考 試 科 目	資料結構及演算法 （資料結構部分） 8141	所　別	資訊科學系 8141	考 試 時 間	3 月 1 日（日）第一節

Short Answer Questions. 50 Points.

(You can answer in either Chinese or English.)

1. (5 points) How would you use a stack to check for balanced parentheses, e.g., ( ), in a string? What condition indicates that the parentheses are balanced when the end of the string is reached?

2. (5 points) If you implement a stack with an array, what operation may be potentially restricted and why?

3. (5 points) A node in a linked list has an `item` data and a `next` pointer. Write the code segment that inserts into a linear linked list the node to which `newPtr` points between the two nodes pointed to by the variables `prev` and `cur`.

4. (5 points) What are the three properties of each node n in a binary search tree?

5. (6 points) Given the following graph and neighboring list, what is the depth first search order starting from vertex A?

A:　　E, C, B
B:　　F, C, A
C:　　D, B, A
D:　　F, E, C
E:　　D, A
F:　　D, B
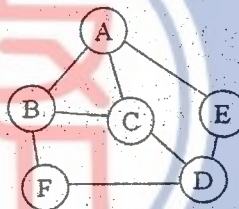
6. (12 points) What is a heap? How is a heap different from a binary search tree? Draw the resultant heap after you insert into the initially empty heap the following values, 10, 9, 3, 5, 2, 6. What is the resultant heap if the insertion order is changed to 6, 3, 5, 10, 9, 2?

7. (12 points) What is a spanning tree? What is a minimum spanning tree? For the following graph, draw the minimum spanning tree rooted at g and c, respectively.
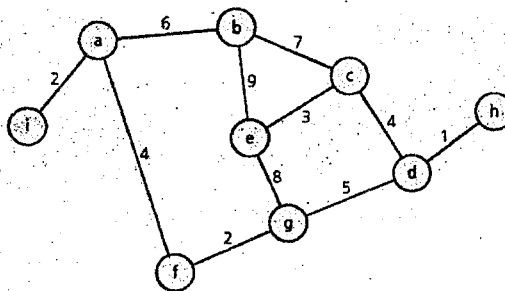
考 試 科 目	資料結構與演算法 （演算法部份）	所　　別	資訊科學系 8141	考 試 時 間	3 月 1 日（日）第一節

說明：請書寫必要的解題過程。僅書寫答案而缺乏必要的過程，亦無法獲得該題滿分。

8. (10 points) Assume the input size is n.

   (a) Formulate the recurrence equation for insertion sort and merge sort. (Explain every parameter you used.)

   (b) Is insertion sort a "in place" sorting algorithm? (Answer YES or NO) and, why?

9. (10 points) Use recursion tree to give an asymptotically tight solution to the following recurrence, where α is a constant in the range $0 < \alpha < 1$ and $c > 0$ is also a constant.

$$T(n) = T(\alpha n) + T\big((1-\alpha)n\big) + cn$$

10-1. (10 points) Coin changing is the problem for n cents using fewest number of coins. Suppose that the available coins are in the denominations that are powers of c, i.e., the denominations are $c^0, c^1, ..., c^k$ for some integers $c > 1$ and $k > 1$. Propose a greedy algorithm and prove your algorithm yields an optimal solution.

10-2. (10 points) Let A[1..n] be an array of n distinct numbers. If i < j and A[i] > A[j], then the pair(i, j) is called an inversion of A. Propose a pseudo code to detect all the inversions of A in $\Theta(n \lg n)$ worse time.

10-3. (10 points) A sequence $< A_1, A_2, ..., A_n >$ of n matrices, where i =1, 2, ... , n, matrix A_i has dimension $p_{i-1} \times p_i$, fully parenthesize the product $A_1 A_2 ... A_n$ in a way that minimizes the number of scalar multiplications. Propose a pseudo code for matrix-chain multiplication using dynamic programming in $O(n^3)$.

備　　註	一、作答於試題上者，不予計分。 二、試題請隨卷繳交。