

CLASS WITH A RESOURCE

Workshop 6 (10 marks - 3% of your final grade)

In this workshop, you are to design and code a class type that accesses a resource.

LEARNING OUTCOMES

Upon successful completion of this workshop, you will have demonstrated the abilities

- to define a copy constructor
- to define an assignment operator
- to define a destructor
- to avoid duplication in coding these special member functions
- to describe to your instructor what you have learned in completing this workshop

SUBMISSION POLICY

The "in-lab" section is to be completed during your assigned lab section. It is to be completed and submitted by the end of the workshop period. If you attend the lab period and cannot complete the in-lab portion of the workshop during that period, ask your instructor for permission to complete the in-lab portion after the period. If you do not attend the workshop, you can submit the "in-lab" section along with your "at-home" section (with a penalty; see below). The "at-home" portion of the lab is due on the day that is two days before your next scheduled workshop (23:59:59).

All your work (all the files you create or modify) must contain your name, Seneca email and student number.

You are responsible to back up your work regularly.

LATE SUBMISSION PENALTIES:

- *In-lab* portion submitted late, with *at-home* portion: **0** for *in-lab*. Maximum of 7/10 for the entire workshop.
- If any of *in-lab*, *at-home* or *reflection* portions is missing, the mark for the workshop will be **0**/10.

IN-LAB (30%)

Design a class named `Contact`, in namespace `sict`. This class holds information about a person and his/her phone numbers. The type `Contact` contains the following information:

- an array of characters of size 21 (including `'\0'`) that holds the name of the contact;
- a **dynamically allocated** array of phone numbers. A valid phone number has one to two digits for the country code (cannot be zero), **exactly** three digits for the area code (cannot start with zero) and **exactly** seven digits for the number (cannot start with zero);
- the number of phone numbers in the array;

Your type exposes the following public member functions:

- default constructor** (a constructor with no parameters): this constructor sets the current object to a safe empty state;
- constructor with 3 parameters**: This constructor receives the address of an unmodifiable C-style string that holds the name of the contact, the address of an unmodifiable array of phone numbers and the number of phone numbers in the array. This constructor allocates enough memory dynamically to hold **only the valid** phone numbers from the array received and copies the valid numbers into the allocated array;
- destructor**: the destructor deallocates any memory that has been allocated dynamically;
- `bool` `isEmpty()` `const`: a query that returns false if the current object has valid data; true if the object is in a safe empty state;
- `void` `display()` `const`: a query that prints the data stored by the object in the following format:

- If the object is in a safe empty state, this function displays the following message:

```
Empty contact!<ENDL>
```

- If the object is not in a safe empty state, this function displays the following message:

```
CONTACT_NAME<ENDL>
(+COUNTRY_CODE) AREA_CODE NNN-NNNN<ENDL>
(+COUNTRY_CODE) AREA_CODE NNN-NNNN<ENDL>
...
(+COUNTRY_CODE) AREA_CODE NNN-NNNN<ENDL>
```

Introduce as many private member functions as necessary to avoid duplication of code in your `Contact` module. Store your class definition in a header file named `Contact.h` and your function definitions in an implementation file named `Contact.cpp`. Avoiding duplication will reduce the time you need to spend on the at home section.

Using the sample implementation of the `w6_in_lab.cpp` main module listed below, test your code and make sure that it works. The expected output from your program is below this source code. The output of your program should match **exactly** the expected one.

IN-LAB MAIN MODULE

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

using namespace std;
using namespace sict;

int main()
{
    cout << "-----" << endl;
    cout << "Testing the default constructor!" << endl;
    cout << "-----" << endl;
    sict::Contact empty; // sict::intentional
    empty.display();
    cout << "-----" << endl << endl;

    cout << "-----" << endl;
    cout << "Testing an invalid contact!" << endl;
    cout << "-----" << endl;
    Contact bad(nullptr, nullptr, 0);
    bad.display();
    Contact alsoBad("", nullptr, 0);
    alsoBad.display();
}
```

