

國立彰化師範大學九十六學年度碩士班招生考試試題

系所：資訊工程學系

科目：資料結構

請在答案紙上作答

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1. Order the following functions by growth rate: (10%)
 $n, n^{1.5}, n \log n, n \log(\log n), n \log(n^2), n(\log n)^2, 2^n, n^3, 3^n$
2. What is the time complexity of $T(n)$ defined below? (5%)
If $n=2$ then $T(n)=2$ else
If $n>2$ then $T(n)=T(n/2)+\log n$
3. Please prove the following statements: (10%)
(1) If $f(n) = a_m n^m + a_{m-1} n^{m-1} + \dots + a_1 n + a_0$, then $f(n) = O(n^m)$
(2) If $f(n) = 1^k + 2^k + \dots + n^k$, then $f(n) = O(n^{k+1})$
4. Write a procedure to determine and return the height of a binary tree. Analyze the time complexity of your algorithm. (10%)
5. Construct Huffman binary code for eight characters whose probabilities of appearance are A: 0.15, B: 0.19, C: 0.23, D: 0.04, E: 0.11, F: 0.08, G: 0.14 and H: 0.06. What is the average number of bits per character? (10%)
6. Let b_n denote the number of distinct binary trees with n nodes. Please derive and solve the recurrence of b_n . (10%)
7. Explain the following terms in the context of data structures: (12%)
 - (a) Theta " $\theta(n)$ "
 - (b) NP problem
 - (c) NP-Complete problem
 - (d) NP-hard problem
8. Let p be a pointer to the first node in a singly link-list that at least contains three nodes. Write a procedure in some programming language of your choice (or in pseudo code) to reverse every link in the list. Please note that at the end, set p to point to the first node of the new list. (8%)
9. Show that building a heap of size n can be done in linear time. (8%)
10. What is the lower bound of the comparison based sorting algorithm? Justify your answer. (7%)
11. Read the following data in the given order, and show the corresponding trees.
17, 35, 23, 38, 26, 11, 33, 19, 9
 - (a) AVL tree (5%)
 - (b) Min-Max Heap (5%)