

編號: 256 系所: 電機工程學系丁組

科目: 資料結構

本試題是否可以使用計算機: 可使用, 不可使用 (請命題老師勾選)

Ⓐ 注意事項:

1. 本試題除各題另有限制之外, 可使用 Pseudo Code, Java, C 或 C++ 作答。
2. 請依題號序作答於答案紙。作答時可不必抄題, 但請務必將各題之完整題號(例: (1-A) 或 (2-B) 等等)標示清楚。
3. 本試題共計二頁。配分標示於各題或各小題。不可使用電子計算機。

Ⓑ 試題:

(1) Briefly explain the following terms: (本題 18 分, 各小題 3 分)

- | | |
|------------------------|--------------------------------|
| (1-A) Algorithm | (1-B) Full binary tree |
| (1-C) Red-Black tree | (1-D) Stable sorting algorithm |
| (1-E) Min-leftist tree | (1-F) Dynamic hashing |

(2) Answer **True** or **False** for each the following statements: (本題 10 分, 各小題 1 分)

- (2-A) Using doubly linked list to implement hashing table is a good choice.
- (2-B) When finding the shortest path between the node pair u and v over an undirected graph G , it is better to implement G using adjacency lists.
- (2-C) A queue can be used to implement level-order traversal of a tree.
- (2-D) Sorting 10 elements with a comparison-based sorting algorithm requires at least 9 comparisons in the worst case.
- (2-E) The height of any binary search tree is $O(\log n)$.
- (2-F) Let T_s be the minimum cost spanning tree of graph G . For any node pair u and v , the shortest path from u to v in G is the path from u to v in T_s .
- (2-G) If $f(n) = O(g(n))$ and $g(n) = O(h(n))$, the $f(n) = O(h(n))$.
- (2-H) All sorting methods for an array of n elements take time $O(n^5)$.
- (2-I) An AVL tree is a complete binary tree with balance factor less than 2..
- (2-J) Radix sorting can sort any set of integers in linear time.

(3) [Recurrences] (本題 10 分, 各小題 5 分)

- (3-A) $T(n) = 2T(n/3) + n \log n$
- (3-B) $T(n) = T(n-2) + \log n$

(4) Give your answer with explanation for the following: (本題 12 分, 各小題 3 分)

- (4-A) When implementing the quick sort algorithm, if the implementation always chooses the third element in the partition as the pivot node (the partition element), then what is the worst-case time complexity of this implementation?
- (4-B) What is the time complexity of inserting a new value into an existing heap of n elements?
- (4-C) Is the merge sort algorithm a choice of sorting algorithms better than the heap sort algorithm in any case?
- (4-D) Which searching algorithm is better assuming the following conditions:
 - (a) The number of keys is about 250000 and the length is 10 bytes;
 - (b) About 50% of the total keys have at least one duplicate;
 - (c) About 30% of the total keys have at least two duplicates.

(背面仍有題目, 請繼續作答)

編號： 256 系所：電機工程學系丁組

科目：資料結構

本試題是否可以使用計算機：可使用，不可使用（請命題老師勾選）

- (5) Suppose you are assigned the task of setting up the communication network that connects 3 cities namely A, B, C. The distances between A and B, B and C, C and A are all 1000 meters. For simplicity, assume that the cities A, B, C are situated at the same height above sea level, and the communication link between a node pair can be implemented by a straight line segment. The cost of setting up the network consists of the total cost of all communication links at the price of 100 dollars per meter and all switching equipments at the price of 6000 dollars per node. Based on above information, answer the following: (本題 20 分，各小題配分另行說明)
- (5-A) How will you set up the communication network? (本小題 5 分)
- (5-B) What is the cost of the network for your answer in (5-A)? (本小題 5 分)
- (5-C) Is it possible to set up the network with the budget limit of 200000 dollars? Explain your answer to get the marks. (本小題 10 分)
- (6) Given a directed graph $G_0 = (V, E)$ where V is the set of nodes (vertices) and E is the set of edges. Assume that $V = \{A, B, C, D, E, F, G, H\}$, $|E| = 12$ and G_0 has 3 strongly connected components. Please answer the following: (本題 30 分，各小題配分另行說明)
- (6-A) Describe a possible configuration of G_0 by drawing the graph. (本小題 5 分)
- (6-B) Based on your answer in (6-A), give the depth-first search over G_0 starting from node A. (本小題 5 分)
- (6-C) Based on your answer in (6-A), give the breadth-first search over G_0 starting from node C. (本小題 5 分)
- (6-D) Describe an algorithm to discover all the strongly connected components of a given directed graph and explain why it is correct. (本小題 10 分)
- (6-E) Give the time complexity of your algorithm described in (6-D). (本小題 5 分)