

# 國立臺灣師範大學 99 學年度碩士班招生考試試題

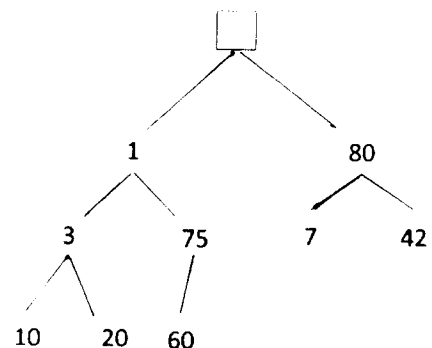
科目：軟體基礎

適用系所：資訊工程學系

注意：1.本試題共 3 頁，請依序在答案卷上作答，並標明題號，不必抄題。2.答案必須寫在指定作答區內，否則不予計分。

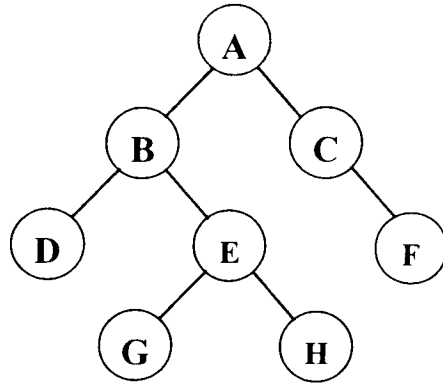
1. (5 分) What is the bound for  $6n^3 / (\log n + 1)$ :  
(a)  $O(n^3)$       (b)  $O(n^3 / \log n)$       (c)  $O(n^2)$       (d)  $O(n^2 \log n)$
2. (5 分) Which number is the pivot during the second pass of the quicksort if the numbers to be sorted are: 5, 9, 8, 7, 6, 4, 2, 3, 1?
3. (5 分) On the average how many nodes must be accessed to FIND a particular value in an UNORDERED linked list of  $n$  nodes if the value is in the list?
4. (5 分) On the average how many nodes must be accessed to FIND a particular value in an ORDERED linked list of  $n$  nodes if the value is in the list?
5. (5 分) On the average how many nodes must be accessed to ADD a node to an UNORDERED linked list of  $n$  nodes?
6. (5 分) On the average how many nodes must be accessed to ADD a node to an ORDERED linked list of  $n$  nodes?
7. (5 分) Given a binary tree  $T$ , if the pre-order traversal of  $T$  yields "1 2 3 4 5 6 7 8 9 0" and the in-order traversal of  $T$  yields "3 2 5 4 6 1 8 7 0 9". What is the post-order traversal of the tree  $T$ ?
8. (5 分) Give an empty hash table with 7 buckets (0~6) and each bucket has two slots (1 and 2). If the hash function  $h(x) = x \bmod 7$  with linear probing overflow strategy is used to insert the following sequence of numbers into the hash table: 15, 23, -12, 7, 5, 9, 0, -2, 16, 10, 12, 8. What number falls in bucket 4 slot 1?
9. (5 分) Build and show the final **min** heap tree if the following values are added to the tree in sequence: 44, 62, 31, 5, 82, 49, 16, 7.
10. (5 分) Give the SMMH tree on the right.

Please show the resulting SMMH tree if the min node is deleted from given tree.



國立臺灣師範大學 99 學年度碩士班招生考試試題

11. Given a tree shown as below, start a traversal at vertex A and resolve ties by the vertex alphabetical order. Write down the order in which the vertices are reached for the first time.



- (a) (3 分) Traverse the tree by depth-first search.
- (b) (3 分) Traverse the tree by breadth-first search.
- (c) (4 分) Now we add an edge that connects vertex C and vertex E. Do (a) and (b) again.
12. Consider the following algorithm:

<b>ALGORITHM</b> <i>Mystery</i> ( $n$ ) <b>if</b> $n = 1$ <b>return</b> 1 <b>else return</b> $Mystery(\lfloor n/2 \rfloor) + 1$
---------------------------------------------------------------------------------------------------------------------------------------

- (a) (3 分) What does this algorithm compute?
- (b) (3 分) Describe the running time requirement of the algorithm in terms of big-O notation.
- (c) (4 分) Design a non-recursive version of the algorithm. Compare its running time to that in (b).

國立臺灣師範大學 99 學年度碩士班招生考試試題

13. (10 分) Given  $n$  integers in the range of 1 to  $k$ , describe an algorithm that is used to pre-process the integers so that we can access the number of integers that fall into a range  $[a, b]$  in  $O(1)$  time. Your preprocessing algorithm should perform in  $O(n+k)$  time.
14. In the longest-common-subsequence (LCS) problem, we are given two sequences  $X = \langle x_1, x_2, \dots, x_m \rangle$  and  $Y = \langle y_1, y_2, \dots, y_n \rangle$  and want to find a maximum-length common subsequence of  $X$  and  $Y$ .
- (a) (5 分) Describe a dynamic programming algorithm to solve the LCS problem.
- (b) (5 分) Analyze the running time and space requirements of your algorithm.
- (c) (5 分) Compute the LCS for the DNA sequences  $X = \text{GCTCAGC}$  and  $Y = \text{CCATCGCG}$ . (You will not get the full credit if you write down only the answer such as TCG.)
- (d) (5 分) If we want to find only the length of the LCS, what is the space requirement? Why?