

## CSC/DSCI 2720: Data Structures Assignment 5

**Due: 04/23/2023 @ 11:59 PM ET**

Answer the below questions.

You may use whatever IDEs / editors you like, but you must submit your responses on iCollege as .java files. Failure to comply with this simple requirement will result in a score of Zero.

Please, be careful not to be assigned a Zero score this way.

Few Rules to be followed, else will receive a score of ZERO.

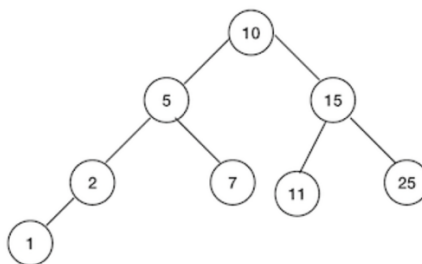
- (1) Your submissions will work exactly as required.
- (2) Your files shall not be incomplete or worse corrupted such that the file does not compile at all. Make sure you submit a file that compiles.
- (3) Your submission will show an output. Should you receive a Zero for no output shown do not bother to email me with “but the logic is perfect”!

Note that your program’s output must exactly match the specs (design, style) given here for each problem to pass the instructor’s test cases.

Design refers to how well your code is written (i.e., is it clear, efficient, and elegant), while Style refers to the readability of your code (commented, correct indentation, good variable names).

1. (60 points) In this problem, you will be given a binary tree represented **as a list**. Your job will be to verify if it is a binary search tree or not.

Input will be given as a space-separated array representing a binary tree as we discussed in class, with the root node occupying the 0th index, the root node’s children occupying indices 1 and 2, their children occupying indices 3-6, etc. **All trees will be balanced and will be filled left to right in the bottom layer.** For example, the list [10,5,15,2,7,11,25,1] represents the below graph:



Thus, if you are given the following input: [10,5,15,2,7,11,25,1]

then you should print: **True**

since this tree is indeed a binary search tree.

As another example, the input 2 4 5 does not represent a binary search tree since the number 2 is less than both its children (4 and 5).

2. (40 points) In this problem, you will be given an input list. Your job will be finding the top k frequent elements in the input array. Assume you will be given an integer list and an integer k, return the k most frequent elements in an output array. For example: if input array is [1,2,1,3,2,2] and k = 2, the output will be [1,2]; if input array is [1] and k = 1, the output will be [1]. **Please solve this problem in two different ways.** For example:

- (1) Using a Sorting algorithm (the implementation is by your choice)
- (2) Using a Priority Queue (the implementation is by your choice)

Try your best to optimize both of your solutions. Please also write a paragraph for each solution in the comment to analyze the time and space complexity.

### Very Very Important:

(1) Your code should be well commented which explains all the steps you are performing to solve the problem. **A submission without code comments will immediately be deducted 15 points!**

(2) As a comment in your code, please write your test-cases on how you would test your solution assumptions and hence your code. **A submission without test cases will immediately be deducted 15 points!** Example of cases to be tested for are like: What if the array input which is expected does not exist - that is, input is a null. How should your code handle such a situation? Maybe output some message like “Null input case, so no output”? What if the length of the array is one? ... so on and so forth.

Please Remember: Although, written as comments - You will address your test cases in the form of code and not prose :)