國立中山大學108學年度
碩士暨碩士專班招生考試試題

科目名稱：資料結構【資管系碩士班乙組】

—作答注意事項—

考試時間：100分鐘

- **考試開始響前不得翻閱試題，並不得書寫、劃記、作答。**請先檢查答案卷（卡）之應考證號碼、桌角號碼、應試科目是否正確，如有不同立即請監試人員處理。
- **答案卷限用藍、黑色筆(含鉛筆)書寫、繪圖或標示，**可攜帶橡皮擦、無色透明無文字墊板、尺規、修正液（帶）、手錶(未附計算器者)。每人每節限使用一份答案卷，不得另攜帶紙張，請衡酌作答。
- 答案卡請以2B鉛筆劃記，不可使用修正液（帶）塗改，未使用2B鉛筆、劃記太輕或污損致光學閱讀機無法辨識答案者，其後果由考生自行負擔。
- 答案卷（卡）應保持清潔完整，不得折疊、破壞或塗改應考證號碼及條碼，亦不得書寫考生姓名、應考證號碼或與答案無關之任何文字或符號。
- 可否使用計算機請依試題資訊內標註為準，如「可以」使用，廠牌、功能不拘，唯不得攜帶具有通訊、記憶或收發等功能或其他有礙試場安寧、考試公平之各類器材、物品（如鬧鈴、行動電話、電子字典等）入場。
- **試題及答案卷（卡）請務必繳回，未繳回者該科成績以零分計算。**
- **試題採雙面列印，考生應注意試題頁數確實作答。**
- **違規者依本校招生考試試場規則及違規處理辦法處理。**

國立中山大學108學年度碩士暨碩士專班招生考試試題

科目名稱：資料結構【資管系碩士班乙組】　　題號：442002

※本科目依簡章規定「不可以」使用計算機(問答申論題)　　共2頁第1頁

1. (10%) The complexity and stability of sorting algorithms. (2% for each sorting algorithm)

	Best Case	Average Case	Worst Case	Stable
Bubble Sort	O(n)	$O(n^2)$	$O(n^2)$	yes
Insertion Sort				
Selection Sort				
Quick Sort				
Merge Sort				
Heap Sort				

2. Consider a binary tree T whose preorder and inorder traversal sequences are as follows.
   Preorder: F,B,A,D,C,E,G,I,H.
   Inorder: A,B,C,D,E,F,G,H,I.
   A. Please show the postorder traversal sequence of T. (5%)
   B. Please show the level-order traversal sequence of T. (5%)

3. Consider a sequence of keys: 9,4,8,7,12,15,3,5,14,18 for inserting into a heap.
   A. Please draw the result after inserting all these keys into an empty min heap. (5%)
   B. Following A, please draw the result after deleting the root. (5%)

4. Consider a sequence of keys 5,19,23,13,7,17,3,2,11. Please draw the result after inserting all these keys into an empty AVL tree. (8%)

5. A complete binary tree B containing 100 nodes (with indices 1, 2, …, 100) is stored in an array. Let node *i* be in position *i* of the array (array[0] is empty).
   A. What is the height of tree B? (4%)
   B. What is the index of **the parent** of array[71]? (4%)
   C. How many nodes are leaf nodes? (4%)

6. (12%) Consider the following recursive program:

```
Public int fact(int a, int b)
{
  If (a%b == 0) return b;
  else return fact(b, a%b);
}
```

(1) What is the output given by fact(17, 3)? (4%)
(2) What is the output given by fact(3, 9) ? (4%)
(3) Explain briefly the purpose of the fact function. (4%)

試題請隨卷繳回

國立中山大學108學年度碩士暨碩士專班招生考試試題

科目名稱：資料結構【資管系碩士班乙組】　　題號：442002

※本科目依簡章規定「不可以」使用計算機(問答申論題)　　

7. (15%) For a given graph $G = (V, E)$, arbitrarily partition the nodes V into two disjoint sets, V_1 and V_2. Let E_1 be all the edges such that both nodes in the edge are in V_1, E_2 be all edges such that both nodes are in V_2, and E_3 be all edges (u, v) such that $u \in V_1$ and $v \in V_2$. If we construct a minimum spanning tree T_1 on graph (V_1, E_1) and a minimum spanning tree T_2 on (V_2, E_2), then connect T_1 and T_2 on the lowest-weighted edge connecting T_1 and T_2. Will the connected result be a minimum spanning tree of G? Proof the above method if it is correct, or give a counterexample.

8. (15%)

(a) For a directed graph $G = (V, E)$, $V = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$, $E = \{(1, 2), (1, 4), (1, 5), (2, 3), (2, 4\}$, $(2, 5), (2, 6), (3, 5), (3, 6), (4, 7), (4, 8), (5, 4), (5, 7), (5, 8), (6, 5), (6, 8), (6, 9), (8, 7), (9, 5), (9, 8)\}$, and each (u, v) indicates an arc from vertex u to vertex v. Assume the adjacency lists are in sorted order: for example, when iterating through the arcs pointing from 1, consider the arc 1→2 before 1→4, 1→5. Run *Depth-First Search*, starting at vertex 1. Complete the list of vertices in the order they are first discovered by DFS: 1 2 3 _ _ _ _ _ _. (5%)

(b) For the same graph G, run *Breadth-First Search*, starting at vertex 1. Complete the list of vertices in the order in which they are enqueued: 1 2 4 5 _ _ _ _ _. (5%)

(c) Consider two vertices m and n that are simultaneously on the function-call stack at some point during the execution of depth-first search from vertex s in a digraph. Which of the following must be true? (5%)

(I) There is both a directed path from s to m and a directed path from s to n.

(II) If there is no directed path from m to n, then there is a directed path from n to m.

(III) There is both a directed path from m to n and a directed path from n to m.

9. (8%) For each of the following scenarios, give the "best" data structure or a combination of data structures, for example, an unsorted array, linked list, doubly linked list, circular linked list, stack, or queue. In each case, justify your answer briefly.

(a) Suppose that a shop decided that customers who come first will be served first. (2%)

(b) A list must be maintained so that any element can be accessed randomly. (2%)

(c) A program needs to remember operations it performed in opposite order. (2%)

(d) The size of a file is unknown. The entries need to be entered as they come in. Entries must be deleted when they are no longer needed. It is important that structure has flexible memory management. (2%)