

國 立 清 華 大 學 命 題 紙

98 學年度 資訊系統與應用研究所 系(所) 甲 組碩士班入學考試

科目 計算機概論 科目代碼 2001 共 1 頁第 1 頁 *請在【答案卷卡】內作答

1. (12%)
 - (a) For a function $f(n)$, we usually use $f(n)=O(g(n))$ to denote the upper bound of the complexity of the function, and $f(n)=\Omega(h(n))$ to denote the lower bound of the complexity of the function. Please define both of them.
 - (b) If the time complexity of the highest lower bound of a problem is found to be $\Omega(n \log n)$ and the time complexity of the best available algorithm to solve this problem is $O(n^2)$, what are the possibilities for further improvement on these bounds?
2. (12%) Consider the problem: Given a sequence $S = x_1, x_2, \dots, x_n$ of elements and an integer k , where $1 \leq k \leq n$, find the k th-smallest element in S .
 - (a) Give a linear-time worst case algorithm for solving this problem.
 - (b) Analyze the complexity of your algorithm in (a).
3. (12%)
 - (a) What is "heap"? Please define it.
 - (b) Let $A[1..16]$ be an array that represents a heap (using the implicit representation). What is the minimal number of heap elements that can occupy an array of size 16?
 - (c) Can you build up a heap by a linear-time worst case algorithm?
4. (10%) Is the LRU algorithm a stack algorithm? (6%) Is the optimal replacement algorithm a stack algorithm? You need to prove your answer to get the score.
5. (4%) What is an object-oriented programming language? (4%) Please list the two most popular object-oriented programming languages.
6. (6%) What are the requirements that a correct solution to the critical-section problem must satisfy?
7. (8%) (a) Explain why modern digital computers use binary number representation. (b) Explain why modern digital computers use two's complement representation for integers.
8. (16%) (a) Show the differences between a sequential circuit and a combinational circuit. (b) Suppose you are assigned the task of designing a circuit to control the traffic light. (i) Is this circuit sequential or combinational? (ii) What are the inputs and outputs of your circuit? (iii) Draw the state transition diagram of your circuit.
9. (10%) (a) Draw a block diagram showing the internal organization of a typical processor. (b) Use the diagram to explain the instruction cycle of a processor, i.e. how the processor performs instruction fetch, instruction decode, operand fetch, execution, write back, etc.