國立彰化師範大學 97 學年度碩士班招生考試試題

系所：數學系碩士班　　組別：丙組　　科目：計算機概論(含資料結構)

☆☆請在答案紙上作答☆☆　　

1. As we all know, a matrix is a mathematical object that arises in many physical problems. Assume that we have a sparse matrix consists of *m* rows and *n* columns of numbers denoted as *m*×*n* matrix, in which the number of nonzero elements is *s* that is more less than *mn*.

(1) Excepting the representation of two-dimensional array (i.e., *A*[*m*][*n*]), please present two alternative representations using programming languages (ex., C, C++, Java) or graphic forms (Hint: one is an array of triple <row, column, value> and another is a linked list with the same triple). (5%)

(2) Considering the transposing operation on a matrix, please write the transposing algorithms for two representations of two-dimensional array *A*[*m*][*n*] and an array of triple <row, column, value>, respectively. Meanwhile, please present the analysis of time complexity for two algorithms, as well as memory requirements. (10%)

2. Many applications require “Queue” structures to keep the scenario of “First-In-First-Out”. Some operations on “Queue” are required to be implemented. Answer the following sub-problems:

(1) Firstly define a data structure “Circular Queue” using an array and some related variables, and then describe two operations that consist of Add and Delete. (8%)

(2) Firstly define a data structure “Queue” using a linked list, and then describe two operations that consist of Add and Delete. (7%)

3. Binary tree is an important data structure. Answer the following sub-problems:

(1) What are “Full”, “Complete”, “Formal”, and “skewed” binary trees? (4%)

(2) Linked representation is one of many representations for a binary tree. Given two binary trees, please write the algorithm or the program of “testing equality” for two binary trees. (Note that you may pre-assume the structure of Linked representation by yourself.) (6%)

(3) Given the pre-order sequence “ABDGCEHIF”and the in-order sequence “DGBAHEICF”, please draw the corresponding binary tree and present its post-order sequence. (10%)

4. “Divide and Conquer” is an important approach for algorithms, and this approach can be implemented by using recursive programs. Answer the following sub-problems:

(1) Given a sorted list with *n* elements, please prove the worst-case time complexity of the binary

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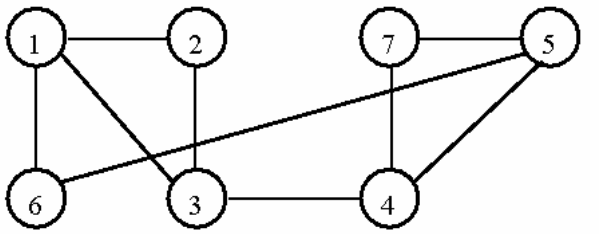
searching algorithm. (Note: Using Big-O) (7%)

(2) As we all know, the famous "Hanoi Tower" problem with *n* disks is also solved by recursive method. Please derive the minimal number of moving disks. (8%)

5. Given the following undirected graph, please write the Depth-First Search (DFS) and the Breadth-First-Search (BFS) sequences, respectively (starting from node 1). (10%)



6. Please explain or define the following items: (10%)

(1) NP-Complete problem.

(2) Java virtual machine (environment).

(3) WiMax and WiFi.

(4) Embedded system.

(5) Data mining.

7. Please output the result for the following programs: (15%)

(1)

```
#include <stdio.h>
main()
{    int a[5]={100,200,300,400,500} ;
     int *pa;
    pa=&a[0];
     printf("%d, ", *pa);
     printf("%d, ", *(pa+2));
    printf("%d, ", *pa+2);
    printf("%d", a[2]);
}
```

(2)

```
#include <stdio.h>
main()
  { int i;
      i=10;
      printf("%d, ", ++i);
      printf("%d, ", i++);
      printf("%d, ", i);
      printf("%d", i--);
  }
```