Lab 10

Submission Instructions:

1. Create a folder named Lab10_LastName_FirstInitial (e.g. Lab10_Neal_T).

2. In your folder, place a **PDF** file containing your answers to questions with a ◇.

3. Copy your directories containing your programs for questions with a ♠ into the folder; **these directories should only contain files needed to run your program, which may include one or more of the following file types: .cpp, .h., and .txt**. Do NOT include the full project (e.g., solution file). Test your program on CIRCE before submitting by compiling and running with g++. Your file containing main() should **always** be named main.cpp.

4. Ensure that all programs have block comments at the very beginning (starting at the first line) in the file containing main() with your name and the program's description. **The block comment's format should be identical to what's provided in Figure 2-1.**

5. Use single-line comments to describe your code's functionality as needed.

6. Do not submit anything for questions with a ♣.

7. Zip the folder and submit it via Canvas.

◇ = 5 points each, ♠ = 15 points each

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1. ♣ Read *Chapter 18: How to work with templates.*

2. ◇ A function template allows a function
   a. to accept a variable number of parameters
   b. to accept parameters with different data types
   c. to return different data types
   d. to be generated at runtime

3. ◇ A class template can define one or more type parameters that can then be used
   a. anywhere in the class
   b. only in the private code for the class
   c. only in the public code for the class
   d. only in the member functions of the class

4. ◇ Why is the code for a class template typically stored in its own header file?
   a. Because it's required by some compilers
   b. Because it makes it easier to include function templates in the class
   c. Because class templates are often designed to be used by multiple programs
   d. Because it makes the class template more flexible

5. ♠ **Lab10_Q12: Multiset (Bag)**

Code a custom container for a multiset (also known as a bag) that stores data of any type in no particular order and allows duplicates. Then, write some code that tests this custom container. Save your file(s) in folder lab10_q5.

Console

```
Multiset/Bag Test

ELEMENTS
John
Joel
Samantha
John

isEmpty() returns false
isFull() returns false
contains() for John returns true
contains() for Bob returns false

Calling remove()

ELEMENTS
John
Joel
Samantha
```

Specifications

- Create a class template named ArrayBag that uses a private built-in array to store the underlying data for this container.
- Provide a no-argument constructor to create the array on the heap, set its capacity to 1000, and set its size to 0.
- Provide a destructor that returns the memory used by the array to the heap.
- Implement the following member functions:
    - getSize() – return the current number of items in the bag.
    - isEmpty() – return a value that indicates whether the bag is empty.
    - isFull() – return a value that indicates whether the bag is full.
    - add() – add the specified item to the bag.
    - remove() – remove one item from the bag.
    - contains() – return a value that indicates whether the bag contains the specified item.
    - makeEmpty() – clear the bag of all items.
    - printElements() – print all items in the bag to standard output.
- If the user tries to add to a full bag, or remove from an empty bag, return false and don't perform the operation. Otherwise, perform the operation and return true.

TIP: You can use the boolalpha stream manipulator to convert the 0 and 1 values returned by the isEmpty(), isFull(), and contains() functions to "true" and "false". For more information about this stream manipulator, you can search the internet.

6. ♠ Leave any questions that you have concerning the content presented in Chapter 18 in this week's Q&A (Week 12) discussion and/or provide answers or feedback for other students. If you have none, provide other resources relevant to this week's topics that you found helpful or feel may help others.