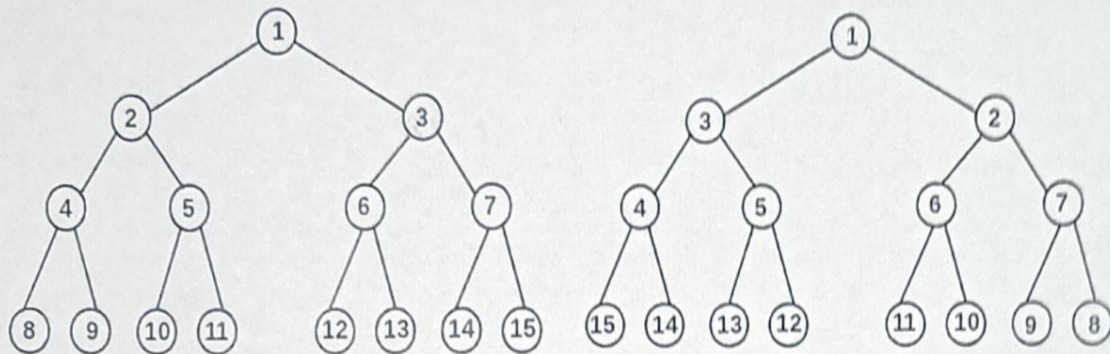


Algorithms Laboratory (CS29203)
Lab Test 2
Department of CSE, IIT Kharagpur

3rd November 2022

Question-1 (40 points)

Consider a perfect binary tree in which every internal node has exactly two child nodes and all the leaf nodes are at the same level. We intend to do some modifications in the tree in certain levels only. The goal is to mirror the odd levels of the tree and print the new set of nodes. For example, consider the following tree in the left side of the figure and the corresponding desired new tree in the right hand side, where the odd level (i.e. level 1, 3, etc starting from the root which is at level 0) have been inverted.



Your task is to write a code to solve the above mentioned problem. You may read the input (integer) data either from an user, or initialize in an array in your code. Finally print the *level order* traversal of all nodes of the new tree (i.e., print from left to right, level by level. For example, the left tree will have the following level order traversal: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15).

Example:

Input: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15

Level order traversal: 1, 3, 2, 4, 5, 6, 7, 15, 14, 13, 12, 11, 10, 9, 8

Question-2 (40 points)

Consider a list of classes of second year engineering students of different courses in IIT Kgp, where each class has a final exam. You are given a 2D integer array *classes*, where *classes*[*i*] = [*passi*, *totali*]. You know beforehand that in the *i*-th class, there are *totali* total students, but only *passi* number of students will pass the exam.

You are also given an integer *extraStudents*. There are another *extraStudents* brilliant students that are guaranteed to pass the exam of any class they are assigned to. You want to assign each of the *extraStudents* students to a class in a way that maximizes the average pass ratio across all the classes.

The pass ratio of a class is equal to the number of students of the class that will pass the exam divided by the total number of students of the class. The average pass ratio is the sum of pass ratios of all the classes divided by the number of the classes.

Return the maximum possible average pass ratio after assigning the *extraStudents* students. For example, consider the array *classes* = $[[1, 2], [3, 5], [2, 2]]$ and *extraStudents* = 2. Then you can assign the two extra students to the first class. The average pass ratio will be equal to $(3/4 + 3/5 + 2/2)/3 = 0.78333$.

Your task is to write a code to solve the above mentioned problem. You must use the the idea of heap/priority queue in your implementation.

Example:

Input: *classes* = $[[2, 4], [3, 9], [4, 5], [2, 10]]$
extraStudents = 4

Output: 0.5348

Question-3 (20 points)

Consider two unordered arrays of integers. Your task will be to check whether both arrays have the same set of numbers. A simple solution can be the following: for each element of 'A' check if it is in 'B' or not. However, problem arises if there are duplicates in the arrays. For example, consider the following input:

A = {2, 5, 6, 8, 10, 2, 2} B = {2, 5, 5, 8, 10, 5, 6}

The above simple solution will be wrong because, for each element in 'A' there is an element in 'B', but the number of occurrences in them are not the same. Time complexity is $O(n^2)$ too, considering n as the number of elements in each array. Sorting can be used to overcome the problem, but that would also mean $O(n \log n)$ complexity for a generic array. Use the ideas learned in hash tables to improve the efficiency of the algorithm to $O(n)$.

Assume maximum size of each of the arrays as 10 and no need to consider resizing.