Programming in C/C++
Exercises set four: containers

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December 7, 2016

Exercise 22, Containers solving complex tasks

We are asked to order all words obtain by the standard input and print them in the screen.

Code listings

Listing 1: main.cc

```
1  #include <iostream>
2  #include <vector>
3  #include <string>
4  #include <algorithm>
5
6  int main()
7  {
8      std::vector<std::string> vec;
9      std::string stringTemp;
10
11     while (std::cin >> stringTemp)
12         vec.push_back(stringTemp);
13
14     sort(vec.begin(), vec.end());
15
16     for (std::size_t ind = 0; ind < vec.size(); ++ind)
17         std::cout << ind  << ".\t" << vec[ind]
```

```
18              << std::endl;
19  }
```

Exercise 23, vectors and shrinking

So we experimented with slicing off extra capacity with vectors and a class with a vector as a data member.

Output

```
1  size: 10 capacity: 16
2  size: 11 capacity: 16
3  size: 11 capacity: 11
4
5  size: 11 capacity: 16
6  size: 12 capacity: 16
7  size: 12 capacity: 12
```

Code listings

Listing 2: main.ih

```
1  #include "main.h"
2
3  using namespace std;
```

Listing 3: main.h

```
1  #ifndef MAIN_H_
2  #define MAIN_H_
3
4  #include <iostream>
5  #include "uwl/uniquewordlist.h"
6
7  void reader(std::istream &stream,
8    std::vector<std::string> &wordList);
9  void printer(std::ostream &stream,
10   std::vector<std::string> const &wordList);
11 void printer(std::ostream &stream,
12   UniqueWordList const &wordList);
13
14 #endif
```

Listing 4: main.cc

```
1  #include "main.ih"
2
3  int main(int argc, char **argv)
4  {
5    vector<string> wordList;
6    reader(cin, wordList);
7    cout << "size: " << wordList.size()
8      << " capacity: " << wordList.capacity() << '\n';
9
10   wordList.push_back("test");
11   printer(cout, wordList);
12
13   wordList.shrink_to_fit();
14   printer(cout, wordList);
15
16   UniqueWordList uwl;
17   for (auto it = wordList.begin(); it != wordList.end
       (); ++it)
18     uwl.addWord(*it);
19   cout << '\n';
20
21   printer(cout, uwl);
22
23   uwl.addWord("west");
24   printer(cout, uwl);
25
26   uwl = uwl;
27   printer(cout, uwl);
28 }
```

Listing 5: printer1.cc

```
1  #include "main.ih"
2
3  void printer(ostream &stream,
4    vector<string> const &wordList)
5  {
6    stream << "size: " << wordList.size()
7      << " capacity: " << wordList.capacity() << '\n';
```

```
8 }
```

Listing 6: printer2.cc

```
1 #include "main.ih"
2
3 void printer(ostream &stream,
4   UniqueWordList const &wordList)
5 {
6   stream << "size: " << wordList.size()
7     << " capacity: " << wordList.capacity() << '\n';
8 }
```

Listing 7: reader.cc

```
1 #include "main.ih"
2
3 #include <algorithm>
4
5 void reader(istream &stream, vector<string> &wordList)
6 {
7   string word;
8   while (stream >> word)
9   {
10    if (!findWord(wordList, word))
11      wordList.push_back(word);
12  }
13 }
```

UniqueWordList

Listing 8: uniquewordlist.ih

```
1 #include "uniquewordlist.h"
2
3 using namespace std;
```

Listing 9: uniquewordlist.h

```
1 #ifndef UNIQUEWORDLIST_H_
2 #define UNIQUEWORDLIST_H_
3
4 #include <vector>
```

```
5  #include <string>
6
7  class UniqueWordList
8  {
9    std::vector<std::string> d_list;
10
11   public:
12     UniqueWordList &operator=(
13       UniqueWordList const &uwl);
14
15     void swap(UniqueWordList &uwl);
16
17     void addWord(std::string word);
18
19     std::size_t size();
20     std::size_t capacity();
21
22     std::size_t size() const;
23     std::size_t capacity() const;
24 };
25
26 bool findWord(std::vector<std::string> &wordList,
27   std::string word);
28
29 #endif
```

Listing 10: addword.cc

```
1  #include "uniquewordlist.ih"
2
3  #include <algorithm>
4
5  void UniqueWordList::addWord(string word)
6  {
7    if (!findWord(d_list, word))
8      d_list.push_back(word);
9  }
```

Listing 11: capacity.cc

```
1  #include "uniquewordlist.ih"
```

```
2
3  size_t UniqueWordList::capacity()
4  {
5    return d_list.capacity();
6  }
```

Listing 12: capacityconst.cc

```
1  #include "uniquewordlist.ih"
2
3  size_t UniqueWordList::capacity() const
4  {
5    return d_list.capacity();
6  }
```

Listing 13: findword.cc

```
1  #include "uniquewordlist.ih"
2
3  bool findWord(vector<string> &wordList,
4    string word)
5  {
6    for (auto it = wordList.begin();
7      it != wordList.end(); ++it)
8    {
9      if (*it == word)
10       return true;
11   }
12
13   return false;
14 }
```

Listing 14: `operator=`.cc

```
1  #include "uniquewordlist.ih"
2
3  UniqueWordList &UniqueWordList::operator=(
4    UniqueWordList const &uwl)
5  {
6    UniqueWordList copy(uwl);
7    swap(copy);
8    return *this;
9  }
```

