國立彰化師範大學 97 學年度碩士班招生考試試題

系所：資訊工程學系碩士班　　科目：資料結構

☆☆請在答案紙上作答☆☆　　

1. Please prove the following statements: (10%)
   (1) If $f(n) = a_m n^m + a_{m-1} n^{m-1} ..... + a_1 n + a_0$, then $f(n) = O(n^m)$
   (2) If $f(n) = 1^k + 2^k + ... + n^k$, then $f(n) = O(n^{k+1})$

2. If a tree has a node of degree one, two nodes of degree two, three nodes of degree three....., n nodes of degree n, how many leaf nodes are there in this tree? (10%)

3. Let b_n denote the number of distinct binary trees with n nodes. Please derive and solve the recurrence of b_n. (15%)

4. Explain the following terms in the context of data structures: (15%)
   (a) NP problem
   (b) NP-Complete problem
   (c) NP-hard problem

5. Show that building a heap of size n can be done in linear time. (10%)

6. What is the lower bound of the comparison based sorting algorithm? Justify your answer. (10%)

7. Suppose there are n branch nodes of a binary tree. Let I and E denote the sum of path lengths of the branch nodes and the sum of the path lengths of the leaves, respectively. How related E to I? and why? (10%)

8. Read the following data in the given order, and show the corresponding trees.
   17, 35, 23, 38, 26, 11, 33, 19, 9
   (a) Binary search tree (5%)
   (b) AVL tree (5%)
   (c) Min-Max Heap (5%)
   (d) 2-3 tree (5%)