Sort Methods

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Chapter 1

Sorting algorithms for sequences

1.0.1 Description

Through this program developed in c++ we can study the different types of sorting algorithms that exist and their complexity. The following algorithms are used:

- · Insertion
- · Mergesort
- Shellsort
- Heapsort
- Radixsort

1.0.2 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.

1.0.3 Author

Fabrizzio Daniell Perilli Martín - alu0101138589@ull.edu.es

Chapter 2

Hierarchical Index

2.1 Class Hierarchy

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

| ortMethod< Key > | 19 |
|-------------------|------|
| HeapSort< Key > | . 9 |
| Insertion < Key > | . 11 |
| MergeSort < Key > | . 13 |
| RadixSort < Key > | . 15 |
| ShellSort< Key > | . 17 |

4 Hierarchical Index

Chapter 3

Class Index

3.1 Class List

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

| HeapSort< Key > | | | | | | | | | | | | | | | | | | | | | | 9 |
|--------------------------------------|---|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|------|--|----|
| ${\sf Insertion}{<{\sf Key}>} \ \ .$ | | | | | | | | | | | | | | | | | | | | | | 11 |
| MergeSort< Key > | | | | | | | | | | | | | | | | | | | | | | 13 |
| RadixSort< Key > | | | | | | | | | | | | | | | | | | | | | | 15 |
| ${\sf ShellSort}{<}{\sf Key}>.$ | | | | | | | | | | | | | | | | | | | | | | 17 |
| SortMethod< Key > | > | | | | | | | | | | | | | | | | | | | | | 19 |

6 Class Index

Chapter 4

File Index

4.1 File List

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

| include/HeapSort.h | |
|--|----|
| This file contains the HeapSort class | 23 |
| include/Insertion.h | |
| This file contains the Insertion class | 25 |
| include/MergeSort.h | |
| This file contains the MergeSort class | 27 |
| include/RadixSort.h | |
| This file contains the RadixSort class | 30 |
| include/ShellSort.h | |
| This file contains the ShellSort class | 32 |
| include/SortMethod.h | |
| This a abstract class that contains the basic methods for the sorting algorithms | 34 |
| src/main.cc | |
| This file contains the main function of the program | 35 |
| | |

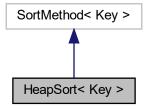
8 File Index

Chapter 5

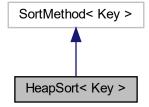
Class Documentation

${\bf 5.1 \quad HeapSort {< Key > Class\ Template\ Reference}}$

Inheritance diagram for HeapSort< Key >:



Collaboration diagram for HeapSort < Key >:



10 Class Documentation

Public Member Functions

```
    HeapSort (std::vector< Key >, unsigned)
```

Construct a new Heap Sort < Key>:: Heap Sort object.

· void Sort () override

Sort the sequence using the HeapSort algorithm.

Additional Inherited Members

5.1.1 Constructor & Destructor Documentation

5.1.1.1 HeapSort()

Construct a new Heap Sort < Key>:: Heap Sort object.

Template Parameters



Parameters



5.1.2 Member Function Documentation

5.1.2.1 Sort()

```
template<class Key >
void HeapSort< Key >::Sort [override], [virtual]
```

Sort the sequence using the HeapSort algorithm.

Template Parameters



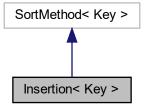
Implements SortMethod< Key >.

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

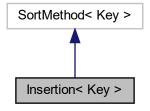
• include/HeapSort.h

5.2 Insertion < Key > Class Template Reference

Inheritance diagram for Insertion < Key >:



Collaboration diagram for Insertion < Key >:



Public Member Functions

- Insertion (std::vector< Key >, unsigned)
 Construct a new Insertion
 Key>:: Insertion object.
- · void Sort () override

Sort the sequence using the Insertion algorithm.

12 Class Documentation

Additional Inherited Members

5.2.1 Constructor & Destructor Documentation

5.2.1.1 Insertion()

```
template<class Key > Insertion< Key >:: Insertion ( std::vector< Key > seq, unsigned size )
```

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

Template Parameters



Parameters

| seq | |
|------|--|
| size | |

5.2.2 Member Function Documentation

5.2.2.1 Sort()

```
template<class Key >
void Insertion< Key >::Sort [override], [virtual]
```

Sort the sequence using the Insertion algorithm.

