NYU, Tandon School of Engineering
Bridge to Computer Science Program — Winter 2023 Extended

Third Midterm Exam

- There are 100 points total.
- Note that there are longer programming problems at the end. Be sure to allow enough time for these.
- We supplied you with a file, named ‘solutions.txt’, where you should type all your answers in.
- For editing this file, you are allowed to use compilers such as Visual Studio, VSCode, XCODE, CLion, textedit and notepad
- You may use 2 scratch papers.
- Calculators are not allowed.
- This is a closed-book exam. No additional resourced are allowed.
- Pay special attention to the style of your code. Indent your code correctly, choose meaningful names for your variables, define constants where needed, choose most suitable control statements, etc.
- In all questions you may assume that the users enter inputs as they are asked. For example, if the program expects a positive integer, you may assume that users will enter positive integers.
- No need to document your code in this exam, but you may add comments if you think they are needed for clarity.
- Read every question completely before answering it.

1. (5 pts) When using an iterator on an STL list of integers, which of the following will advance the iterator to the next item?
    a. itr++
    b. itr = itr->data
    c. itr = itr->next
    d. itr = *itr++

2. (5 pts) Which data structure stores things in reverse chronological order (i.e. The last item inserted is the first item removed)?
    a. Array
    b. Linked List
    c. Stack
    d. Queue
3. (5 pts) Which is of the following lines in the class definition would cause the class to be abstract?
    a. `virtual void func(){}`
    b. `void func();`
    c. `virtual void func()=0`
    d. `virtual void func();`

4. (5pts)A derived class wants to access the base class's private data member. Provide the appropriate function call at the point listed below.

```
class Base{
          int val;
    public:
          void func(int x){ val = x; }
};

class Derived: public Base{
    public:
           void func(int x){/* Your code HERE!   */}
};
```

5. (10 pts) Given a pointer to a BSTNode (not the root), provide the code to determine if it's a left or right child of its parent.

6. (10 pts) Given an unsorted linked list of integers, describe in English a way you could sort these elements in N log N time. Speed is important but we have sufficient RAM to store multiple copies of the list.

7. (10 pts) You are given a Tree and want to determine if it meets the requirements for an AVL tree. Discuss, in English, how you would make that determination in the most efficient way possible. In your answer, please indicate your Big Theta runtime.

8. (25 pts) A file on the hard drive ("input.txt" it exists, you do not need to test for it) contains two "columns" of data. The first is an integer, the second is a single string. These are separated with a tab character and the string will contain no whitespace. Unfortunately, the integers are in unsorted order. We would like to sort them while keeping the integers associated with the strings. Please store the results back in the original file. (NB: You are not required to write a sorting algorithm, simply use one that we have previously defined or use the STL as you like)

Input.txt before running the program	Input.txt after
3 Daniel 4 John 1 Betty 2 Jane	1 Betty 2 Jane 3 Daniel 4 John

9. (25 pts) You are given two pointers, one is to the first node of a doubly linked list (LListNode*) of sorted integers, the other pointer is to the root node of a binary search tree of integers (BSTNode*). The classes are similar to the ones we've described in class and homework. You also have the BST class and the LList class to use. You may assume everything is public in all of the classes.

   Write a function "compare" which will determine if the list and the tree contain the same values. Your function will be graded for both accuracy and efficiency.