

國立臺灣科技大學
八十九學年度博士班招生考試試題

系所組別：資訊管理系甲組
科目：資料結構

1. (1) Explain the Cook Theorem. (10%)
(2) What is the halting problem? (10%)
2. To illustrate how the asymptotic notation can be used to rank the efficiency of algorithms, use the relation " \subset " and " $=$ " to put the orders of the following functions into a sequence, where " ϵ " is an arbitrary real constant, $0 < \epsilon < 1$.

$$n \log n \quad n^8 \quad n^{1+\epsilon} \quad (1+\epsilon)^n \quad n^2/\log n \quad (n^2 - n + 1)^4$$

Do not use the symbol " \subseteq ". Prove your answers. (15%)

3. Let T be an integer array of n elements and let s be an integer between 1 and n . The s -th smallest element of T is defined as the element that would be in the s -th position if T were sorted into nondecreasing order. Given T and s , the problem of finding the s -th smallest element of T is known as the selection problem. Design a linear time algorithm for solving the selection problem. (15%)
4. Given an $n \times n$ matrix (for n is odd) M shown as below. The $(n+1)/2$ -th row and column contain nonzero elements *. Use row-major and column-major approaches to map the nonzero elements in $M[i,j]$ (for $i, j = 1, 2, \dots, n$) to a linear array $A[k]$ (for $k = 1, 2, \dots, 2n-1$), respectively. (each has 10%, total 20%)
Hint: Your answers should determine the relationship of i, j and k .

$$M = \begin{bmatrix} & & * & & & & \\ & & * & & & & \\ * & * & * & * & * & & \\ & & * & & & & \\ & & * & & & & \end{bmatrix}$$

5. Given the input sequence of data $\langle 10, 30, 20, 15, 8, 33, 7, 6, 25 \rangle$. Draw all intermediate max-heaps and the final max-heap (which are also full binary trees) when each data in the input sequence is inserted into the existing (intermediate) heap. (15%)
6. Suppose that a binary tree T has nine nodes, A, B, C, D, E, F, G, H, and I. The pre-order traversal of T is GBACHFDEI, and the post-order traversal of T is ACBDEFIHG. Draw the T . (15%)

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