

考試科目	計算機概論	所別	資訊科學系	考試時間	4月22日(日) 星期日 下午第1節
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[7%] 1. (a) (2%) In an introductory course of computer science, we usually introduce base-2 numbering system instead of base-10. Can you explain the reason briefly?

(b) (5%) Using 2-input AND, OR, and NOT gates, design a circuit to implement the following truth table. Can you use as minimum number of gates as possible?

a	b	output
0	0	1
0	1	1
1	0	0
1	1	1

[8%] 2. (a) (4%) Consider the following structure of the instruction register.

What is the maximum number of distinct operation codes that can be recognized and executed by the processor on this machine? What is the maximum memory size on this machine?

op code	address-1	address-2
6 bits	18 bits	18 bits

(b) (4%) Assume that our MAR (Memory Address Register) contains 20 bits, enabling us to access up to  $2^{20}$  memory cells, which is 1MB. However, our computer has 4MB of memory. Explain how it might be possible to address all 4MB memory cells using a MAR that contains only 20bits.

[6%] 3. Assume that any individual program spends about 50% of its time waiting for I/O operations to be completed. What percentage of time is the processor doing useful work (called processor utilization) if there are three programs loaded into memory? How many programs should we keep in memory if we want processor utilization to be at least 95%?

[8%] 4. (a) (4%) Describe the language defined by the following grammar:

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<goal> ::= <letter> | <letter><next>
<next> ::= ,<letter>
<letter> ::= A

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(b) (4%) Create a BNF grammar that describes simple Boolean expressions of the form

var AND var                      var OR var

where var is one of the symbols w, x, y, and z.

[8%] 5. Write an iterative C/C++ function and a recursive C/C++ function to compute the  $n$ -th element of Fibonacci sequence. The sequence is defined:

$$f_0 = 0, \quad f_1 = 1, \quad f_{i+1} = f_i + f_{i-1} \quad \text{for } i = 1, 2, \dots$$

[8%] 6. (a) (4%) What are differences between packet switching and circuit switching networks? You should compare their advantages and disadvantages.

(b) (2%) For delay-sensitive and loss-sensitive applications, which one (packet switching or circuit switching) is suitable, respectively? Why?

(c) (2%) In packet switching networks, considering some applications which need quality of service (QoS), what technologies can you use to achieve QoS?

[5%] 7. One definition of Computer Science is the study of algorithms, including (i) their formal and mathematical properties (ii) their hardware realizations (iii) their linguistic realizations (iv) their applications.

Recently, Internet is very popular and can be the focus for any fields of computer science. The famous domains are like ISP (Internet Service Provider), ICP (Internet Content Provider), ASP (Application Service Provider), IDC (Internet Data Center), etc. Can you pick up one of the above and write a short essay to explain how you can play the right role in it according to the above definition of computer science. (Note: The more concretely and clearly you describe, the higher score you will get.)

備 考 試 題 隨 卷 繳 交

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國立政治大學圖書館

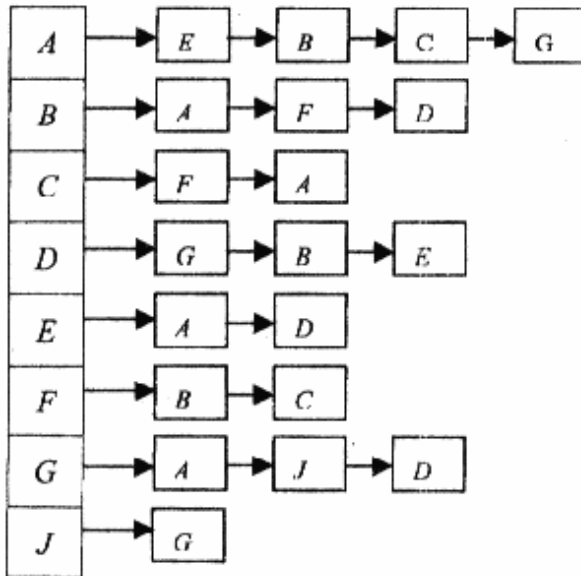
8. (10%) A logical expression contains three types of operators, namely, in order of precedence, ~ (not), ∨ (or), ∧ (and). Given the following logical expression

$$A \wedge \sim (B \vee (\sim D \wedge (C \wedge E \vee F))) \wedge G,$$

(1) Please give the postfix expression.

(2) Assume that  $A, B, D$  and  $F$  are false,  $C, E$  and  $G$  are true. Please evaluate this logical expression based on the postfix form. Please elaborate the evaluation process step by step.

9. (8%) Given the following graph represented as the adjacency list representation, please list the traversal order of vertices using Depth First Traversal and Breadth First Traversal, respectively, of the graph starting from the vertex  $A$ .



10. (10%) Given two strings  $A$  and  $B$ , please design an efficient algorithm to change  $A$  string to  $B$  string character by character with minimum editing cost. Three types of edit steps are allowed:

(1) insert: insert a character, each insertion is assigned a cost of 2

(2) delete: delete a character, each deletion is assigned a cost 3

(3) replace: replace one character with another character, each replacement is assigned a cost which equals the ASCII code difference between two characters.

The algorithm should take  $O(m \times n)$  time in the worst case, where  $m, n$  is the number of characters of the string  $A$  and  $B$  respectively. Please describe your algorithm by the example where  $A = "bacd"$ ,  $B = "adc"$ .

11. (10%) Please design an efficient data structure and corresponding algorithms to support the following operations:

Insert( $x$ ): insert  $x$  into the data structure only if it is not already there.

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					星期		下			

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Delete( $x$ ): delete  $x$  from the data structure if it is there.

Find( $k$ ): find the  $k$ -th smallest element in the data structure.

All these operations should take  $O(\log n)$  time in the worst case, where  $n$  is the number of elements in the data structure.

12. (12%) 是非題，每題 1.5 分，答錯倒扣 1.5 分

- (1) ( ) The minimum spanning tree is a binary tree.
- (2) ( ) The third element in a minimum heap must be one of the children of the root.
- (3) ( ) Every problem which can be solved in polynomial time by deterministic algorithm must be a nondeterministic polynomial problem.
- (4) ( ) Up to now, none of the NP-Complete problems can be solved by any polynomial time algorithm.
- (5) ( ) The Dijkstra's algorithm for shortest path problem is based on the greedy strategy.
- (6) ( ) Merge sort is stable whereas insertion sort is not.
- (7) ( ) Binary searching of a sorted  $n$  element linked list takes  $O(\log n)$  time in the worst case.
- (8) ( ) It is impossible to generate the topological ordering for the cyclic graph.

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