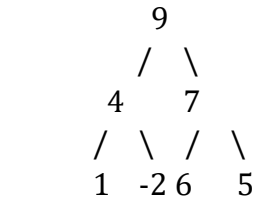
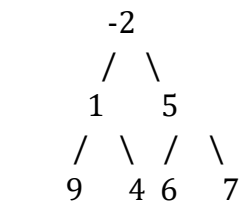
Assignment 3 (due: Nov. 30)

Note: Please upload the softcopy to Blackboard If you have any questions, please contact the leading TA (Yingli ZHOU: yinglizhou@link.cuhk.edu.cn)

1. [20 marks] Give an example that deletion (always uses successors – the left-most node of the right child -- to take the position of the deleted internal node) might make the left sub-trees deeper than the right. Try to give some solutions to avoid the unbalances.
2. [20 marks] Given an array representing a max-heap, please convert it into a min-heap. For example, given a max-heap:



It gives a min-heap like



Write code or pseudocode and also analyze the time complexity. An algorithm with O(n) is expected (otherwise you could get a maximum score of 15).

3. [20 marks] We usually define a modulo function as a hash function, for example, h(x) =x % p. Is there any benefit to using a prime number for p? If yes, explain why and in which scenario prime numbers are better.
4. [20 marks] Please draw the final hash tables when inserting a sequence of numbers [6, 12, 29, 28, 34, 11, 23, 7, 0, 33, 30, 45,10001] using the two following ways to resolve collision separately. In other words, you have to give two hash tables, one using linear probe and the other one using double hashing.

   (1) Linear probe, $h(k) = k \,\%\, 17$

   (2) Double hashing $h(k) = k \,\%\, 17$ and $h'(k) = 1 + k\%5$

Which one do you prefer? Please explain the reason (no standard answers here).

5. [20 marks] How to delete an item in a hashing table with linear probe and double hashing respectively? You do not need to write the code.