Template Parameters



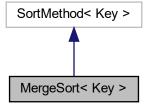
Implements SortMethod< Key >.

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

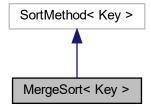
• include/Insertion.h

5.3 MergeSort < Key > Class Template Reference

Inheritance diagram for MergeSort< Key >:



Collaboration diagram for MergeSort< Key >:



Public Member Functions

- MergeSort (std::vector < Key >, unsigned)
 Construct a new Merge Sort < Key>:: Merge Sort object.
- · void Sort () override

Sort the sequence using the MergeSort algorithm.

Additional Inherited Members

5.3.1 Constructor & Destructor Documentation

14 Class Documentation

5.3.1.1 MergeSort()

Construct a new Merge Sort < Key>:: Merge Sort object.

Template Parameters

Parameters

| seq | |
|------|--|
| size | |

5.3.2 Member Function Documentation

5.3.2.1 Sort()

```
template<class Key >
void MergeSort< Key >::Sort [override], [virtual]
```

Sort the sequence using the MergeSort algorithm.

Template Parameters



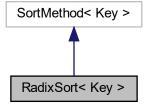
Implements SortMethod< Key >.

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

• include/MergeSort.h

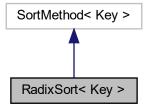
5.4 RadixSort < Key > Class Template Reference

Inheritance diagram for RadixSort< Key >:



16 Class Documentation

Collaboration diagram for RadixSort< Key >:



Public Member Functions

- RadixSort (std::vector < Key >, unsigned)
 Construct a new Radix Sort < Key>:: Radix Sort object.
- · void Sort () override

Sort the sequence using the RadixSort algorithm.

Additional Inherited Members

5.4.1 Constructor & Destructor Documentation

5.4.1.1 RadixSort()

Construct a new Radix Sort < Key>:: Radix Sort object.

Template Parameters



Parameters

| seq | |
|------|--|
| size | |

5.4.2 Member Function Documentation

5.4.2.1 Sort()

```
template<class Key >
void RadixSort< Key >::Sort [override], [virtual]
```

Sort the sequence using the RadixSort algorithm.

Template Parameters



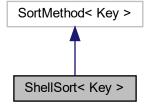
Implements SortMethod< Key >.

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

· include/RadixSort.h

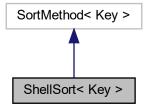
5.5 ShellSort < Key > Class Template Reference

Inheritance diagram for ShellSort < Key >:



18 Class Documentation

Collaboration diagram for ShellSort< Key >:



Public Member Functions

- ShellSort (std::vector< Key >, unsigned)
 Construct a new Shell Sort< Key>:: Shell Sort object.
- void Sort () override

Sort the sequence using the ShellSort algorithm.

Additional Inherited Members

5.5.1 Constructor & Destructor Documentation

5.5.1.1 ShellSort()

Construct a new Shell Sort < Key>:: Shell Sort object.

Template Parameters



Parameters

| seq | |
|------|--|
| size | |

5.5.2 Member Function Documentation

5.5.2.1 Sort()

```
template < class Key >
void ShellSort < Key >::Sort [override], [virtual]
```

Sort the sequence using the ShellSort algorithm.

Template Parameters



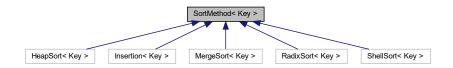
Implements SortMethod< Key >.

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

· include/ShellSort.h

5.6 SortMethod< Key > Class Template Reference

Inheritance diagram for SortMethod < Key >:



Public Member Functions

- SortMethod (std::vector< Key >, unsigned)
- Construct a new Sort Method< Key>:: Sort Method object.
 virtual void Sort ()=0
- void Write (int)

Write the sequence in the console.

Protected Attributes

- · unsigned size_
- std::vector< Key > seq_

20 Class Documentation

5.6.1 Constructor & Destructor Documentation

5.6.1.1 SortMethod()

Construct a new Sort Method < Key>:: Sort Method object.

Template Parameters



Parameters

| seq | |
|------|--|
| size | |

5.6.2 Member Function Documentation

5.6.2.1 Sort()

```
template<class Key >
virtual void SortMethod< Key >::Sort ( ) [pure virtual]
```

 $Implemented \ in \ HeapSort<Key>, Insertion<Key>, MergeSort<Key>, RadixSort<Key>, and ShellSort<Key>.$

5.6.2.2 Write()

Write the sequence in the console.

