國立彰化師範大學113學年度碩士班招生考試試題

系所：數學系(選考丁)、統計資訊研究所(選考丁)　　科目：資料結構

☆☆請在答案紙上作答☆☆　　

一、(50%)請寫出下列程式碼的執行結果(共 5 題，每題 10 分)：

(1)

```
#include <stdio.h>
int main() {
    int a = 10;
    printf("%3d", a);
    while (a > 1) {
        if (a % 2 == 0)
            a /= 2;
        else
            a = 3 * a + 1;
        printf("%3d", a);
    }
    return 0;
}
```

(2)

```
#include <stdio.h>
#define N 9
int f(int a) {
    if (a == 1)
        return a;
    else {
        int b = a - 1;
        while (a % b != 0)
            b--;
        if (b == 1)
            return a;
        else
            return b;
    }
}

int main() {
    int a[N] = {5, 1, 8, 2, 9, 7, 3, 4, 6};
    for (int i = 0; i < N; i++) {
        printf("%3d", f(a[i]));
```

```
    }
    return 0;
}
```

(3)

```
#include <stdio.h>
void f (int *x, int *y);
int main() {
    int a = 10, b = 20;
    printf("%3d %3d\n", a, b);
    f(&a, &b);
    printf("%3d %3d\n", a, b);
    return 0;
}
void f(int *a, int *b) {
    int temp = -(*a);
    *a = -(*b);
    *b = temp;
}
```

(4)

```
#include <stdio.h>
#define N 9
int main() {
    int a[N] = {5, 1, 8, 2, 9, 7, 3, 4, 6};
    int flag = 1;
    while (flag){
        flag = 0;
        for (int i = 0; i < N - 1; i++){
            if (a[i+1] < a[i]){
                int temp = a[i+1];
                a[i+1] = a[i];
                a[i] = temp;
                flag = 1;
            }
            printf("%3d", a[i]);
        }
        printf("%3d\n", a[N-1]);
```

```
    }
    return 0;
}
```

(5)

```
#include <stdio.h>
#define N 3
int main() {
    int a[N][N] = {0};
    int i = 0, j = (N+1) / 2;
    for(int k = 1; k <= N * N; k++) {
        if((k % N) == 1)
            i++;
        else {
            i--;
            j++;
        }
        if(i == 0)
            i = N;
        if(j > N)
            j = 1;
        a[i - 1][j - 1] = k;
    }
    for(int m = 0; m < N; m++) {
        for(int n = 0; n < N; n++)
            printf("%3d ", a[m][n]);
    }
    return 0;
}
```

二、Given the input list (29, 48, 96, 58, 24), please

(a) Use insertion sort algorithm, manually sort the following list and show your work in each pass. **(4%)**

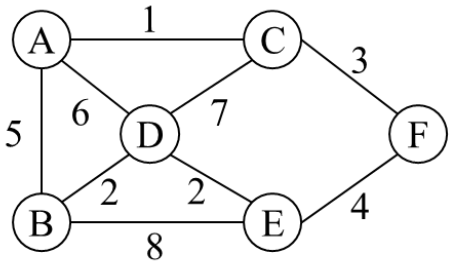
(b) Write and introduce pseudocode of insertion sort algorithm **(3%)**

(c) Briefly analyze the time complexity (include best and worst case) of insertion sort algorithm, suppose that there are N numbers in a list. **(3%)**

三、Please briefly explain

(a) What is minimum-cost spanning tree (MCST)? **(5%)**

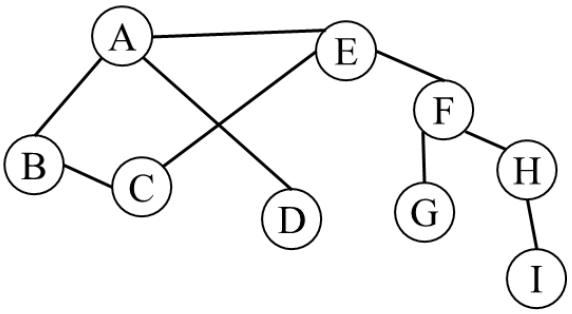
(b) The numbers between vertices represent the distances between adjacent points; for example, the distance between A and B is 5. Calculate the total distance of MCST for this graph by using Kruskal's algorithm. (Note: explain your answers) **(5%)**

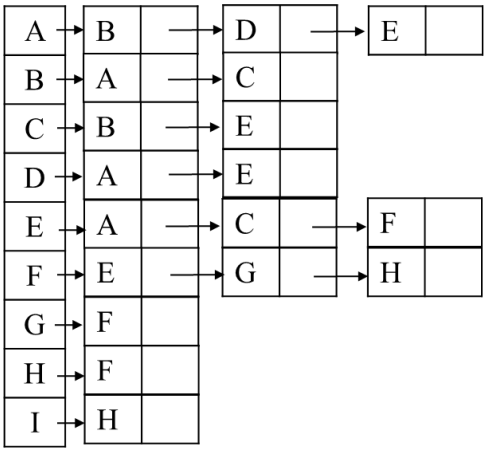


四、Assume that we start the traversal from Vertex A and the undirected graph is stored by adjacency list as shown in the follows.

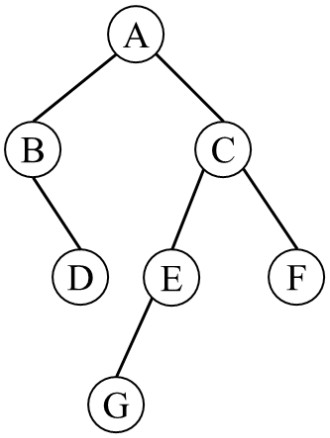
(a) What is the traversal result (the order of the visited vertex) of depth-first search using **Stack**. **(5%)**

(b) What is the traversal result (the order of the visited vertex) of breadth-first search using **Queue**. **(5%)**





五、Show the result of (a) preorder**(3%)**, inorder**(3%)**, and postorder**(4%)** traversals on the following binary tree.



六、**(10%)** The AVL tree is a self-balancing binary search tree. Please insert the numbers 71, 90, 51, 30, 67, and 54 into the initially empty AVL tree in sequence, and draw a diagram representing the data insertion sequence (step by step). Additionally, explain the rotation process and annotate the balancing factors. Briefly analyze the time complexity in the worst case.