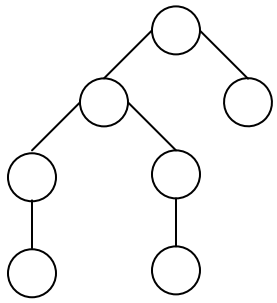
CSE 326 – Data Structures, Winter 2004
Dry assignment #3.
Due date: 2/9/04 (submit at mid-term)

1. Given a binary tree, let l_i denote the number of leaves at depth i. For example, in the following tree $l_0=0$, $l_1=1$, $l_2=0$, $l_3=2$.

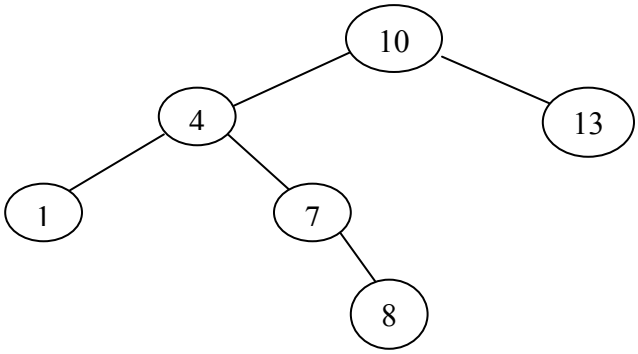


1a. Prove that $\sum_{i=0}^{h} l_i \cdot 2^{-i} \leq 1$

1b. When does $\sum_{i=0}^{h} l_i \cdot 2^{-i} = 1$?. Give a sufficient and necessary condition and explain.

2. The following is an **AVL tree** right after one operation of insert or find was performed, before the required rotations were performed.

.

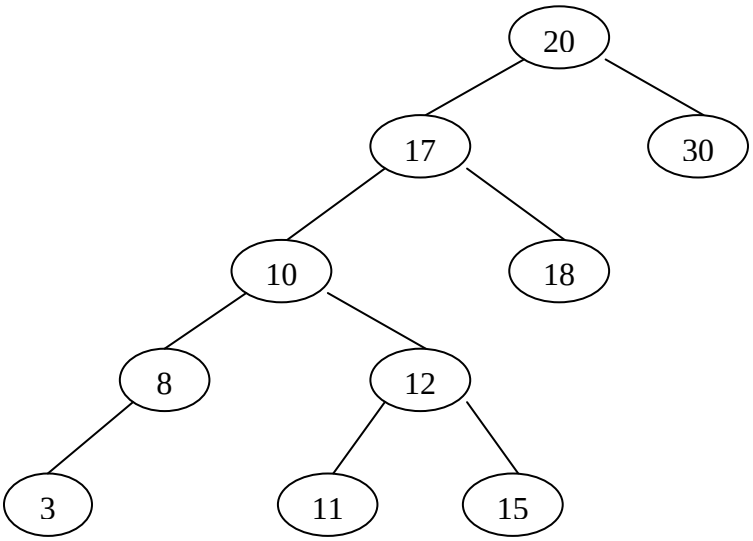


2.a For each of the following operations (separately), is it possible that this operation was performed? If your answer is positive draw the tree before the operation, if your answer is negative, justify it shortly. Note that some answers are not trivial!

1) insert(4)
2) insert(8)
3) insert(13)
4) delete(2)
5) insert(1)
6) delete(6)
7) delete(9)
8) delete(20)
9) delete(12)

2.b Which rotation should be done in order to fix the tree? Draw the tree after the rotation.

3.a Draw the resulting **splay** tree after find(12) is performed. It is OK to draw only the final state. However, you can draw one intermediate state that will be considered if your final state is not correct. If you do provide an intermediate state please mark clearly what is the final state and what is the intermediate one.



3.b Draw the resulting **2-3 tree** after insert(18), insert(1),delete(13) are performed, one after the other, on the tree on the following page. Draw the two intermediate states and the final state.