Template Parameters

| Key | |
|-----|--|

| Parameters | | |
|------------|--|--|
| count | | |

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

• include/SortMethod.h

22 Class Documentation

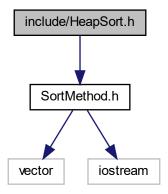
Chapter 6

File Documentation

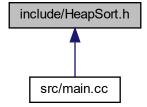
6.1 include/HeapSort.h File Reference

This file contains the HeapSort class.

#include "SortMethod.h"
Include dependency graph for HeapSort.h:



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



24 File Documentation

Classes

class HeapSort< Key >

6.1.1 Detailed Description

This file contains the HeapSort class.

Author

Fabrizzio Daniell Perilli Martin alu0101138589@ull.edu.es

Version

0.1

Date

2023-04-03

Copyright

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6.2 HeapSort.h

Go to the documentation of this file.

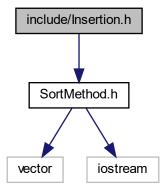
```
12 #include "SortMethod.h"
13
14 template <class Key>
15 class HeapSort : public SortMethod<Key>
17 public:
18 HeapSort(std::vector<Key>, unsigned);
19 void Sort() override;
20 };
29 template <class Key>
30 HeapSort<Key>::HeapSort(std::vector<Key> seq, unsigned size) : SortMethod<Key>(seq, size) {}
31
32
38 template <class Key>
39 void HeapSort<Key>::Sort()
40 {
41
     int count = 0;
42
     for (size_t i = 1; i < this->size_; i++)
43
44
       int pos = i;
45
       while (pos > 0)
46
         int father = (pos - 1) / 2;
if (this->seq_[pos] > this->seq_[father])
48
49
50
           std::swap(this->seq_[pos], this->seq_[father]);
51
           pos = father;
         else
55
           break;
56
       this->Write(count);
58
       count++;
```

```
60
     for (int i = this->size_ - 1; i > 0; i--)
       std::swap(this->seq_[0], this->seq_[i]);
62
       int pos = 0;
int son = 2 * pos + 1;
while (son < i)</pre>
63
64
65
66
          if (son + 1 < i)
68
            if (this->seq_[son] < this->seq_[son + 1])
69
70
               son++;
71
72
73
          if (this->seq_[pos] < this->seq_[son])
            std::swap(this->seq_[pos], this->seq_[son]);
74
75
76
            pos = son;
son = 2 * pos + 1;
77
78
          else
            break;
80
        this->Write(count);
81
82
       count++;
83
84 }
```

6.3 include/Insertion.h File Reference

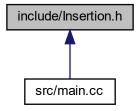
This file contains the Insertion class.

```
#include "SortMethod.h"
Include dependency graph for Insertion.h:
```



26 File Documentation

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



Classes

class Insertion
 Key >

6.3.1 Detailed Description

This file contains the Insertion class.

Author

Fabrizzio Daniell Perilli Martin alu0101138589@ull.edu.es

Version

0.1

Date

2023-04-03

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6.4 Insertion.h

6.4 Insertion.h

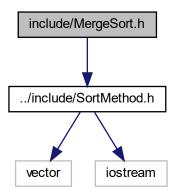
Go to the documentation of this file.

```
12 #include "SortMethod.h"
13
14 template <class Key>
15 class Insertion : public SortMethod<Key>
17 public:
   Insertion(std::vector<Key>, unsigned);
void Sort() override;
1.8
19
20 };
29 template <class Key>
30 Insertion<Key>::Insertion(std::vector<Key> seq, unsigned size) : SortMethod<Key>(seq, size) {}
31
32
38 template <class Key>
39 void Insertion<Key>::Sort()
40 {
    int count = 0;
int pos, aux;
41
42
     for (size_t i = 0; i < this->size_; i++)
43
44
      pos = i;
aux = this->seq_[i];
while (pos > 0 && aux < this->seq_[pos - 1])
47
48
         std::swap(this->seq_[pos], this->seq_[pos - 1]);
49
50
         pos--;
51
        this->seq_[pos] = aux;
        this->Write(count);
54
        count++;
55
56 }
```

6.5 include/MergeSort.h File Reference

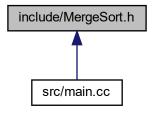
This file contains the MergeSort class.

```
#include "../include/SortMethod.h"
Include dependency graph for MergeSort.h:
```



28 File Documentation

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



Classes

class MergeSort< Key >

6.5.1 Detailed Description

This file contains the MergeSort class.

