copyright

6.2 Block.h

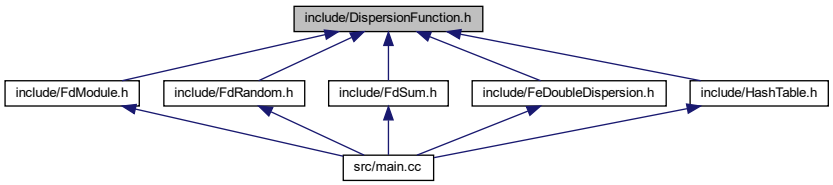
Go to the documentation of this file.

```
1
12 #include "Sequence.h"
13 #include <vector>
14
15 template <class Key>
16 class Block : public Sequence<Key>
17 {
18 public:
19   Block();
20   Block(const unsigned);
21   bool Search(const Key &) const override;
22   bool Insert(const Key &) override;
23   bool IsFull() const override;
24   std::ostream &Write(std::ostream &) const override;
25
26 private:
27   unsigned block_size_;
28   std::vector<Key> block_;
29 };
30
36 template <class Key>
37 Block<Key>::Block() : block_size_(0), block_(0) {}
38
45 template <class Key>
46 Block<Key>::Block(const unsigned size) : block_size_(size) {}
47
56 template <class Key>
57 bool Block<Key>::Search(const Key &k) const
58 {
59   for (auto &i : block_)
60     if (i == k)
61       return true;
62   return false;
63 }
64
73 template <class Key>
74 bool Block<Key>::Insert(const Key &k)
75 {
76   if (IsFull())
77     return false;
78   if (Search(k))
79     return false;
80   block_.push_back(k);
81   return true;
82 }
83
91 template <class Key>
92 bool Block<Key>::IsFull() const
93 {
94   return block_.size() == block_size_;
95 }
96
104 template <class Key>
105 std::ostream &Block<Key>::Write(std::ostream &os) const
106 {
107   for (auto &i : block_)
108     os « i « " ";
109   return os;
110 }
```

6.3 include/DispersionFunction.h File Reference

It is an abstract class, it has a pure virtual method that is the overload of the operator() that will be implemented in the derived classes.

This graph shows which files directly or indirectly include this file:



Classes

- class DispersionFunction< Key >

6.3.1 Detailed Description

It is an abstract class, it has a pure virtual method that is the overload of the operator() that will be implemented in the derived classes.

Author

Fabrizzio Daniell Perilli Martín

Version

0.1

Date

2023-03-12

Copyright

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6.4 DispersionFunction.h

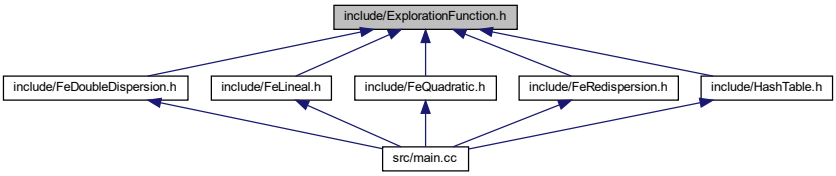
Go to the documentation of this file.

```
1
12 #pragma once
13
14 template <class Key>
15 class DispersionFunction
16 {
17 public:
18   virtual unsigned operator()(const Key &) const = 0;
19 };
```

6.5 include/ExplorationFunction.h File Reference

It is an abstract class, it has a pure virtual method that is the overload of the operator() that will be implemented in the derived classes.

This graph shows which files directly or indirectly include this file:



Classes

- class ExplorationFunction< Key >

6.5.1 Detailed Description

It is an abstract class, it has a pure virtual method that is the overload of the operator() that will be implemented in the derived classes.

Author

Fabrizzio Daniell Perilli Martín

Version

0.1

Date

2023-03-12

Copyright

Copyright (c) 2023

6.6 ExplorationFunction.h

Go to the documentation of this file.

