

# 國立彰化師範大學 98 學年度碩士班招生考試試題

系所：數學系

組別：丙組

科目：計算機概論(含資料結構)

☆☆請在答案紙上作答☆☆

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1. For performance analysis and measurement, some asymptotic notations are defined as follows:

$O(\text{Big oh}): f(n)=O(g(n))$  iff  $\exists$  positive constants  $c, n_0, \exists |f(n)| \leq c|g(n)|$  for  $\forall n \geq n_0$

$\Omega(\text{Omega}): f(n)=\Omega(g(n))$  iff  $\exists$  positive constants  $c, n_0, \exists |f(n)| \geq c|g(n)|$  for  $\forall n \geq n_0$

$\Theta(\text{Theta}): f(n)=\Theta(g(n))$  iff  $\exists$  positive constants  $c_1, c_2, n_0, \exists c_1|g(n)| \leq |f(n)| \leq c_2|g(n)|$   
for  $\forall n \geq n_0$

Answer the following questions: (15%)

- (1) According to the above notations, what are “lower bound”, “upper bound” and “optimal solution” of a problem? (6%)
  - (2) Re-arrange the following  $O(\text{Big oh})$  function in increasing order: (5%)  
 $O(n \log n), O(\log n^2), O(n!), O(\log \log n), O((\log n)^2), O(2^n), O(n^2)$
  - (3) If there are two algorithms and their required steps are  $100n + 50000$  and  $n \log n + 100$ , respectively. Note that  $n$  denotes the amount of input data. Please find their  $O(\text{Big oh})$ , and which algorithm has the better performance? (4%)
2. For presenting the processed data into computer memory, “Data structures” course introduces many kinds of data structures for different information. In which, “array” and “linked list” are two major structures. (10%)
- (1) Please use “array” to represent a complete binary tree.
  - (2) Please use “linked list” to represent a tree.  
(Note that the number of subtrees is not fixed.)
3. Please solve the following recurrence relations, that is, find the following time complexities  $T(n)$  using the Big-O notion (i.e.,  $O(\quad)$ ), respectively. (10%).
- (1)  $T(n) = T(n/2) + n^2$        $n > 1$   
1       $n \leq 1$
  - (2)  $T(n) = 4T(n/2) + n^2$        $n > 1$   
1       $n \leq 1$
4. If  $G$  is an undirected graph, please write an algorithm to determine whether it is connected or not. (10%) (Hint: You may self-define some pre-assumptions for representation of the undirected graph)
5. Owing to the rapid growth in popularity of Internet, cryptography is an important technology for providing network security. Please present the applications and functionalities of the following protocols: (10%)
- (1) SSL
  - (2) SSH
  - (3) S-MIME

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共 2 頁，第 2 頁

6. In a specific computer system, let an integer be stored in 8 bits, the retrieved bit pattern from a memory location is 11100011. Please represent the corresponding decimal integers according to three representations. (10%)

(1) Sign-and-magnitude representation.

(2) One's complement representation.

(3) Two's complement representation.

7. Given a string consisting of some symmetric symbols ( , ), [ and ], this string must satisfy the location symmetric rule. Please write an algorithm or a program to check whether this string is valid or not. (Hint: You can use Stack operations to complete it) (10%) For example:

|             |            |
|-------------|------------|
| Input       | output     |
| ( ) [ ]     | => valid   |
| [ ( ) ]     | => valid   |
| [ ( ] )     | => invalid |
| ( [ ] ) ( ) | => valid   |
| [ ] ( ) [ ] | => invalid |

8. Many famous tree structures are provided to improve data searching performance. Please give the definitions of the following tree structures: (15%)

(1) Optimal binary search tree

(2) AVL tree

(3) B-tree

(4) 2-3 tree

(5) Red-Black tree

9. Please output the result for the following C programs: (10%)

(1)

```
#include <stdio.h>
void list(int n)
{
    if (n >= 100)
        printf("done\n");
    else{
        printf("%d \n", n);
        n=n+20;
        list(n);
    }
}
void main()
{
    int a=42, b=80;
    list(a);
    list(b);
}
```

(2)

```
#include <stdio.h>
#define SQUARED(a,b) a*a-a*b
void main()
{
    int x=1;
    int y=2;
    int i,j;

    i=SQUARED(x,y);
    j=SQUARED(x,x+y);
    printf("i=%d\n", i);
    printf("j=%d\n", j);
}
```