

1. Please describe the differences between Microsoft .NET Framework and Sun Java architecture with the following respects, 1) programming maintenance and management, 2) software and hardware compatibility, 3) executing performance. 4) object code portability (20%)
2. What is the naming space in Object Oriented Language? (10%) Please describe its hierarchical architecture with JAVA language. (10%)
3. Write one program with at least one inner class and describe the characteristics of the inner class (20%)
4. Please describe the differences between two mechanisms, inheritance and composition, give one example to show their differences (20%)
5. Try to explain what the method loading is and give one example to show its characteristics (20%)

1. (10%) 有一顆 2-3 tree, 一開始是空的,

(a) 依序 insert

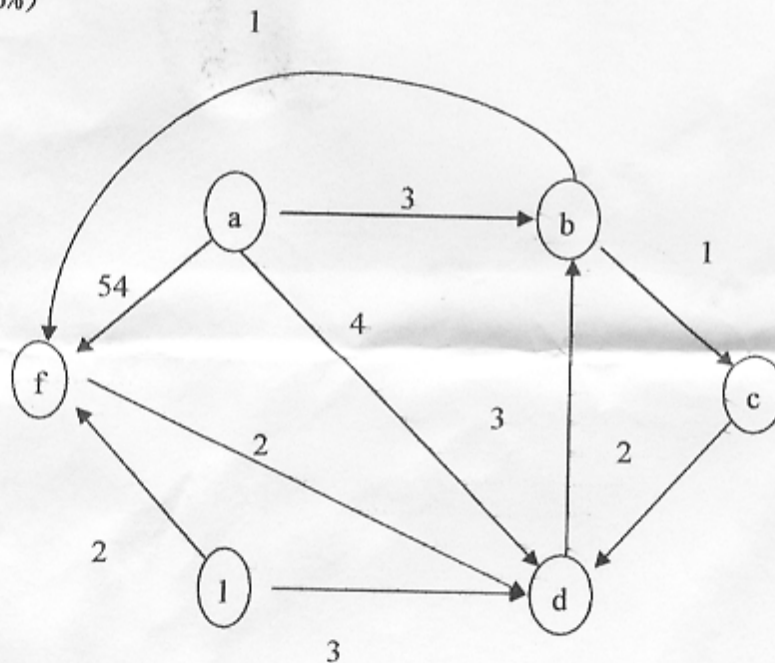
5, 2, 7, 0, 3, 4, 6, 1, 8, 9

之後, 繪圖顯示該樹

(b) 接著, delete 3, 之後

繪圖顯示該樹.

2. (6%)



上圖中, 邊 (arc) 之數字代表成本 (cost).

(一) 請用相鄰矩陣 (adjacency matrix) 表示此圖之成本

(二) 請用相鄰串列 (adjacency list) 表示此圖之成本

3. (7%) 假設我們用五個桶 (buckets) 的雜湊表 (hashing table), 每個桶可放一筆資料, 而雜湊函數 (hash function) h 為:

$$h(i) = i \bmod 5$$

使用線性探測 (linear probing) 來解決碰撞 (collision)。假設一開始雜湊表

是空的，依序放入 (insert) 23, 48, 35, 4, 10 五筆資料。請繪圖顯示最後雜湊表之內容。

4. (15%) 資工系全系課程可視為一個集合，裏面每個 element 即每門課，含：
(1) courseNo (課號)，(2) courseName (名稱)，(3) Description (簡介)等，請分別用下面三種資料結構來 represent 該集合，並寫出一個 operation，用 Java 寫出答案。

- (a) a linked list
- (b) a hash table
- (c) a binary search tree

5. (12%) 下面有 16 個數

22, 36, 6, 79, 26, 45, 75, 13, 31, 62, 27, 76, 33, 16, 62, 47

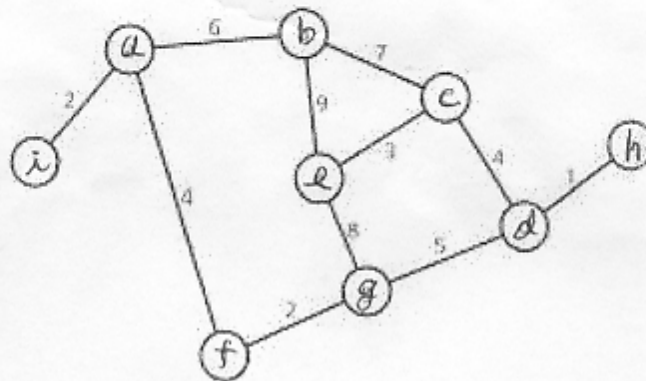
請分別用四種演算法進行排序：

- (a) quick sort
- (b) insertion sort
- (c) heap sort
- (d) radix sort, 視每個數為 range 0-9 的兩個數字(digits)

請繪簡圖表示之。

6. (30%) Consider the graph below. (a) Please design a data structure to implement the depth-first search. Then, please show the contents of the data structure and the traversal visits the vertices in the order beginning at vertex "a" using depth-first search. (b) Please design a data structure to implement the bread-first search and then show the contents of the data structure and the traversal visits the vertices in the order beginning at vertex "a" using breadth-first search. (c) Write a program using Prim's algorithm to find a minimum spanning tree of the graph beginning at vertex "a".