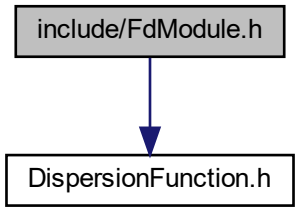
```
1
12 #pragma once
13
14 template <class Key>
15 class ExplorationFunction
16 {
17 public:
18   virtual unsigned operator()(const Key &, unsigned) const = 0;
19 };
```

6.7 include/FdModule.h File Reference

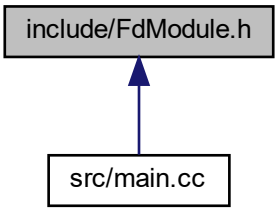
It is a class derived from DispertionFunction that implements the operator() for the module function.

```
#include "DispersionFunction.h"
```

Include dependency graph for FdModule.h:



This graph shows which files directly or indirectly include this file:



Classes

- class FdModule< Key >

6.7.1 Detailed Description

It is a class derived from DispertionFunction that implements the operator() for the module function.

Author

Fabrizzio Daniell Perilli Martín

Version

0.1

Date

2023-03-12

Copyright

6.8 FdModule.h

Go to the documentation of this file.

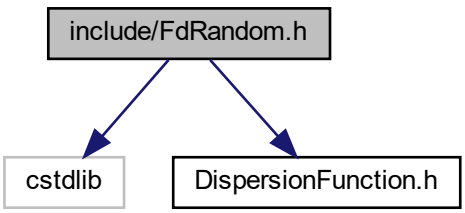
```
1
12 #include "DispersionFunction.h"
13
14 template <class Key>
15 class FdModule : public DispersionFunction<Key>
16 {
17 public:
18   FdModule(const unsigned);
19   unsigned operator()(const Key &) const override;
20
21 private:
22   unsigned table_size;
23 };
24
31 template <class Key>
32 FdModule<Key>::FdModule(const unsigned n) : table_size(n) {}
33
41 template <class Key>
42 unsigned FdModule<Key>::operator()(const Key &k) const
43 {
44   return k % table_size;
45 }
```

6.9 include/FdRandom.h File Reference

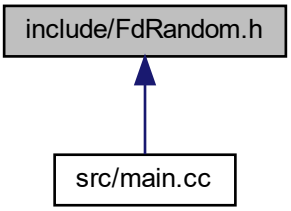
It is a class derived from DispertionFunction that implements the operator() for the pseudorandom function.

```
#include <cstdlib>
#include "DispersionFunction.h"
```

Include dependency graph for FdRandom.h:



This graph shows which files directly or indirectly include this file:



Classes

- class FdRandom< Key >

6.9.1 Detailed Description

It is a class derived from DispertionFunction that implements the operator() for the pseudorandom function.

Author

Fabrizzio Daniell Perilli Martín

Version

0.1

Date

2023-03-12

Copyright

6.10 FdRandom.h

Go to the documentation of this file.

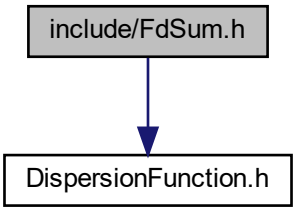
```
1 #include <cstdlib>
13 #include "DispersionFunction.h"
14
15 template <class Key>
16 class FdRandom : public DispersionFunction<Key>
17 {
18 public:
19   FdRandom(const unsigned);
20   unsigned operator()(const Key &) const override;
21
22 private:
23   unsigned table_size;
24 };
25
32 template <class Key>
33 FdRandom<Key>::FdRandom(const unsigned n) : table_size(n) {}
34
42 template <class Key>
43 unsigned FdRandom<Key>::operator()(const Key &k) const
44 {
45   srand(k);
46   return rand() % table_size;
47 }
```

6.11 include/FdSum.h File Reference

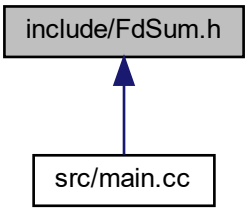
It is a class derived from DispertionFunction that implements the operator() for the sum function.

```
#include "DispersionFunction.h"
```

Include dependency graph for FdSum.h:



This graph shows which files directly or indirectly include this file:



Classes

- class FdSum< Key >

6.11.1 Detailed Description

It is a class derived from DispertionFunction that implements the operator() for the sum function.

Author

Fabrizzio Daniell Perilli Martín

Version

0.1

Date

2023-03-12

Copyright

6.12 FdSum.h

Go to the documentation of this file.