```

cout << "-----" << endl << endl;

cout << "-----" << endl;
cout << "Testing the constructor with parameters!" << endl;
cout << "-----" << endl;
Contact temp("A contact with a very looooong name!", nullptr, 0);
temp.display();
cout << "-----" << endl << endl;

cout << "-----" << endl;
cout << "Testing a valid contact!" << endl;
cout << "-----" << endl;
long long phoneNumbers[] = { 1416123456LL, 14161234567LL, 1416234567890LL,
                             14162345678LL, -1LL, 124163456789LL};
Contact someContact("John Doe", phoneNumbers, 6);
someContact.display();
cout << "-----" << endl << endl;

return 0;
}

```

IN-LAB OUTPUT

```

-----
Testing the default constructor!
-----
Empty contact!
-----

-----
Testing an invalid contact!
-----
Empty contact!
Empty contact!
-----

-----
Testing the constructor with parameters!
-----
A contact with a ve
-----

-----
Testing a valid contact!
-----
John Doe
(+1) 416 123-4567
(+1) 416 234-5678
(+12) 416 345-6789
-----

```

IN-LAB SUBMISSION

To test and demonstrate execution of your program use the same data as the output example above.

If not on matrix already, upload `Contact.h`, `Contact.cpp` and `w6_in_lab.cpp` to your matrix account. Compile and run your code and make sure everything works properly.

Then, run the following script from your account: (use your professor's Seneca `userid` to replace `profname.proflastname`)

```
~profname.proflastname/submit 244_w6_lab<ENTER>
```

and follow the instructions.

IMPORTANT: Please note that a successful submission does not guarantee full credit for this workshop. If your professor is not satisfied with your implementation, your professor may ask you to resubmit. Resubmissions will attract a penalty.

AT-HOME (30%)

To the `Contact` class that you created for the “in-lab” portion, add the following member functions (and implement them):

copy constructor: this constructor makes a copy of an existing instance;

copy assignment operator: this operator receives an unmodifiable reference to a `Contact` object and copies that object into the current object and returns a reference to the current object, as updated.

an overloaded += operator: this operator receives a new phone number as its parameter, validates the number received and, if valid, resizes the phone number list to hold all of the existing numbers plus this one and finally adds this new number to the array. If the number is not valid, this operator retains the original array and does not add the number. In either case, this operator returns a reference to the current object.

NOTE: When you implement the copy assignment operator, make sure that the `Contact` instance is not being set to itself.

Using the sample implementation of the `w6_at_home.cpp` main module listed below, test your code and make sure that it works. The expected output from your program is below the source code. The output of your program should match **exactly** the expected one.

AT-HOME MAIN MODULE

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

using namespace std;
using namespace sict;

int main() {
    sict::Contact theContact("John Doe", nullptr, 0); // sict:: intentional
    theContact.display();
    theContact += 14161234567LL;
    theContact += 14162345678LL;
    theContact += 14163456789LL;
    theContact += 114164567890LL;
    theContact.display();

    cout << endl << "Testing! Please wait:" << endl;

    for (int i = 1; i <= 5000000; i++)
    {
        Contact temp = theContact;
        theContact = temp;
        theContact = theContact;
        if (!(i % 10000))
            cout << ".";
        if (!(i % 500000))
            cout << endl;
    }
    cout << endl;
    theContact.display();

    return 0;
}
```

AT-HOME OUTPUT

```
John Doe
John Doe
(+1) 416 123-4567
(+1) 416 234-5678
(+1) 416 345-6789
(+11) 416 456-7890
```

```
Testing! Please wait:
```

```
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....
```

```
John Doe
```

```
(+1) 416 123-4567
```

```
(+1) 416 234-5678
```

```
(+1) 416 345-6789
```

```
(+11) 416 456-7890
```

REFLECTION (40%)

Create a file `reflect.txt` that contains the following:

- 1) Explain why the copy assignment operator checks for self-assignment before doing anything else.
- 2) Explain why a class that uses dynamic memory to hold its resources needs custom definitions of its copy constructor and its copy assignment operator.
- 3) How did you avoid duplication of code?
- 4) List what you have learned in completing this workshop

QUIZ REFLECTION:

Add a section to `reflect.txt` called **Quiz X Reflection**. Replace the **X** with the number of the last quiz that you received and list the numbers of all questions that you answered incorrectly.

Then for each incorrectly answered question write your mistake and the correct answer to that question. If you have missed the last quiz, then write all the questions and their answers.

AT-HOME SUBMISSION

To submit the *at-home* section, demonstrate execution of your program with the exact output as in the example above. Upload `reflect.txt`, `Contact.h`, `Contact.cpp` and `w6_at_home.cpp` to your matrix account. Compile and run your code and make sure everything works properly. To submit, run the following script from your account (and follow the instructions):

`~profname.proflastname/submit 244_w6_home`<ENTER>

IMPORTANT: Please note that a successful submission does not guarantee full credit for this workshop. If the professor is not satisfied with your implementation, your professor may ask you to resubmit. Resubmissions will attract a penalty.