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7. (12%) Please implement the stack by using an **array**.

```
#define MAX_STACK 100;
typedef int ITEM_TYPE;
typedef struct stack_type {
    ITEM_TYPE item[MAX_STACK];
    int top;
} STACK_TYPE;

void create_stack (STACK_TYPE *stack);(2%)
void destory_stack (STACK_TYPE *stack);(2%)
BOOLEAN empty_stack (STACK_TYPE *stack);(2%)
BOOLEAN full_stack (STACK_TYPE *stack);(2%)
void push (STACK_TYPE *stack, ITEM_TYPE new_item);(2%)
void pop (STACK_TYPE *stack, ITEM_TYPE *old_item);(2%)
```

8. (8%) Explain the following terms:

- (a) ADT
- (b) Data type
- (c) Array
- (d) Data structures

- Q1: (a) What is the *8's complement* of an octal number 7654321 ?
 (b) What is the *7's complement* of an octal number 7654321 ?
 (c) Convert the octal number 7654321 to hexadecimal number.

(15%)

- Q2: Use K-map method to simplify the following Boolean function in (a) sum of products and (b) product of sums.

$$F(w,x,y,z) = x'y' + x'z' + w'xy'z$$

$$d(w,x,y,z) = \Sigma(4,6,14)$$

(20%)

- Q3: (a) List the truth table of a function $F(A,B,C,D) = A \oplus B \oplus C \oplus D$ where the symbol \oplus denotes the Exclusive-OR function.

- (b) List the truth table of a function $F(A,B,C,D) = A \odot B \odot C \odot D$ where the symbol \odot denotes the Equivalence function.

(10%)

- Q4: (a) Use a *decoder* to implement the following Boolean function:

$$F(w,x,y,z) = \Sigma(0,1,2,3,4,11,12,13,14,15)$$

- (b) Use a *multiplexer* to implement the same Boolean function

(20%)

- Q5: Given you the flow table (after state reduction) as shown below.

- (a) Assign output values to the dashes associated with the unstable states.

- (b) Design the asynchronous sequential circuit without using SR latch.

- (c) Design the asynchronous sequential circuit using SR latch.

	x_1x_2			
	00	01	11	10
a	a, 0	a, 1	a, 0	b, -
b	a, -	a, -	b, 1	b, 1

(35%)

科目： 離 散 數 學 第一頁 共 頁

1. (25 Points)

The Towers of Hanoi is a popular puzzle. It consists of three pegs and a number of discs of differing diameters, each with a hole in the center. The discs initially sit on one of the pegs in order of decreasing diameter (smallest at top, largest at bottom, thus forming a triangular tower. The object is to move the tower to one of the other pegs by transferring the discs to any peg one at a time in such a way that no disc is ever placed upon a smaller one.

(a) Solve the puzzle when there are $n = 2$ discs and show your moves by completing a little table like that below. [The pegs are labeled A, B, C, and we have used an asterisk (*) to denote an empty peg. The disks are numbered in order of increasing size, thus disk 1 is the smallest.]

	A	B	C
Initial position	1, 2	*	*
Move 1			
Move 2			

(b) Give a recurrence relation for a_n , the number of moves required to transfer n discs from one peg to another.

(c) Find an explicit formula for a_n

2. (25 Points)

If \sim denote an equivalence relation on a set A , the equivalence class of an element $a \in A$ is the set $\bar{a} = \{x \in A \mid x \sim a\}$.

Let $A = \{1, 2, 3, 4, 5, 6, 7, 8, 9\}$. For $a, b \in A$, define $a \sim b$ if and only if $a*b$ is a perfect square (that is, the square of an integer).

(a) What are the ordered pairs in this relation?

(b) For each $a \in A$, find $\bar{a} = \{x \in A \mid x \sim a\}$

3. (25 Points)

(A) Define $f: \mathbb{Z} \rightarrow \mathbb{Z}$ by $f(x) = 3x^3 - x$. Is f onto? Is f one-to-one?

(B) (A) Define $f: \mathbb{R} \rightarrow \mathbb{R}$ by $f(x) = 3x^3 - x$. Is f onto? Is f one-to-one?

4. (25 Points)

Carling has three weeks to prepare for a tennis tournament. She decides to play at least one set every day but not more than 36 sets in all. Show that there is a period of consecutive days during which she will play exactly 21 sets.