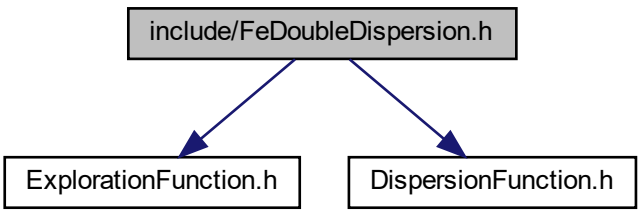
```
1
11 #include "DispersionFunction.h"
12
13 template <class Key>
14 class FdSum : public DispersionFunction<Key>
15 {
16 public:
17   FdSum(const unsigned);
18   unsigned operator()(const Key &) const override;
19
20 private:
21   unsigned table_size;
22 };
23
30 template <class Key>
31 FdSum<Key>::FdSum(const unsigned n) : table_size(n) {}
32
40 template <class Key>
41 unsigned FdSum<Key>::operator()(const Key &k) const
42 {
43   unsigned sum = 0;
44   Key temp = k;
45   while (temp > 0)
46   {
47     sum += temp % 10;
48     temp /= 10;
49   }
50   return sum % table_size;
51 }
```

6.13 include/FeDoubleDispersion.h File Reference

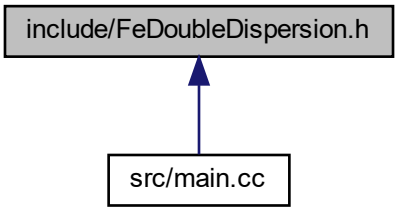
It is a class derived from ExplorationFunction.h that implements the pure virtual method to perform the double hash exploration function.

```
#include "ExplorationFunction.h"
#include "DispersionFunction.h"
```

Include dependency graph for FeDoubleDispersion.h:



This graph shows which files directly or indirectly include this file:



Classes

- class FeDoubleDispersion< Key >

6.13.1 Detailed Description

It is a class derived from ExplorationFunction.h that implements the pure virtual method to perform the double hash exploration function.

Author

Fabrizzio Daniell Perilli Martin

Version

0.1

Date

2023-03-12

Copyright

Copyright (c) 2023

6.14 FeDoubleDispersion.h

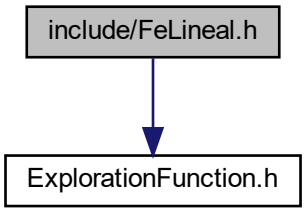
Go to the documentation of this file.

```
1
12 #include "ExplorationFunction.h"
13 #include "DispersionFunction.h"
14
15 template <class Key>
16 class FeDoubleDispersion : public ExplorationFunction<Key>
17 {
18 public:
19   FeDoubleDispersion();
20   FeDoubleDispersion(DispersionFunction<Key> &);
21   unsigned operator()(const Key &, unsigned) const override;
22
23 private:
24   DispersionFunction<Key> *fd_;
25 };
31 template <class Key>
32 FeDoubleDispersion<Key>::FeDoubleDispersion() {}
33
40 template <class Key>
41 FeDoubleDispersion<Key>::FeDoubleDispersion(DispersionFunction<Key> &function)
42 {
43   fd_ = &function;
44 }
45
54 template <class Key>
55 unsigned FeDoubleDispersion<Key>::operator()(const Key &k, unsigned i) const
56 {
57   return fd_->operator()(k) * i;
58 }
```

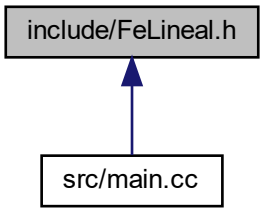
6.15 include/FeLineal.h File Reference

It is a class derived from ExplorationFunction.h that implements the pure virtual method to perform the linear exploration function.

`#include "ExplorationFunction.h"`
Include dependency graph for FeLineal.h:



This graph shows which files directly or indirectly include this file:



Classes

- class FeLineal< Key >

6.15.1 Detailed Description

It is a class derived from ExplorationFunction.h that implements the pure virtual method to perform the linear exploration function.

Author

Fabrizzio Daniell Perilli Martín

Version

0.1

Date

2023-03-12

Copyright

6.16 FeLineal.h

Go to the documentation of this file.

