國立中正大學
112 學年度碩士班招生考試
試 題

［第 2 節］

科目名稱	資料結構
系所組別	資訊管理學系-乙組

－作答注意事項－

※作答前請先核對「試題」、「試卷」與「准考證」之系所組別、科目名稱是否相符。

1. 預備鈴響時即可入場,但至考試開始鈴響前,不得翻閱試題,並不得書寫、畫記、作答。

2. 考試開始鈴響時,即可開始作答;考試結束鈴響畢,應即停止作答。

3. 入場後於考試開始 40 分鐘內不得離場。

4. 全部答題均須在試卷(答案卷)作答區內完成。

5. 試卷作答限用藍色或黑色筆(含鉛筆)書寫。

6. 試題須隨試卷繳還。

1. (10 points) Give tight asymptotic bounds for each of the following recurrences.

(1) $T(n) = 2T\left(\frac{n}{2}\right) + n$

(2) $T(n) = T\left(\frac{n}{4}\right) + T\left(\frac{3n}{4}\right) + n$

(3) $T(n) = T\left(\frac{n}{5}\right) + T\left(\frac{3n}{4}\right) + n$

(4) $T(n) = 2T(\sqrt{n}) + \log n$

(5) $T(n) = 2T\left(\frac{n}{2}\right) + \frac{n}{\log n}$

2. (8 points) Given a 3-D integer array A[3][5][7]. The address of the first element A[0][0][0] is 1000, and size of an integer is 4 bytes. Please find the possible addresses of A[1][2][4] (for both row-major and column-major).

3. (8 points) A postfix expression is given as "abc/de -- +/fg +×". The values a, b, c, d, e, f, g are 8, 4, 2, 3, 1, 2, 1, respectively.
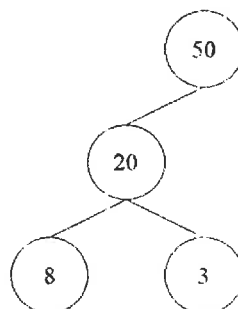(1) Convert the expression to an infix expression.
(2) Evaluate the expression to get an output.

4. (10 points) Given the following recurrence function. Please calculate f(2) and f(4).

```
int f (int x) {
    if (x == 1)
        return 0;
    else
        return x * f(x - 1) + x * x * x;
}
```

5. (5 points) Please explain why the following binary tree is not a max-heap.

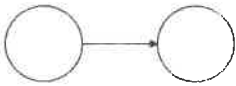6. (10 points) (True or False) Given the binary tree where the outcome of inorder traversal is BADECF and

postorder traversal is BDEFCA. Please answer the following questions.
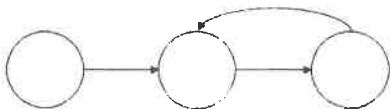
(1) Whether A is the root.

(2) Whether D is E's parent.

(3) Whether E is a leaf node.

(4) Whether C has 2 children.

(5) Whether F is E's child.

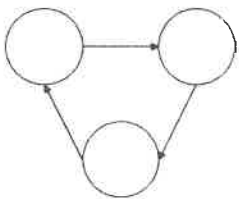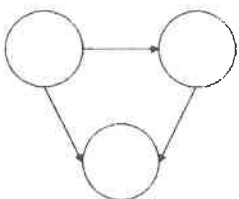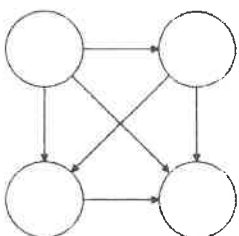7. (10 points) Which of the following digraphs is (are) strongly connected?

(1)

(2)

(3)

(4)

(5)

8. (4 points) Please illustrate the update formula of Floyd-Warshall algorithm, if $d_{ij}^{(k)}$ denotes the weight of a shortest path from vertex i to vertex j for which all intermediate vertices are in the set $\{1, 2, \cdots, k\}$.

9. (9 points) Given the following list, show the steps of locating the target '21' by binary search.
1 3 5 7 9 11 13 15 17 19 21 23
Show the top, bottom, and middle elements in each step.

10. (10 points) What is an optimal Huffman code for the following elements with their frequencies?
a: 15, b: 20, c: 25, d: 10, e: 30

11. (8 points) Construct an AVL tree by inserting 2, 3, 5, 1, 4, 6, 7, and 8 successively from a null tree.

12. (8 points) Given a matrix-chain product $M1 \cdot M2 \cdot M3 \cdot M4$. Please find the optimal parenthesization of the matrix-chain product where the dimensions are: $M1: 25 \times 30$, $M2: 30 \times 15$, $M3: 15 \times 40$, and $M4: 40 \times 20$, respectively.