

# 國立中正大學

## 113 學年度碩士班招生考試

# 試題

[第 2 節]

科目名稱	軟體設計
系所組別	資訊工程學系-甲組

### —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。

# 國立中正大學 113 學年度碩士班招生考試試題

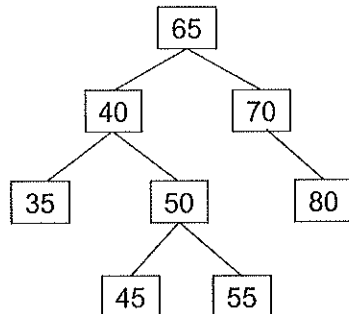
科目名稱：軟體設計

本科目共 7 頁 第 1 頁

系所組別：資訊工程學系-甲組

以下第1題 (Q1) 到第9題 (Q9), 請在第一頁的選擇題作答區作答, 否則不予計分。

The following is an AVL tree, which is implemented/represented as an array. Please answer the following questions from Q1 to Q3.



1. (3%) After inserting a new node with the key "43" into the AVL tree, what does the array representation of the AVL tree look like? Please note that a "-" represents a null value in the array.
  - A. (65, 40, 70, 35, 50, -, 80, -, -, 45, 55, -, 43)
  - B. (65, 40, 70, 35, 45, -, 80, -, -, 43, 50, -, -, 55)
  - C. (65, 45, 70, 40, 50, -, 80, 35, 43, -, 55)
  - D. (65, 45, 70, 35, 50, -, -, 80, 40, 43, -, 55)
  - E. None of the above
  
2. (3%) Perform the post-order traversal on the AVL tree constructed for the first question (Q1) after the insertion. What is the sequence of nodes in the post-order traversal of the AVL tree?
  - A. 35→43→45→55→50→40→80→70→65
  - B. 35→43→55→50→45→40→80→70→65
  - C. 35→43→40→55→50→45→80→70→65
  - D. 65→40→35→50→45→43→55→70→80
  - E. None of the above
  
3. (3%) Remove the node with the key "65" from the AVL tree constructed for the first question (Q1) after the insertion. What does the array representation of the AVL tree look like?
  - A. (35, 45, 70, 40, 50, -, 80, -, 43, -, 55)
  - B. (55, 45, 70, 40, 50, -, 80, 43, 35)
  - C. (45, 40, 70, 35, 43, 50, 80, -, -, -, -, 55)
  - D. (45, 40, 70, 55, 43, 50, 80, 35)
  - E. None of the above

Given a fully parenthesized arithmetic expression provided below, please answer the following questions from Q4 to Q5.

$$B - E / (A - D) + E + C * D - A * B$$

# 國立中正大學 113 學年度碩士班招生考試試題

科目名稱：軟體設計

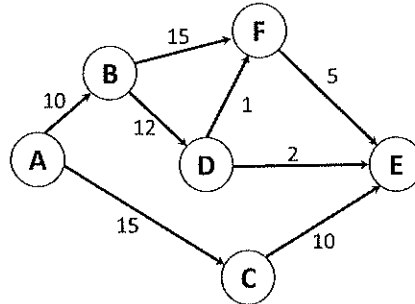
本科目共 7 頁 第 2 頁

系所組別：資訊工程學系-甲組

4. (3%) Please find the expression tree and answer the level-order traversal of the expression tree. When operators have the same precedence, please evaluate them sequentially in the order presented within the expression. For instance, in the expression "a + b + c," calculate "a + b" first before combining the result with "c."
- A.  $- + + - * A B B / E * E - C D A D$   
 B.  $+ - + - * E * B / A B C D E - A D$   
 C.  $- + * - + A B B / E * E - C D A D$   
 D.  $- + - + * A B / B E * E - C D A D$   
 E. None of the above
5. (3%) What is the expression in prefix form?
- A.  $+ - - B / E - A D * A B + E * C D$   
 B.  $- B E A D / - A B * - E C D * + +$   
 C.  $- + - B / E - A D + E * C D * A B$   
 D.  $+ - - / B E - A * D A B + E * C D$   
 E. None of the above
6. (3%) Given the following failure function in the KMP matching algorithm and a string "AAABAAAABAAA" with 12 characters, what are the values of the failure function for the entire string?
- $$f(j) = \begin{cases} \text{largest } k < j, \text{ such that } p_0 p_1 \dots p_k = p_{j-k} p_{j-k+1} \dots p_j, & \text{if such a } k \geq 0 \text{ exists} \\ -1, & \text{otherwise} \end{cases}$$
- A. -1, 0, 1, -1, 0, 1, 2, 0, -1, 0, 1, 2  
 B. -1, 0, 1, 0, 1, 2, 2, 2, 3, 4, 5, 6  
 C. -1, 0, 1, -1, 0, 1, 2, 2, 3, 4, 5, 6  
 D. -1, -1, 0, -1, -1, 0, 1, 2, 3, 4, 5, 6  
 E. None of the above
7. (3%) Determine the binary tree using the provided in-order and post-order traversals. What is the resulting pre-order traversal of the constructed binary tree?
- In-order : A, B, G, E, D, I, J, F, H, C  
 Post-order : G, E, J, I, H, F, D, C, B, A
- A. A, B, C, D, E, F, G, I, H, J  
 B. A, B, G, E, D, C, I, J, F, H  
 C. A, B, C, D, E, G, F, I, J, H  
 D. A, B, C, D, E, F, G, I, J, H  
 E. None of the above