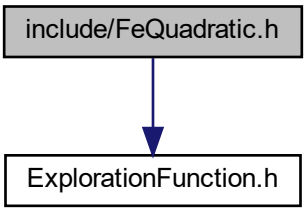
```
1
12 #include "ExplorationFunction.h"
13
14 template <class Key>
15 class FeLineal : public ExplorationFunction<Key>
16 {
17 public:
18   FeLineal();
19   unsigned operator()(const Key &, unsigned) const override;
20 };
21
27 template <class Key>
28 FeLineal<Key>::FeLineal() {}
29
38 template <class Key>
39 unsigned FeLineal<Key>::operator()(const Key &k, unsigned i) const
40 {
41   return i;
42 }
```

6.17 include/FeQuadratic.h File Reference

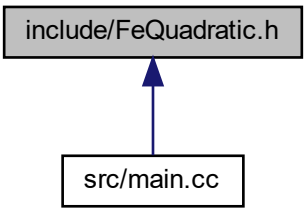
It is a class derived from ExplorationFunction.h that implements the pure virtual method to perform the quadratic exploration function.

```
#include "ExplorationFunction.h"
```

Include dependency graph for FeQuadratic.h:



This graph shows which files directly or indirectly include this file:



Classes

- class FeQuadratic< Key >

6.17.1 Detailed Description

It is a class derived from ExplorationFunction.h that implements the pure virtual method to perform the quadratic exploration function.

Author

Fabrizzio Daniell Perilli Martín

Version

0.1

Date

2023-03-12

Copyright

6.18 FeQuadratic.h

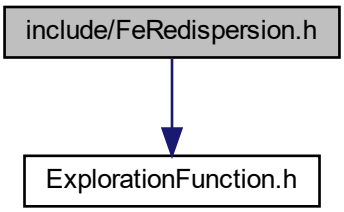
Go to the documentation of this file.

```
1
12 #include "ExplorationFunction.h"
13
14 template <class Key>
15 class FeQuadratic : public ExplorationFunction<Key>
16 {
17 public:
18   FeQuadratic();
19   unsigned operator()(const Key &, unsigned) const override;
20 };
21
27 template <class Key>
28 FeQuadratic<Key>::FeQuadratic() {}
29
38 template <class Key>
39 unsigned FeQuadratic<Key>::operator()(const Key &k, unsigned i) const
40 {
41   return i * i;
42 }
```

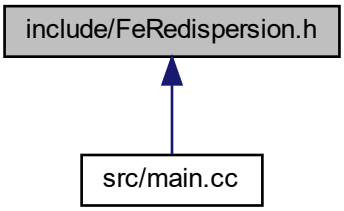
6.19 include/FeRedispersion.h File Reference

It is a class derived from ExplorationFunction.h that implements the pure virtual method to perform the redispersion exploration function.

`#include "ExplorationFunction.h"`
Include dependency graph for FeRedispersion.h:



This graph shows which files directly or indirectly include this file:



Classes

- class FeRedispersion< Key >

6.19.1 Detailed Description

It is a class derived from ExplorationFunction.h that implements the pure virtual method to perform the redispersion exploration function.

Author

Fabrizzio Daniell Perilli Martín

Version

0.1

Date

2023-03-12

Copyright

Copyright (c) 2023

6.20 FeRedispersion.h

Go to the documentation of this file.

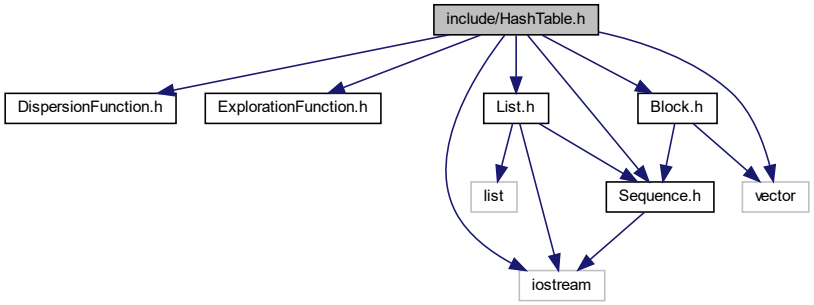
```
1
11 #include "ExplorationFunction.h"
12
13 template <class Key>
14 class FeRedispersion : public ExplorationFunction<Key>
15 {
16 public:
17   FeRedispersion();
18   unsigned operator()(const Key &, unsigned) const override;
19 };
20
26 template <class Key>
27 FeRedispersion<Key>::FeRedispersion() {}
28
37 template <class Key>
38 unsigned FeRedispersion<Key>::operator()(const Key &k, unsigned i) const
39 {
40   srand(k);
41   for (size_t j = 0; j < i; j++)
42     rand();
43   return rand();
44 }
```

