國立臺灣師範大學108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 6 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，否則依規定扣分。

1. 選擇題(1.1~1.8 單選, 1.9~1.12 複選, 共 28 分, 請將答案寫在答案紙上並標明題目編號)

※提醒：選擇題請於「作答區」作答，勿答於「評分欄」以免扣分。

1.1 Depth First Search is equivalent to which of the traversal in the Binary Trees? (2 分)

A) Pre-order Traversal
B) Post-order Traversal
C) Level-order Traversal
D) In-order Traversal

1.2 Given an infix expression: 4 + 3*(6*3-12). Suppose a stack is used to convert the expression from infix to postfix notation. What is the maximum number of symbols that will appear on the stack at one time during the conversion of this expression? (2 分)

A) 1
B) 2
C) 3
D) 4

1.3 Given the following adjacency matrix of a graph(G) determine the number of components in the G. (2 分)

```
[0 1 1 0 0 0],
[1 0 1 0 0 0],
[1 1 0 0 0 0],
[0 0 0 0 1 0],
[0 0 0 1 0 0],
[0 0 0 0 0 0].
```

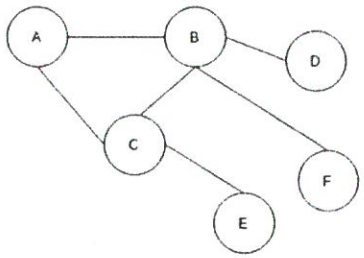
A) 1
B) 2
C) 3
D) 4

1.4 When performing a Breadth First Search on a graph, which of the following data structure is used? (2 分)

A) Stack
B) Queue
C) Linked list
D) None of the mentioned

1.5 In the given graph which edge should be removed to make it become a Bipartite Graph? (2 分)

A) A-C
B) B-E
C) C-D
D) D-E



1.6 Give the following list of numbers: 4, 8, 7, 5, 6, 3, 9 which are stored in array T[1], T[2], …, T[7]. In the heap sort algorithm, you have to perform an adjust procedure to construct a maximum heap. What is the number in tree[3] of the maximum heap? (2 分)

A) 8
B) 7
C) 4
D) 3

1.7 According to the result of the constructed maximum heap in the previous question, T[1] and T[7] is interchanged and followed the readjust procedure to recreate a max heap for tree[1] to tree[6]. What will be the position of number 4 in the array after performing the readjust procedure? (2 分)

A) T[3]
B) T[4]
C) T[5]
D) T[6]

1.8 Let T be a binary tree with only leaf nodes and degree-2 nodes. Assume that the number of the leaf nodes is 101. Then, what is the number of the degree-2 nodes? (2 分)

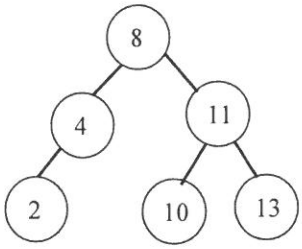
A) 101
B) 100
C) 51
D) 50

1.9 Consider an unsorted singly linked list which has its representation with a head pointer only. Which of the following operation can be implemented in O(1) time? (3 分)

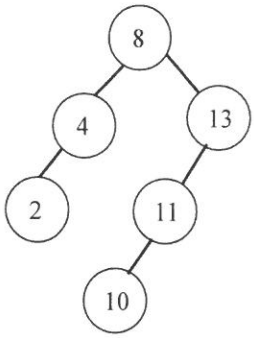
A) Insertion at the front of the linked list
B) Insertion at the end of the linked list
C) Deletion of the front node of the linked list
D) Deletion of the last node of the linked list

1.10 Which of the below diagram satisfies the AVL tree property? (3 分)

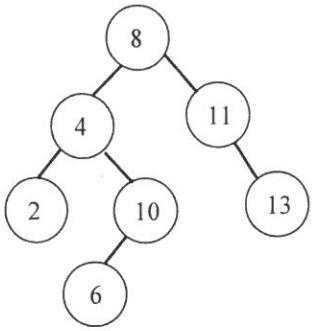
A)



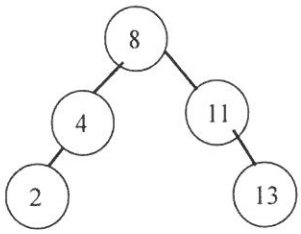
B)



C)



D)



1.11 Suppose we are sorting an array of eight integers using the quicksort algorithm, and we have just finished the first partitioning with the array looking like this: (3 分)

3 5 1 6 8 11 9 10

Which number could be the pilot of the first partitioning?

