

國 立 清 華 大 學 命 題 紙

九十二學年度 資訊系統與應用研究 系(所) 甲 組碩士班研究生招生考試  
 科目 計算機概論 科號 2801 共 3 頁第 1 頁 \*請在試卷【答案卷】內作答

1. (8%) Consider the following matrix multiplication program:

```
for(i=0; i<n; i++)
  for(j=0; j<n; j++)
    for(k=0, c[i][j]=0; k<n; k++)
      c[i][j] = c[i][j] + a[i][k] * b[k][j];
```

- (a) According to this program, we say that the matrix multiplication problem is in  $O(f(n))$ . What is  $f(n)$ ?
- (b) Can we say that the matrix multiplication problem has a time complexity of  $\Theta(f(n))$ ? Give your reasons.

2. (10%) Suppose we are at the Hsinchu Train Station and would like to get to the CSEE Building in NTHU. From the Train Station, there are three bus routes: Route-1 to NTHU main entrance, Route-2 to NCTU main entrance, and Route-15 to Nain-Liao Harbor. From the main entrance of NTHU, we can take Route-2 bus to NCTU, or ride a bicycle to the CSEE Building. From the main entrance of NCTU, we can walk to the CSEE Building of NTHU. From the Nain-Liao Harbor, we can take Route-13 bus to NCTU main entrance or a taxi to NTHU main entrance.

- (a) Formulate the above problem, i.e., getting to the CSEE Building from the Hsinchu Train Station, as a production system. List all the states, the start state, the goal state, and the productions.
- (b) Suggest one way to assign a heuristic (a quantitative value) to each state so that a solution to the above problem can be found faster, i.e., instead of enumerating all possible moves.

3. (7%) Consider the following two relations in a relational database:

Relation A

V	W
r	2
t	4
p	6

Relation B

X	Y	Z
5	g	p
4	d	e
2	m	q
4	t	f

What is the result of executing the following SQL statement?  
 select A.V, B.Y from A, B where A.W < B.X

4. (5%) Assume that a real number is represented as  $b_0b_1b_2b_3b_4b_5b_6b_7$ , where  $b_0$  is the sign bit,  $b_1b_2b_3$  is exponent and  $b_4b_5b_6b_7$  is mantissa. Note that the exponent is represented with the three-bit access method. What is the value for 10010001?

- 5. (5%) The ASCII code for the alphabet A is represented as 01000001.
  - (a) (3%) What is the alphabet for 01000110 in ASCII code?
  - (b) (2%) If it is adjusted for odd parity what the parity bit is?

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6. (10%) For example: ANSI is the abbreviated from American National Standards Institute. Give the original form in English for the following abbreviated terms:
- (a) ISO
  - (b) MIMD
  - (c) DMA
  - (d) RISC
  - (e) Pixel
7. (5%) It is known that one second of CD music encoded at a rate of 44,100 samples. Assume that each sample is represented as 16 bits (32 bits for stereo recording).
- (a) (3%) How many bits per second for CD music with stereo recording?
  - (b) (2%) Suppose that MP3 (MPEG-1 Layer-3) can obtain compression ratio 12 to 1. How many bits per second for MP3 music with stereo recording.
8. (7%) Giving  $n$  numbers, all numbers are in the range from 0 to  $n^3$ , is it possible to sort this  $n$  numbers in linear time? Please justify your answer.
9. (10%) According to some text book, deadlock cannot occur unless all three of the following conditions are satisfied:
- a. There is competition for non-shareable resources.
  - b. The resources are requested on a partial basis; that is, having received some resources, a process will return later to request more.
  - c. Once a resource has been allocated, it cannot be forcibly retrieved.

This is the problem: A banker only has \$600,000. He loans \$300,000 to each of two customers. Later, both customers say that before they can repay their loans they must each borrow another \$50,000 to complete the business deals in which their previous loans are involved. The banker resolves this deadlock by borrowing the additional funds from another bankers and passing on this loan (the interest rate is increased) to the two customers. Which of the three conditions for deadlock has the banker removed? Please briefly explain your answer.

10. (8%) Suppose we define the procedure *Test* as follows:

```
Procedure Test(Y)
  Y ← 8;
  Print the value of X;
  Print the value of Y;
```

Here X is a global variable.

- (a) If parameters are passed by value, what will be printed when the following program segment is executed?  
X ← 4;  
*Test*(X);  
Print the value of X;
- (b) What if the parameters are passed by reference?

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11. (15%) The table below represents a tree stored in a machine's memory. Each node of the tree consists of three cells. The first cell contains the data (a letter), the second contains a pointer to the node's left child, and the third contains a pointer to the node's right child. A value of 0 represents a NIL pointer. Let the values of the root pointers be 88 in tree 1, 61 in tree 2, 94 in tree 3, and 70 in tree 4.
- (a) (4%) Draw the pictures of these four trees.
  - (b) (2%) Identify two trees whose nodes would be printed in alphabetical order by the procedure *PrintTree*.
  - (c) (4%) Design two procedures to print the nodes of the other two trees in alphabetical order.
  - (d) (5%) Design a procedure to merge two trees, whose nodes would be printed in alphabetical order by the procedure *PrintTree*, into one.

Address	Contents	Address	Contents
52	O	76	E
53	0	77	64
54	97	78	0
55	C	79	L
56	0	80	0
57	67	81	0
58	J	82	I
59	0	83	85
60	0	84	0
61	N	85	H
62	82	86	0
63	73	87	0
64	A	88	G
65	0	89	76
66	0	90	58
67	D	91	M
68	0	92	0
69	0	93	0
70	B	94	K
71	52	95	55
72	91	96	79
73	F	97	P
74	0	98	0
75	0	99	0

**procedure** *PrintTree* (Tree)

**If** (Tree is not empty)

**then** (apply the procedure *PrintTree* to the left subtree of Tree;

print the root node of Tree;

apply the procedure *PrintTree* to the right subtree of Tree;)

12. (10%) Design a hash function that distributes records with keys 6, 9, 14, 21, 30, 41, 54, 69, 86, 105, 126 to buckets 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, respectively. (10 points)