6.21 include/HashTable.h File Reference

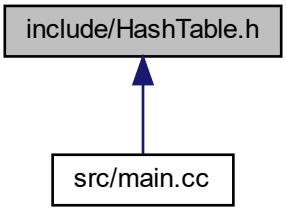
Represents the HashTable class that allows searching and inserting elements and displaying them.

```
#include "DispersionFunction.h"
#include "ExplorationFunction.h"
#include "Sequence.h"
#include "List.h"
#include "Block.h"
#include <iostream>
#include <vector>
```

Include dependency graph for HashTable.h:



This graph shows which files directly or indirectly include this file:



Classes

- class HashTable< Key >

Functions

- template<class Key >
  std::ostream & operator<< (std::ostream &os, const HashTable< Key > &ht)
  Overload the operator << to write the hash table.

6.21.1 Detailed Description

Represents the HashTable class that allows searching and inserting elements and displaying them.

Author

Fabrizio Daniell Perilli Martín

Version

0.1

Date

2023-03-12

Copyright

Copyright (c) 2023

6.21.2 Function Documentation

6.21.2.1 operator<<()

```
template<class Key >
std::ostream & operator<< (
            std::ostream & os,
            const HashTable< Key > & ht )
```

Overload the operator << to write the hash table.

Template Parameters

Key	

Parameters

os	
ht	

Returns

std::ostream&

6.22 HashTable.h

Go to the documentation of this file.

```
1
12 #pragma once
13 #include "DispersionFunction.h"
14 #include "ExplorationFunction.h"
15 #include "Sequence.h"
16 #include "List.h"
17 #include "Block.h"
18 #include <iostream>
19 #include <vector>
20
21 template <class Key>
22 class HashTable;
23
24 template <class Key>
25 std::ostream &operator«(std::ostream &, const HashTable<Key> &);
26
27 template <class Key>
28 class HashTable
29 {
30 public:
31   HashTable();
32   HashTable(unsigned, DispersionFunction<Key> *, ExplorationFunction<Key> * = nullptr, unsigned = 0);
33   ~HashTable();
34   bool Insert(const Key &) const;
35   bool Search(const Key &) const;
36   std::ostream &Write(std::ostream &) const;
37   friend std::ostream &operator« <Key>(std::ostream &, const HashTable<Key> &);
38
39 private:
40   DispersionFunction<Key> *fd_;
41   ExplorationFunction<Key> *fe_;
42   unsigned table_size_;
43   std::vector<Sequence<Key> *> table_;
44   unsigned block_size_;
45 };
46
52 template <class Key>
53 HashTable<Key>::HashTable() {}
54
64 template <class Key>
65 HashTable<Key>::HashTable(unsigned table_size, DispersionFunction<Key> *fd, ExplorationFunction<Key> *fe,
       unsigned block_size)
66 {
67   table_size_ = table_size;
68   block_size_ = block_size;
69   fd_ = fd;
70   fe_ = fe;
71
72   for (size_t i = 0; i < table_size_; i++)
73   {
74     if (fe_ == nullptr)
75       table_.push_back(new List<Key>());
76     else
77       table_.push_back(new Block<Key>(block_size_));
78   }
79 }
```

```
80
86 template <class Key>
87 HashTable<Key>::~HashTable()
88 {
89   for (size_t i = 0; i < table_size_; i++)
90     delete table_[i];
91 }
92
101 template <class Key>
102 bool HashTable<Key>::Insert(const Key &k) const
103 {
104   unsigned index = fd_->operator()(k);
105
106   if (fe_ == nullptr)
107   {
108     if (table_[index]->Insert(k))
109     {
110       std::cout « "Key inserted in position: " « index « std::endl;
111       return true;
112     }
113     else
114     {
115       std::cout « "Key already exists" « std::endl;
116       return false;
117     }
118   }
119   else
120   {
121     for (size_t i = 0; i < table_size_; ++i)
122     {
123       unsigned exploration_index = (index + fe_->operator()(k, i)) % table_size_;
124       if (table_[exploration_index]->Insert(k))
125       {
126         std::cout « "Key inserted in position: " « exploration_index « std::endl;
127         return true;
128       }
129       else if (table_[exploration_index]->IsFull())
130         continue;
131       else
132       {
133         std::cout « "Key already exists" « std::endl;
134         return false;
135       }
136     }
137   }
138   std::cout « "Key not inserted table is full" « std::endl;
139   return false;
140 }
141
150 template <class Key>
151 bool HashTable<Key>::Search(const Key &k) const
152 {
153   unsigned index = fd_->operator()(k);
154
155   if (fe_ == nullptr)
156   {
157     if (table_[index]->Search(k))
158     {
159       std::cout « "Key found in position: " « index « std::endl;
160       return true;
161     }
162     else
163     {
164       std::cout « "Key not found" « std::endl;
165       return false;
166     }
167   }
168   else
169   {
170     for (size_t i = 0; i < table_size_; ++i)
171     {
172       unsigned exploration_index = (index + fe_->operator()(k, i)) % table_size_;
173       if (table_[exploration_index]->Search(k))
174       {
175         std::cout « "Key found in position: " « exploration_index « std::endl;
176         return true;
177       }
178       else if (table_[exploration_index]->IsFull())
179         continue;
180       else
181       {
182         std::cout « "Key not found" « std::endl;
183         return false;
184       }
185     }
186   }
187   return false;
```

