NYU, Tandon School of Engineering
Bridge to Computer Science Program — Winter 2024 Extended

Third Midterm Exam

- You have two hours
- There are 100 points total.
- Note that there are longer 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.
- Write your name, netID and NYU ID at the head of the solutions file.
- For editing this file, you are allowed to use only plain text editors (Notepad for Windows users, or textEdit for Mac users).
- You are permitted to use Visual Studio (C++) or XCode as compilers. And Textedit/Notepad for text editing but should copy/paste your answers to the TXT file.
- 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.
- **When done, please upload your answer file to Brightspace.nyu.edu, Gradescope and email to dkatz@nyu.edu**

1. (3 pts) Assuming that we are implementing a member function which will return the tail of a linked list, what is the appropriate header for the function as defined outside of the class (not inline), choose the best answer.
    A. LList* LList::getTail(LListNode* head)
    B. LList LList::getTail(LListNode* head)
    C. LListNode* LList::getTail(LListNode* head)
    D. LListNode* LListNode::getTail(LListNode* head)

2. (3 pts) Given two classes, Base and Derived where Derived derives from Base (obviously) both of which have a function, func, appropriately defined, which of the following can be used inside Derived's func to call the base class version of the function?

    A. func();
    B. this->func();
    C. Base::func();
    D. super.func();

3. (3 pts) Given a base class pointer (Base * bptr) to a derived class object is the following allowed or not allowed?
    Derived d = *bptr;
    A. Always allowed
    B. Never Allowed
    C. Allowed if there exists a function to do so in the base class
    D. Allowed if there exists a function to do so in the derived class

4. (3 pts) Convert the math expression (2+3)*4-5-6 to post fix form.

5. (3 pts) Evaluate the post fix expression "`3 2 * 2 - 2 /`" to a value.

6. (15 pts) Given a binary search tree of integers without a stored height parameters in each node, explain, in English, not code, how you would, as efficiently as possible, determine if the tree would be considered balanced as an AVL tree. Please include the runtime of your algorithm.

7. (15 pts) You are given a pointer to an arbitrary node in a doubly linked list of integers and asked to sort the list. Explain, in English, not code, how you would do this if the list was exceedingly large and could only be stored once in memory.

8. (20 pts) Given two files (1.txt and 2.txt; they are guaranteed to exist) which both contain integers in sorted order we would like to produce a new file (3.txt) which contains all of the integers in sorted order. Each integer is on a line by itself in each of the two input files and should be similar in the output file. The files are very large and cannot be stored in memory. If any duplicates exist, they should be included in the resulting file (i.e. if one number appears in both files, it will appear twice in the output file).

9. (15 pts) Given a pointer to the root of a binary search tree (has left, right, and parent pointers as well as a data section) write a function (or functions) which will return an STL list (you should not define this class, it's already included) with all of the values from the tree in level order. Your code should run in theta(N) time.

10. (20 pts) Our company manufactures television and computer screens. We're going to design a program to handle our inventory and you are being asked to design classes for the program. Both types of devices have a function to display an image on the screen (showImage). For simplicity, this function will take an integer and display it on the screen (cout) followed by the text "Television" or "Computer" as appropriate for the type of screen. We will need to, eventually, store all of these objects in a vector in order to keep track of our inventory so please allow for that possibility and make sure that both are guaranteed to have the "showImage" function implemented.

    Design the necessary classes and provide a main function to put three chairs into a vector of Furniture object pointers.