Problem 1(10pts): True or False: For each statement, choose T if the statement is correct, otherwise, choose F. *Fill all the answers in the table below.*

Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10

(1) Every full binary tree is also a complete binary tree.

(2) There are n elements inserted one by one into an initially empty binary heap. The total time complexity is $O(nlogn)$.

(3) A full binary tree with n non-leaf nodes contains $2n - 1$ total nodes.

(4) A binary tree of height $h = 0$ is perfect.

(5) We have a binary heap of n elements and wish to add n more elements into it while maintaining the heap property. It can be done in $O(n)$.

(6) In a binary max-heap containing n numbers, the smallest element can be found in time $O(n)$.

(7) If a binary tree is a min-heap, then the post-order traversal of this tree is descending.

(8) If the post-order traversal of a complete binary tree is descending, then the binary tree is a min-heap.

(9) If the pre-order traversal and post-order traversal of two binary trees are equal respectively, then the two binary trees are exactly the same.

(10)In a binary tree, every non-root node has exactly one parent.
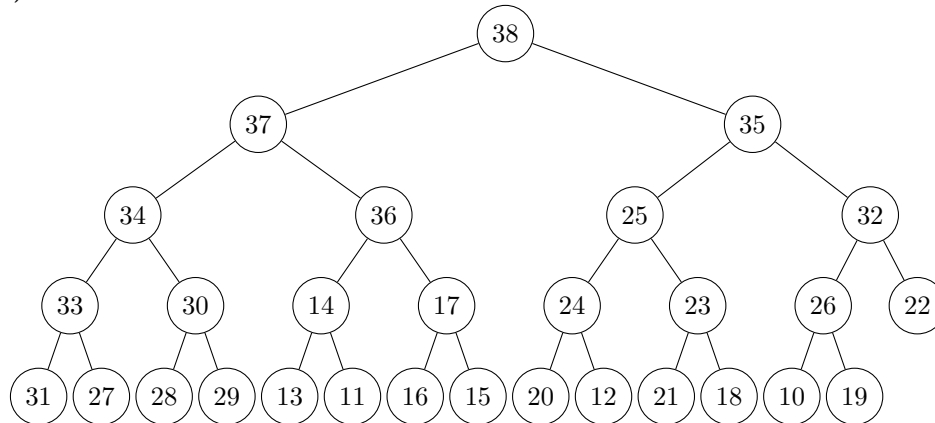
Problem 2(9pts) Fill in the blanks.

(1) The maximum number of nodes in a binary tree of height h is _____

(2) In a binary min-heap with n elements, we can only access the top of the heap. The 7th smallest element can be found in time $O(\,\rule{2cm}{0.4pt}\,)$ if duplicated elements are not allowed.

(3) In a binary min-heap with n elements, we can access the array storing the heap. The 7th smallest element can be found in time $O(\,\rule{2cm}{0.4pt}\,)$ if duplicated elements are not allowed.

(4) (3pts) The elements $32, 15, 20, 30, 12, 25, 33$ are inserted **one by one** in the given order into a **max-heap**. Please represent the final heap as an array (in-place).

0	1	2	3	4	5	6

Problem 3(6pts) Given the in-order and post-order traversal of a binary tree T are $ADHGKLMRUXTW$ and $AHDLKGUXRWTM$ respectively.

Draw the tree T and write the pre-order traversal of T.

Problem 4(6pts)

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                              38
                 37                        35
           34         36            25           32
         33   30   14    17      24    23      26    22
        31 27 28 29 13 11 16 15 20 12 21 18 10 19
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(1) (1pt) Is this heap a max-heap or a min-heap?

(2) (3pts) Suppose that you do a **pop** operation on the heap above. Write down all the elements that need to be compared in the operation.

(3) (3pts) Suppose that inserting the key x was the last operation performed in the binary heap in the figure. That is, after inserting x, the heap is shown as the figure above. Write down all possible value of x.