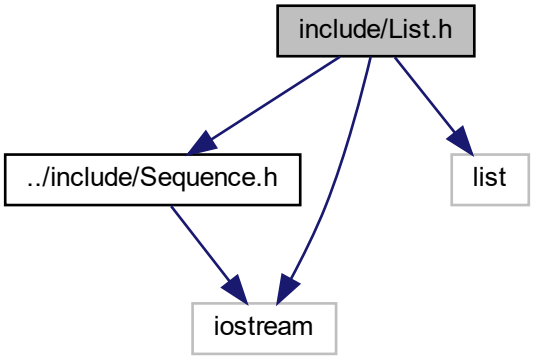
```
188 }
189
197 template <class Key>
198 std::ostream &HashTable<Key>::Write(std::ostream &os) const
199 {
200   for (size_t i = 0; i < table_size_; i++)
201   {
202     os « "\ni: " « i « " --> ";
203     table_[i]->Write(os);
204   }
205
206   return os;
207 }
208
217 template <class Key>
218 std::ostream &operator«(std::ostream &os, const HashTable<Key> &ht)
219 {
220   return ht.Write(os);
221 }
```

6.23 include/List.h File Reference

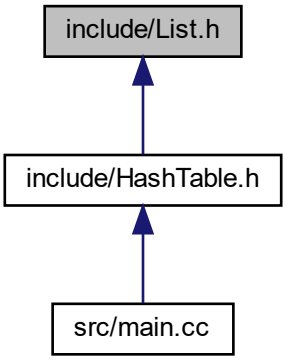
This is a sequence derived class that contains a linked list where the keys will be stored when using open dispersion.

```
#include "../include/Sequence.h"
#include <list>
#include <iostream>
```

Include dependency graph for List.h:



This graph shows which files directly or indirectly include this file:



Classes

- class List< Key >

6.23.1 Detailed Description

This is a sequence derived class that contains a linked list where the keys will be stored when using open dispersion.