Author

Fabrizzio Daniell Perilli Martin alu0101138589@ull.edu.es

Version

0.1

Date

2023-04-03

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6.6 MergeSort.h

6.6 MergeSort.h

Go to the documentation of this file.

```
12 #include "../include/SortMethod.h"
13
14 template <class Key>
15 class MergeSort : public SortMethod<Key>
17 public:
18
    MergeSort(std::vector<Key>, unsigned);
19
    void Sort() override;
20
21 private:
   void Merge(int, int, int);
void Divide(int, int);
23
    int count = 0;
24
25 };
26
35 MergeSort<Key>::MergeSort(std::vector<Key> seq, unsigned size) : SortMethod<Key>(seq, size) {}
37
43 template <class Key>
44 void MergeSort<Key>::Sort()
   Divide(0, this->size_ - 1);
47
     this->Write(count);
48 count++;
49 }
50
51
59 template <class Key>
60 void MergeSort<Key>::Divide(int ini, int fin)
61 {
62
    if (ini < fin)
63
64
     int middle = ini + (fin - ini) / 2;
Divide(ini, middle);
66
      Divide(middle + 1, fin);
Merge(ini, middle, fin);
this->Write(count);
68
69
70
       count++;
     }
72 }
73
74
83 template <class Key>
84 void MergeSort<Key>::Merge(int ini, int middle, int fin)
86
     int i, j, k;
    int n1 = middle - ini + 1;
int n2 = fin - middle;
87
88
89
    std::vector<Key> L(n1), R(n2);
90
    for (i = 0; i < n1; i++)</pre>
93
       L[i] = this->seq_[ini + i];
    for (j = 0; j < n2; j++)
R[j] = this->seq_[middle + 1 + j];
95
96
98
     k = ini;
99
100
      while (i < n1 && j < n2)</pre>
101
      {
    if (L[i] <= R[j])
102
103
104
105
          this->seq_[k] = L[i];
106
          i++;
107
108
         else
109
         this->seq_[k] = R[j];
j++;
110
111
112
113
         k++;
114
115
116
      while (i < n1)
117
118
         this->seq_[k] = L[i];
119
         i++;
```

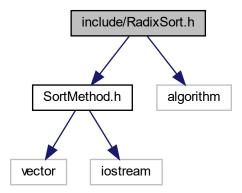
30 File Documentation

```
120
       k++;
121
122
123
      while (j < n2)
124
125
       this->seq_[k] = R[j];
126
        j++;
127
128
129
130 this->Write(count);
131
     count++;
132 }
```

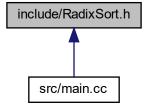
6.7 include/RadixSort.h File Reference

This file contains the RadixSort class.

```
#include "SortMethod.h"
#include <algorithm>
Include dependency graph for RadixSort.h:
```



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



6.8 RadixSort.h

Classes

class RadixSort< Key >

6.7.1 Detailed Description

This file contains the RadixSort class.

Author

Fabrizzio Daniell Perilli Martin alu0101138589@ull.edu.es

Version

0.1

Date

2023-04-03

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6.8 RadixSort.h

Go to the documentation of this file.

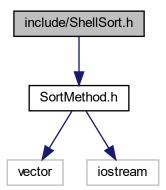
```
12 #include "SortMethod.h"
13 #include <algorithm>
15 template <class Key>
16 class RadixSort : public SortMethod<Key>
17 {
18 public:
19  RadixSort(std::vector<Key>, unsigned);
20  void Sort() override;
21 };
2.2
23
31 template <class Kev>
32 RadixSort<Key>::RadixSort(std::vector<Key> seq, unsigned size) : SortMethod<Key>(seq, size) {}
34
40 template <class Key>
41 void RadixSort<Key>::Sort()
42 {
43
     int count = 0;
   auto max = *std::max_element(this->seq_.begin(), this->seq_.end());
46
     for (int exp = 1; max / exp > 0; exp \star= 10)
47
48
       int output [this->size ]:
49
      int i, bucket[10] = {0};
50
      for (i = 0; i < (int)this->size_; i++)
52
        bucket[(this->seq_[i] / exp) % 10]++;
53
       for (i = 1; i < 10; i++)
  bucket[i] += bucket[i - 1];</pre>
54
55
56
       for (i = this->size_ - 1; i >= 0; i--)
58
         output[bucket[(this->seq_[i] / exp) % 10] - 1] = this->seq_[i];
59
60
        bucket[(this->seq_[i] / exp) % 10]--;
61
      for (i = 0; i < (int)this->size_; i++)
         this->seq_[i] = output[i];
65
       this->Write(count);
66
67
       count++;
68
```

32 File Documentation

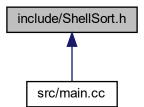
6.9 include/ShellSort.h File Reference

This file contains the ShellSort class.

