Big Homework 3

Data Structures and Algorithms

BST & Heaps

General mentions

• For this project you will work either in teams of 2 people or alone.

• The homework will be uploaded on the Moodle platform (fils.curs.pub.ro), for Hw3 assignment. If you encounter problems with the platform, contact by email your lab assistant.

• The homework must be submitted by 19.05.2019, at 08:00 AM. No late submissions will be accepted.

• The evaluation of the project will take place during the first lab after the submission deadline. Presence at the lab will be mandatory for presenting your projects.

• The final submission will contain an archive named Student1FamilyName_Student1Name_ Student2FamilyName_Student2Name_HW1 with:

· the source files of your project (.cpp and .h) and not the object files (.o) or executables (.exe)

· a README file in which you will specify all the functional sections of the project, together with instructions for the user; additionally, if you have parts of the homework that don't work, you may offer solution ideas for a partial score on these sections.

• For all questions regarding the project, communicate by email with your lab assistant.

• Warning: we will use plagiarism detection software on your submissions. Copied homework will be marked with 0 points.

1) **BST (5p)**

a) Read letters from the keyboard and insert them in a BST. The reading process stops when the user inserts the character 0 (zero) (0.5p)

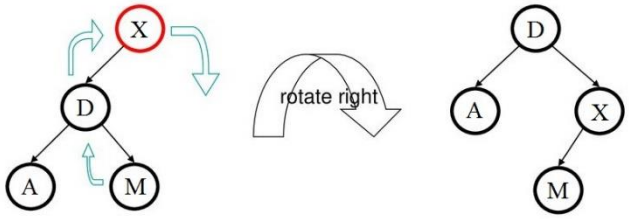
b) Find the common ancestor of 2 given nodes (0.75p)

c) Write a function to check is a node is a grand-parent of a given node. (0.75p)

d) Design an algorithm which creates a linked list of all the nodes at each depth (i.e., if the tree has depth D, you'll have D linked lists). (1p)

e) Check if a BST is perfect or not (all leaves are at the same distance from the root and all internal nodes have 2 children) (1p)

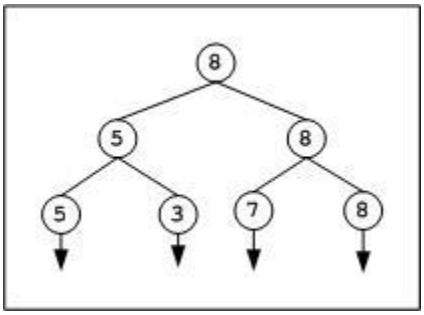
f) Perform a right rotation of the BST. (1p)
More info: https://slideplayer.com/slide/14553828/ Ex:



2) Heap (5p)

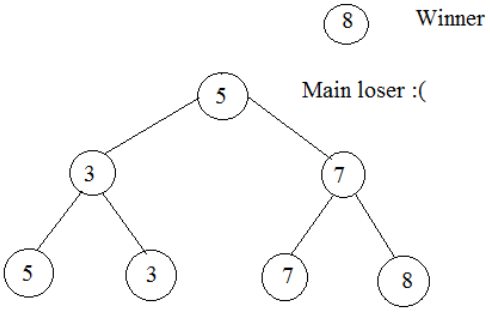
A tournament tree is a form of max (min) heap which is a complete binary tree. Every external node (leaf) represents a player and an internal node represents a winner. We will thus have N-1 internal nodes in a binary tree with N leaves.

Ex:



The above (max) tree contains 4 leaf nodes that represent players (5, 3, 7, and 8). We have 3 levels: 0, 1 and 2. Initially 2 games are played at level 2, one between 5 and 3 and another one between 7 and 8. In the next move (level 1), one more game is conducted between 5 and 8 to conclude the final winner. Overall we need 3 comparisons to find the winner.

a) Check if an input set can form a tournament tree after being inserted in a heap and display an appropriate message. (1p)
   Ex: 3, 5, 5, 6, 6, 2, 5 – it can form a tournament tree
   3, 5, 5, 6, 2 – it cannot form a tournament tree
   Pick a valid set and insert it in your tournament tree.
b) Determinate who is the "second best" player. This is the person who lost in the first round the match against the final winner (here the second best is: 7) (0.5p)
c) Display the history of the matches played by the winner at each level. (1p)
   Ex:
   In the first round, the winner defeated 7.
   In the second round, the winner defeated 5 etc.
d) Construct a "loser tree" using the previous info from the tournament tree (2p).
   Ex:



In round 1, between 5 and 3, 3 is the loser; between 7 and 8, 7 is the loser. In round 2, we have the match between the 2 previous winners (5 and 8): the loser is 5. The winner is 8!

e) Determinate the winner and the main loser from the loser tree (0.5p).