Author

Fabrizzio Daniell Perilli Martín

Version

0.1

Date

2023-03-12

Copyright

6.24 List.h

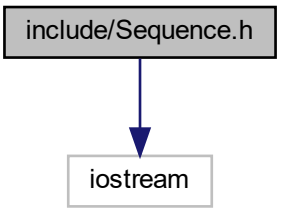
Go to the documentation of this file.

```
1
12 #include "../include/Sequence.h"
13 #include <list>
14 #include <iostream>
15
16 template <class Key>
17 class List : public Sequence<Key>
18 {
19 public:
20   List();
21   bool Search(const Key &) const override;
22   bool Insert(const Key &) override;
23   bool IsFull() const override;
24   std::ostream &Write(std::ostream &) const override;
25
26 private:
27   std::list<Key> list_;
28 };
29
35 template <class Key>
36 List<Key>::List() {}
37
46 template <class Key>
47 bool List<Key>::Search(const Key &k) const
48 {
49   for (auto &i : list_)
50     if (i == k)
51       return true;
52   return false;
53 }
54
63 template <class Key>
64 bool List<Key>::Insert(const Key &k)
65 {
66   if (IsFull())
67     return false;
68   if (Search(k))
69     return false;
70   list_.push_back(k);
71   return true;
72 }
73
81 template <class Key>
82 bool List<Key>::IsFull() const
83 {
84   return false;
85 }
86
94 template <class Key>
95 std::ostream &List<Key>::Write(std::ostream &os) const
96 {
97   for (auto &i : list_)
98     os « i « " ";
99   return os;
100 }
```

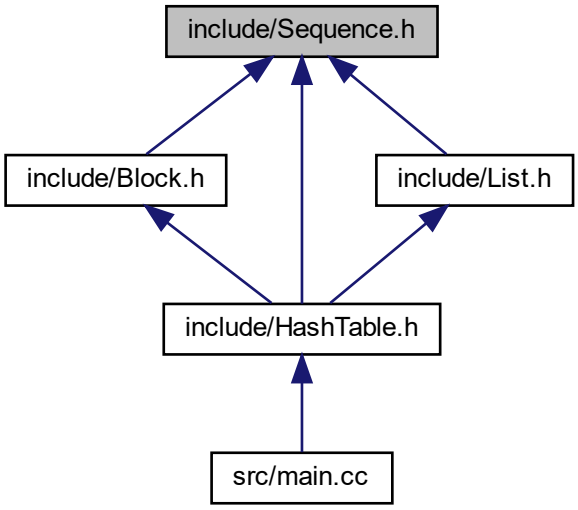
6.25 include/Sequence.h File Reference

Sequence is an abstract class that contains the pure virtual methods that will be implemented in the derived classes.

`#include <iostream>`
Include dependency graph for Sequence.h:



This graph shows which files directly or indirectly include this file:



Classes

- class Sequence< Key >

6.25.1 Detailed Description

Sequence is an abstract class that contains the pure virtual methods that will be implemented in the derived classes.

Author

Fabrizzio Daniell Perilli Martín

Version

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Date

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6.26 Sequence.h

Go to the documentation of this file.

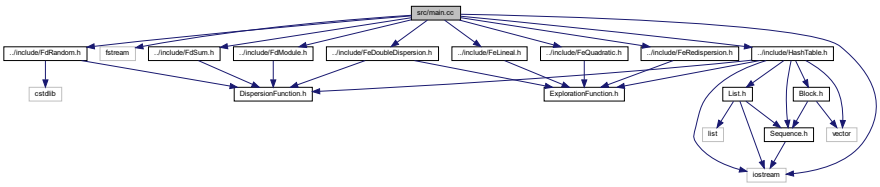
```
1
12 #pragma once
13 #include <iostream>
14
15 template <class Key>
16 class Sequence
17 {
18 public:
19   virtual bool Search(const Key &) const = 0;
20   virtual bool Insert(const Key &) = 0;
21   virtual bool IsFull() const = 0;
22   virtual std::ostream &Write(std::ostream &os) const = 0;
23 };
```

6.27 src/main.cc File Reference

This is the main program.

```
#include <iostream>
#include <fstream>
#include "../include/FdModule.h"
#include "../include/FdSum.h"
#include "../include/FdRandom.h"
#include "../include/FeLineal.h"
#include "../include/FeQuadratic.h"
#include "../include/FeDoubleDispersion.h"
#include "../include/FeRedispersion.h"
#include "../include/HashTable.h"
```

Include dependency graph for main.cc:



Functions

- int **main** ()

6.27.1 Detailed Description

This is the main program.

Author

Fabrizzio Daniell Perilli Martín

Version

0.1

Date

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Index