#include "SortMethod.h"
Include dependency graph for ShellSort.h:



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



Classes

• class ShellSort< Key >

6.9.1 Detailed Description

This file contains the ShellSort class.

6.10 ShellSort.h 33

Author

Fabrizzio Daniell Perilli Martin alu0101138589@ull.edu.es

Version

0.1

Date

2023-04-03

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6.10 ShellSort.h

Go to the documentation of this file.

```
12 #include "SortMethod.h"
13
14 template <class Key>
15 class ShellSort : public SortMethod<Key>
17 public:
18    ShellSort(std::vector<Key>, unsigned);
19    void Sort() override;
20 };
29 template <class Key>
30 ShellSort<Key>::ShellSort(std::vector<Key> seq, unsigned size) : SortMethod<Key>(seq, size) {}
31
32
38 template <class Key>
39 void ShellSort<Key>::Sort()
40 {
41
     int count = 0;
   int count = 0;
int alfa = this->size_ / 2;
int aux, pos;
std::cout « "Alfa: " « alfa « std::endl;
while (alfa > 0)
42
43
44
45
47
        for (size_t i = alfa; i < this->size_; i++)
48
          pos = i;
aux = this->seq_[i];
while (pos >= alfa && aux < this->seq_[pos - alfa])
49
50
51
             std::swap(this->seq_[pos], this->seq_[pos - alfa]);
           pos -= alfa;
55
          this->Write(count);
56
57
          count++;
58
        alfa /= 2;
if (alfa > 0)
60
          std::cout « "Alfa: " « alfa « std::endl;
61
62
63 }
```

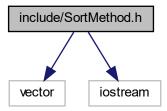
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6.11 include/SortMethod.h File Reference

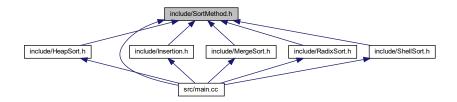
This a abstract class that contains the basic methods for the sorting algorithms.

```
#include <vector>
#include <iostream>
```

Include dependency graph for SortMethod.h:



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



Classes

• class SortMethod< Key >

6.11.1 Detailed Description

This a abstract class that contains the basic methods for the sorting algorithms.

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6.12 SortMethod.h

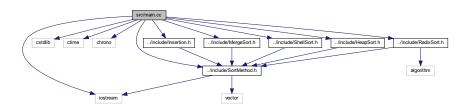
Go to the documentation of this file.

```
12 #include <vector>
13 #include <iostream>
14 #pragma once
1.5
16 template <class Key>
17 class SortMethod
18 {
19 protected:
20
    unsigned size_;
    std::vector<Key> seq_;
22
23 public:
    SortMethod() {}
24
     SortMethod(std::vector<Key>, unsigned);
    virtual void Sort() = 0;
27
    void Write(int);
28 };
2.9
30
38 template <class Key>
39 SortMethod<Key>::SortMethod(std::vector<Key> seq, unsigned size)
40 {
41
     seq_ = seq;
    size_ = size;
42
43 }
44
45
52 template <class Key>
53 void SortMethod<Key>::Write(int count)
54 {
    std::cout « "i: " « count « " -->";
for (unsigned i = 0; i < size_; i++)</pre>
55
56
58
       if (i == 0)
         std::cout « " | ";
59
       std::cout « seq_[i] « " | ";
60
61
     std::cout « std::endl;
```

6.13 src/main.cc File Reference

This file contains the main function of the program.

```
#include <iostream>
#include <cstdlib>
#include <ctime>
#include <chrono>
#include "../include/SortMethod.h"
#include "../include/Insertion.h"
#include "../include/MergeSort.h"
#include "../include/ShellSort.h"
#include "../include/HeapSort.h"
#include "../include/RadixSort.h"
Include dependency graph for main.cc:
```



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Functions

• int **main** ()

6.13.1 Detailed Description

This file contains the main function of the program.

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Write

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