

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

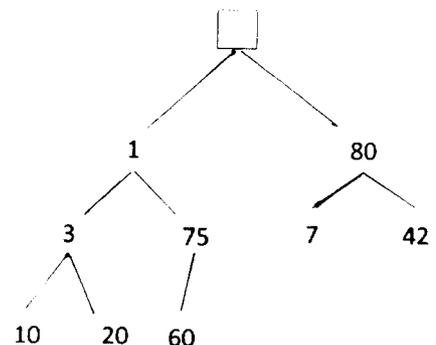
適用系所：資訊工程學系

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 $h(x) = x \text{ mod } 7$ 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.

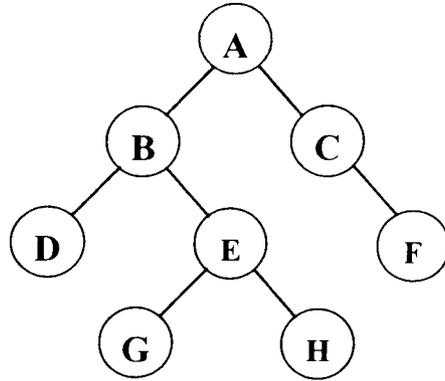
10. (5 分) Give the SMMH tree on the right.

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



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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:

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

- (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).

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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?