2020 FALL quiz: CS 206 A

Maximum points: 200 points

100 points * 2 = 200 points

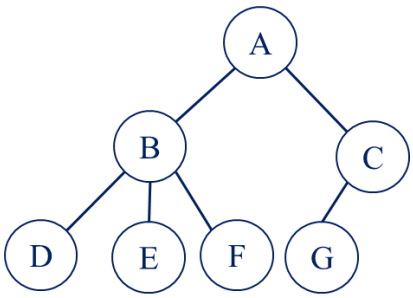
- The total score in this exam file is 100 points.
- 100 points will be converted to 200 points by multiplying your earned score by 2.
- For instance, if you receive 90 points, your final score on the online quiz is computed as 90 * 2 = 180 points.

Problem 0. Information (1 point)

Write your name and KAIST ID at the top of **EACH** page on your answer paper.

Problem 1. (worth 7 points)

Convert the following general tree T to a binary tree using the left-child-right-sibling representation that we studied in class. Draw a final resulting tree.

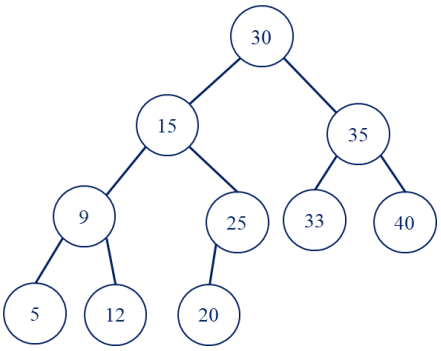


A general tree T

Problem 2. (10 points)

Consider a binary search tree T below. You are required to perform one or more tree rotations to T in order to produce a new tree, which is 1) height-balanced, 2) maintains the binary search tree property, and 3) contains 15 at the root:

A. Draw a final resulting tree (5 points) and
B. Explain which tree rotation at which node was performed. (5 points).



Problem 3. (30 points: 10 points @ each)

For **EACH** of the following statements:

> **1) Write True or False (1 point)**
> **2) Justify your answer. (9 points)**
>
> - If a given statement is true, justify why it takes the given running time.
> - If a given statement is false, justify why the given running time is incorrect, and then, correct the given running time in the statement.

A. Given two max heaps with N elements each, it is possible to construct a single max heap comprising all 2N elements in O(N) time. (Note: You can use extra memory space.)

B. Given a hash table of size N with N elements, using separate chaining, the minimum elements can always be found in O(1) time.

C. We can always find the minimum in a max heap containing N elements in O(log N) time. (Note: The elements in the max heap are distinct from one another.)

Problem 4 (22 points: 11 points @ each)

A given set of N integers can be sorted: 1) first, we build a binary search tree containing these integers, and then 2) print the integers by an inorder traversal.

A. What is the worst-case running time for this sorting algorithm? And why?

B. What is the best-case running time for this sorting algorithm? And why?

*Note: For the running time, use a big-Oh notation.

Problem 5. (30 points)

An array `data[]` contains N distinct integers. You are required to find pairs that sum to a given number X. For example, if `data[]` contains { -50, 0, 1, 3, 5, 7, 9} and X is 10, your program should print out {7, 3} and {9, 1}.

A. For a given array of N distinct integers, explain a linear-time algorithm that performs the task described above. (20 points)

B. Explain why your algorithm takes linear time, for a given array of N distinct integers. (10 points)

- Notes:
  - Use the algorithm, ADT, or data structure that we have studied in class.
  - Your algorithm will be graded based on correctness, running time efficiency, and clarity.
  - Describe your algorithm step by step.
  - You are not required to write the Java code.