Given the directed graph below, please answer the following questions from Q8 to Q9.

8. (2%) Please use the cost on each edge as the weight and perform Dijkstra's algorithm starting from vertex A. What is the order in which the vertices are selected by Dijkstra's algorithm?



- A. A→B→D→F→E→C  
 B. A→C→E→B→D→F  
 C. A→B→D→E→C→F  
 D. A→B→C→D→F→E  
 E. None of the above
9. (2%) What is the topological ordering of the graph? You must choose the node with the label that has the smallest alphabetical order first, when finding the topological order.
- A. A→B→D→F→E→C  
 B. A→C→E→B→D→F  
 C. A→B→D→E→C→F  
 D. A→B→C→D→F→E  
 E. None of the above
10. (10%) 請回答以下 C 語言程式碼執行後在螢幕上顯示之結果，共兩項輸出 (各 5%)。

```

int main() {
    int num = 250;
    printf("X\n", num);
    printf("%.2f\n", (float)num);
    return 0;
}
  
```

# 國立中正大學 113 學年度碩士班招生考試試題

科目名稱：軟體設計

本科目共 7 頁 第 4 頁

系所組別：資訊工程學系-甲組

11. (10%) 請回答以下 C 語言程式碼執行後在螢幕上顯示之結果。

```
int main() {
    int arr[] = {10, 20, 30, 40, 50};
    int *ptr;
    int sum = 0;
    int i;

    for (i = 0; i < 5; i++) {
        ptr = &arr[i];
        if (i%2==0)
            sum += *ptr;
    }
    printf("%d", sum);
}
```

12. (5%) 請回答以下 C 語言程式碼執行後在螢幕上顯示之結果。

```
void fun1(char *str) {
    char *end = str;
    char temp;
    if (str) {
        while (*end) {
            ++end;
        }
        --end;
        while (str < end) {
            temp = *str;
            *str++ = *end;
            *end-- = temp;
        }
    }
}

int main() {
    char str[] = "13579";
    fun1(str);
    int number = atoi(str);
    printf("%d\n", number%10);
    return 0;
}
```

# 國立中正大學 113 學年度碩士班招生考試試題

科目名稱：軟體設計

本科目共 7 頁 第 5 頁

系所組別：資訊工程學系-甲組

13. (5%) Write a C++ program to find the **largest factor** of a number (the user supplies the number). The program is partially completed for you. Please only fill the missing parts. You should **not** introduce any new blocks.

number = 24, largest factor = 12

```
#include <iostream>
using namespace std;

int main () {
    int number;
    cout << "Enter an integer that is larger than 1: ";
    _____; // line (A) (2%)
    if ( number <= 1 ) return -1;

    int factor = number - 1;
    while ( _____ ) factor--; // line (B) (3%)
    cout << "The largest factor is: " << factor << endl;
    return 0; }
```

14. (20%) Find the best match of each term with the descriptions by writing a letter from 1 to 10 in each of the blanks.

