

淡江大學八十九學年度碩士班招生考試試題

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系別：資訊工程學系

科目：計算機概論(含資料結構、程式語言結構)

本試題共 / 頁

1. For the Towers of Hanoi problem, it involves moving a specified number of disks of distinct size from one tower to another while observing the following rules:

- There are n disks labeled 1, 2, 3, ..., n , and three towers labeled A, B, and C.
- No disk can be on the top of a smaller disk at any time.
- Initially, all disks are placed on tower A.
- Only one disk can be moved at a time, and this disk must be the top disk of a tower.

The objective of this problem is to move all disks from A to C with the assistance of B.

- (a) Describe how to solve this problem recursively, and why. (5%)
- (b) Define a C language function for part (a) with output as "Move disk 1 from A to B." (5%)
- (c) Use recurrence relation to derive the number of moves required for moving n disks. (10%)

2. Define the Fibonacci binary tree of order n as follows:

- If $n = 0$ or $n = 1$, the tree consists of a single node.
- If $n > 1$, the tree consists of a root, with the Fibonacci tree of order $n - 1$ as the left subtree and the Fibonacci tree of order $n - 2$ as the right subtree.

- (a) What is the number of leaves in the Fibonacci tree of order n ? Why? (5%)
- (b) What is the depth of the Fibonacci tree of order n ? (5%)

3. Suppose we want to transmit the message

"ADFBACGEECADFGACEDCCEEGFFBACDABBCAA".

- (a) Draw a Huffman tree and write its code. (5%)
- (b) If Huffman code is used to encode the message, how many bits are required? (5%)

4. Consider the list of numbers: 35, 68, 31, 49, 12, 97, 71, 25, 17, 57.

- (a) Construct a max-heap by using the fastest heap construction algorithm and show each step in detail. (5%)
- (b) Show each step of the heap sort by using the above heap in detail. (5%)
- (c) Analyze and obtain the complexity of the heap construction algorithm used in part (a). (10%)

5. (a) Assume the following program was compiled and executed using static scoping rules. What value of X is printed in procedure A ? (5%)

(b) Under dynamic scoping rules, what value of X is printed in procedure A ? (5%)

Briefly describe your answer.

```
program MAIN;
  var X : integer;
  procedure A;
  begin
    writeln('X =', X)
  end;
  procedure B;
  var X: integer;
  begin
    X := 10;
    A
  end;
begin (MAIN)
  X := 5;
  B
end.
```

6. (a) By what principle *pure functional programming* is characterized? (10%)
- (b) Why this principle rules out side effects within expressions? (5%)
- (c) Give an example for demonstrating the side effect problem. (5%)

7. Draw Prolog search trees for the query (10%)

?- reverse([a,b],W).

where reverse is defined by the rules:

```
reverse([], []).
reverse([A|X], Z) :- reverse(X, Y), append(Y, [A], Z).
append([], Y, Y).
append([H|X], Y, [H|Z]) :- append(X, Y, Z).
```