A) 6
B) 8
C) 9
D) 11

1.12 Use an array representation of a complete-binary tree? What are the indices of the children of a node stored in the array with index w? (3 分)

A) w/2 B) w+1 C) w×2 D) w×2 + 1 E) (w+1)/2 F) w×2 – 1

2. 簡答題 (共 15 分)

(a) Please complete the following function to prints all nodes of linked list in reverse order for a given linked list with first node as head? (5 分)

It is known that the node has two fields: ***data*** and ***next***, where ***data*** stores the content of the node and ***next*** stores the pointer of the next node in the linked list

```
void fun1(struct node* head)
{
```

```
    if(head == NULL)
       return;
    _________(1)_____________;
    printf("%d  ", head->data);
}
```

(b) Please complete the following code snippet to perform a matrix multiplication.(a and b are the two given matrices, and c is the resultant marix) (5 分)

```
for (int i = 0; i < n; i++)
{
    for (int j = 0; j < n; j++)
    {
        for (int k = 0; k < n; k++)
        {
            c[i][j] =_________(1)___________;
        }
    }
}
```

(c) Please complete the following code snippet to perform an **iterative binary search**. (5 分)

```
public static int iterative(int arr[], int key)
{       int low = 0;
        int mid = 0;
        int high = arr.length-1;
        while(low <= high)
        {       mid = low + (high - low)/2;
                if(arr[mid] == key)
                {return mid;
                }
                else if(arr[mid] < key)
                {  ___________(1)___________;
                }
                else
                { ___________(2)___________;
                }
        }
        return -1;
}
```

3. There is an undirected graph G. The adjacency matrix of G is shown below. (共 7 分)

(a) Please find the articulation points of G. (3 分)

(b) Please show the result of DFS and BFS traversal starting from 0 on graph G. When there are more than one connected nodes, starts visiting from unvisited one

with the smallest number. (4 分)

	0	1	2	3	4	5
0	0	0	0	1	1	0
1	0	0	1	0	0	0
2	0	1	0	1	0	0
3	1	0	1	0	1	0
4	1	0	0	1	0	1
5	0	0	0	0	1	0

4. Given two sequences, X of length m and Y of length n, the longest common subsequence problem is to find a maximum-length common subsequence of X and Y. For example, the longest common subsequence of the strings 'ABABCA' and 'ABCBA' is string 'ABCA' of length 4.

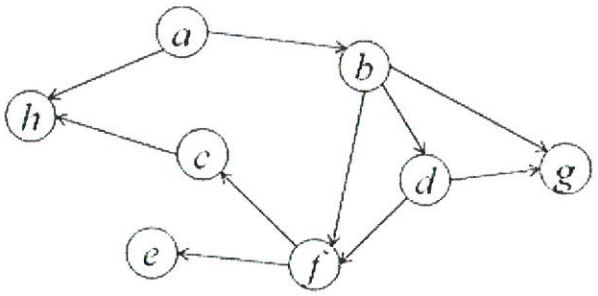
   (a) Describe a brute-force approach for solving this problem. Analyze its time complexity. (10 分)

   (b) Describe a dynamic programming approach for solving this problem: Write down the recurrence and analyze its time complexity. (10 分)

   (c) Continuing above question, please fill the table using the recurrence you derive in (b) for finding the longest common subsequence of 'ABABCA' and 'ABCBA'. (5 分)

	A B A B C A
A	
B	
C	
B	
A	

5. Please answer the questions regarding graph traversal.



(a) Traverse the above graph by using depth-first search (DFS). When you traverse the neighbors, process them in alphabetical order. Start from vertex *a*. (5 分)

(b) Solve the topological sort problem for the above graph. If there is more than one solution, write down one of them. (5 分)

(c) Describe the case where topological sorting does not have a solution. (5 分)

6. Professor Chen discovers a new problem X, which can be verified in polynomial time. He finds two other problems: Y and Z, where Y is a P problem and Z is a NP-complete problem. Given four possible actions described below, please answer the following two questions.

i. Show X is polynomial-time reducible to Y. ($X \leq_P Y$)

ii. Show Y is polynomial-time reducible to X. ($Y \leq_P X$)

iii. Show X is polynomial-time reducible to Z. ($X \leq_P Z$)

iv. Show Z is polynomial-time reducible to X. ($Z \leq_P X$)

(a) If Prof. Chen would like to show that problem X is a NP-complete problem, which action should he take? Why? (5 分)

(b) If Prof. Chen would like to show that problem X is computational tractable, which action should he take? Why? (5 分)