A. function declaration _____	B. if-else statement _____	C. break statement _____
D. pass by value _____	E. local variable _____	F. void _____
G. float _____	H. cast _____	I. promotion _____
J. overloaded function _____		

1. A variable declared inside a function
2. The default method in C++ of passing arguments to parameters
3. The type in C++ of the constant 5.0F
4. The type in C++ which has no values
5. A variable inside of a class definitionIf  $n$  and  $m$  are of type int, the programmer can insert this to request the int in  $n$  to be converted to an equivalent value of type double before the division operation occurs as in this expression:  $(\text{double}) n / m$
6. A specification of a function name, its list of parameter types, and its return type
7. Selects one of two choices of statements to execute depending on a condition
8. Causes execution to leave an 'if', 'switch', or a loop and continue at the next statement after the one that was left

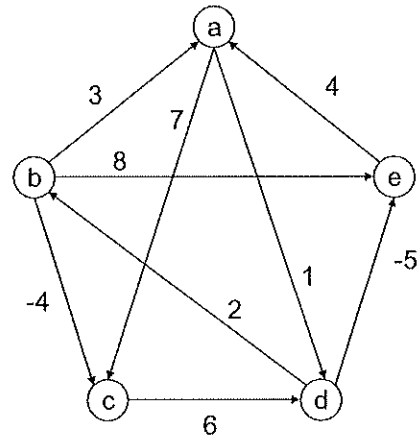
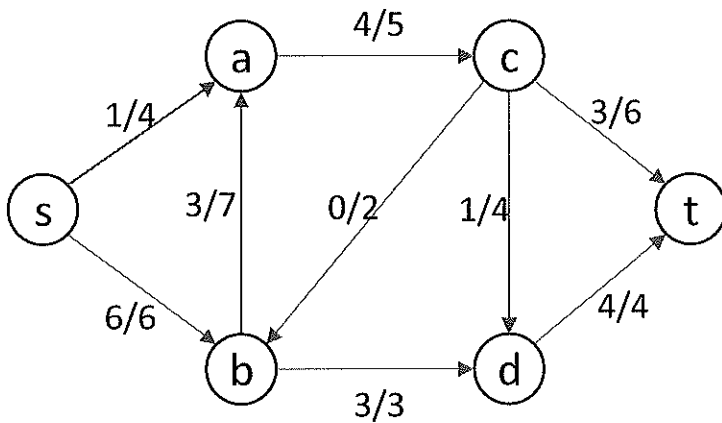
國立中正大學 113 學年度碩士班招生考試試題

科目名稱：軟體設計

本科目共 7 頁 第 6 頁

系所組別：資訊工程學系-甲組

9. A function name that has more than one definition
10. Conversion of char to int or float to double
15. (2%) The solution of the recurrence  $T(n) = 3T\left(\frac{n}{5}\right) + n$  is (a)  $n^{3/5}$ ; (b)  $n$ ; (c)  $n^{5/3}$ ; (d)  $n^{\log_5 3}$ ; (e)  $n \log n$ .
16. (2%) The solution of the recurrence  $T(n) = 4T\left(\frac{n}{4}\right) + n \log n$  is (a)  $n^2$ ; (b)  $n \log n$ ; (c)  $n \log^2 n$ ; (d)  $n \log^{(2)} n$ ; (e)  $n \log n^2$ .
17. (2%) The solution of the recurrence  $T(n) = 4T\left(\frac{n}{2}\right) + n^3$  is (a)  $n^{1/2}$ ; (b)  $n$ ; (c)  $n^2$ ; (d)  $n^3$ ; (e)  $n^2 \log n$ .
18. (2%) Determine if the following statement is true or false: "There is no polynomial time algorithm that can find the value of an s-t minimum cut in a directed graph".
19. (2%) Determine if the following statement is true or false: "Both the subroutines 'Merge' in Merge sort and 'Partition' in Quicksort are linear time operations".
20. (2%) Determine if the following statement is true or false: "Find the median of  $n$  elements takes  $\Omega(n \log n)$  time for any algorithms working in the comparison-based model".
21. (2%) Determine if the following statement is true or false: "Given  $T$  is a minimum spanning tree of a graph  $G$ , for any pair of vertices  $(s, t)$ , the shortest path from  $s$  to  $t$  in  $G$  is the path from  $s$  to  $t$  in  $T$ ".
22. (3%) The following graph (graph on left-hand side with 6 vertices) describes a flow assignment in a flow network. The notation  $x/y$  describes  $x$  units of flow in an edge with capacity  $y$ . Determine if it reaches the maximum flow. If your answer is yes, demonstrate how to derive such flow assignment. If your answer is no, then calculate its maximum flow.



23. (8%) Given the above graph (graph on right-hand side with 5 vertices), determine if each of the following algorithm options (a-h) can be used to find the shortest paths of user-specified pair/pairs of vertices: (a) Kruskal's algorithm; (b) Dijkstra's algorithm; (c) Ford-Fulkerson Algorithm; (d) Johnson's algorithm; (e) Bellman-Ford algorithm; (f) Jarvis's march algorithm; (g) Floyd-Warshall algorithm; (h) Huffman algorithm.