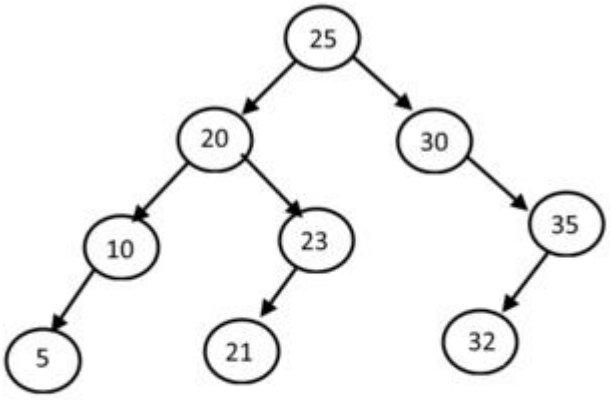
BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI
HYDERABAD
CAMPUS,
Data Structures and Algorithms
CS F211
Homework Assignment – 11

1. Finding common ancestor is an interesting game and you like to play it. Suppose the people are enumerated by numbers and their ancestor chain is represented by a binary search tree. You are given two numbers as input. Using the BST, find the lowest common ancestor of the two numbers. The inputted number will definitely belong to tree.
   Example :



Lowest Ancestor Ancestor (5, 21) = 20
Lowest Ancestor Ancestor (10, 30) = 25
Lowest Ancestor Ancestor (5, 32) = 25
Lowest Ancestor Ancestor (10, 23) = 20

   Note : You are required to create the tree. At time of evaluation we will give you keys of tree.

2. Max doesn't want to go to physics class. So he decides to reach the class as late as possible. It is known to you that his school building is in form of a binary tree where each node represents the time taken to cross that building corresponding to that node. Max can start at any end building (or leaf) in his school and he has to reach the room located at root in most possible time. Help Max in finding such a path. (Time taken to pass a building or node can also be negative.)

   eg: in case like given below

```
      10
     /   \
    -2    7
   /  \
  8   -4
```

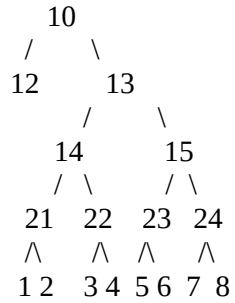
   Max will take a path 7---> 10

3. Tina goes for a movie. But while she is watching a movie, she receives a phone call. Tina is a good girl and doesn't want to disturb people watching movie by her phone call. So she rushes to go outside the hall. But sadly the hall is in the form of binary tree where leaves are the exit gates of the hall. Given an integer x specifying Tina's seat (or the node in binary tree), help Tina finding the closest

exit to her seat. Output the no. of nodes she has to cross while exiting.

Eg:

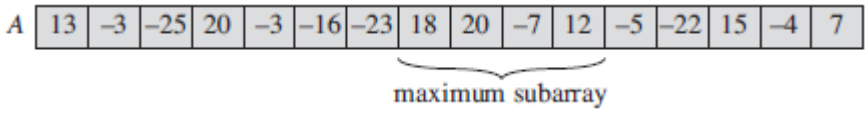
Given x = 13



Output : 2 (Tina takes path 13-->10-->12 (12 represents exit)) rest all path have 3 nodes.

4. You are given an array and you have to find out the maximum sub-array sum using divide-and-conquer (don't use dp) to solve this problem in O(nlogn) time.

   Ex :



   Maximum sub-array sum is 18 + 20 + -7 + 12 = 43

5. You all have used pow(a, n) function in C. Have you wondered how much efficient it is ? Is it O(n) or O(logn) ? Now you have to implement a similar kind of function call it power(a, n) where a and n is an integer and you have solve the problem in O(logn) time.

   Ex : power(2, 5) = 32

6. You are given n coins of denominations d_0, d_1, d_2, … d_{n-1}. Each coins are available in infinite supply. You have to make changes of N from available coins in such a way that minimum number of coins are used. Solve this problem in O(nN) time complexity.

7. John is learning about combinations where he want to compute nCr (n choose r). Given input n and r computer the value of it. **Note: You can't use formula to computer nCr**

8. You are given n points in 2D plane(i.e. (x,y)) and you need to find the distance of the closest points using divide and conquer. Distance between 2 points = sqrt($(x1-x2)^2 + (y1-y2)^2$)

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