Listing 15: size.cc

```
1  #include "uniquewordlist.ih"
2
3  size_t UniqueWordList::size()
4  {
5    return d_list.size();
6  }
```

Listing 16: sizeconst.cc

```
1  #include "uniquewordlist.ih"
2
3  size_t UniqueWordList::size() const
4  {
5    return d_list.size();
6  }
```

Listing 17: swap.cc

```
1  #include "uniquewordlist.ih"
2
3  #include <cstring>
4
5  void UniqueWordList::swap(UniqueWordList &uwl)
6  {
7    char bytes[sizeof(UniqueWordList)];
8    memcpy(bytes, this, sizeof(UniqueWordList));
9    memcpy(this, &uwl, sizeof(UniqueWordList));
10   memcpy(&uwl, bytes, sizeof(UniqueWordList));
11 }
```

Exercise 24, Containers solving complex tasks

Now, we are asked to count the number of repetitions of each word, this is a continuation from exercise 22.

Code listings

Listing 18: main.cc

```
1  #include <iostream>
2  #include <vector>
```

```
3  #include <string>
4  #include <algorithm>
5
6  int main()
7  {
8      std::vector<std::string> vec;
9      std::string stringTemp;
10
11     while (std::cin >> stringTemp)
12         vec.push_back(stringTemp);
13
14     sort(vec.begin(), vec.end());
15
16     for (std::size_t ind = 0; ind < vec.size(); ++ind)
17         std::cout << ind  << ".\t" << vec[ind]
18             << std::endl;
19
20     std::cout << std::endl;
21     //End algorithm from exercise 22
22     for (std::size_t position = 0, posCompare
23         = position; position <= vec.size();
24         ++position)
25     {
26         if (vec[posCompare] != vec[position])
27         {
28             std::size_t times = position -
29                 posCompare - 1;
30             std::cout << "The element "
31                 << vec[posCompare] << " is repited "
32                 << times << " times" << std::endl;
33             posCompare = position;
34         }
35     }
36
37
38 }
```

Exercise 25, unique keys

We made a snippet of code to count the number of unique keys in an `unordered_multimap`. Never again.

Code listings

Listing 19: main.cc

```
#include <unordered_map>
#include <set>
#include <algorithm>
#include <string>
#include <iostream>

using namespace std;

int main(int argc, char **argv)
{
  unordered_multimap<string, string> container;

  // fill the container with data
  // (no need to implement this)


  set<string> keys;
  for (size_t bucket = 0;
    bucket != container.bucket_count(); ++bucket)
  {
    for (auto it = container.begin(bucket);
      it != container.end(bucket); ++it)

      keys.insert(it->first)
  }
  size_t nUniqueKeys = keys.size();

  cout << "There are " << nUniqueKeys
    << " in the container\n";
}
```

Exercise 26, signal handling

We made the class interface for the Signal class and made a TestHandler class that inherits from the class SignalHandler.

Code listings

Listing 20: signal.h

```
#include "signal.h"
#include <iostream>
#include <signal.h>

using namespace std;
```

Listing 21: signal.h

```
#ifndef SIGNAL_H
#define SIGNAL_H

#include <map>

class Signal
{
  // map to store pair of signal with
  // set of signalhandlers
  map<size_t,
    set<SignalHandler>> d_signalHandlerMap;
  static Signal *s_instance = NULL;

  public:
    Signal(Signal const &other) = delete;
    static Signal &instance();

  private:
    Signal();
    ~Signal();
    // calls the signalhanders for the
    // given signal it is linked to all
    // required signals using sigaction
    void (*processSignal)(size_t signum);
```

```
25      void add(size_t signum,
26        SignalHandler &object);
27      void remove(size_t signum,
28        SignalHandler &object);
29      void ignore(size_t signum);
30      void reset(size_t signum);
31  };
32
33  #endif
```

Listing 22: signalhandler.ih

```
1  #include "signalhandler.h"
2  #include <iostream>
3
4  using namespace std;
```

Listing 23: signalhandler.h

```
1  #ifndef SIGNALHANDLER_H
2  #define SIGNALHANDLER_H
3
4  class SignalHandler
5  {
6      friend class Signal;
7
8      public:
9          virtual ~SignalHandler();
10     private:
11         virtual void signalHandler(size_t signum) = 0;
12 };
13
14 #endif
```

Listing 24: testhandler.h

```
1  #ifndef TESTHANDLER_H
2  #define TESTHANDLER_H
3
4  class TestHandler: public SignalHandler
5  {
6      friend class Signal;
```

```
7
8       public:
9           TestHandler();
10          virtual ~TestHandler() override;
11      private:
12          virtual void signalHandler(
13              size_t signum) override;
14  };
15
16  #endif
```

Listing 25: testhandler.cc

```
1  #include "signalhandler.ih"
2
3  TestHandler::TestHandler()
4  {
5      Signal.instance().add(SIGINT, *this);
6  }
```

Listing 26: destructor testhandler.cc

```
1  #include "signalhandler.ih"
2
3  virtual void TestHandler::~TestHandler()
4  {
5      Signal.instance().remove(SIGINT);
6  }
```

Exercise 27, implementing singleton functionality

We have implemented the member function that belong to the singleton property of the class Signal.

Code listings

Listing 27: instance.cc

```
1  #include "signal.ih"
2
3  static Signal &Signal::instance();
4  {
```

```
5       if (s_instance == NULL)
6           s_instance = new Signal;
7
8       return *Signal;
9   }
```

Listing 28: destructor of signal

```
1   #include "signal.ih"
2
3   Signal::~Signal()
4   {
5       delete s_instance;
6   }
```