NDHU CSIE   Ph.D. Qualification Examination
Algorithms, Fall 2009

1. Briefly explain these two algorithm design approaches: **divide and conquer**, **dynamic programming**. For each algorithm approach, give one example including a problem with an algorithm for the problem. What is the difference between them? (20%)

2. Answer the following problems about tree and heap structures:
   (a) Draw a **binary tree** containing keys P, L, A, C, E, such that the postorder traversal visits nodes in this order: E, A, L, C, P and the inorder traversal visits nodes in order: E, L, A, P, C. (10%)
   (b) Given a sequence S containing the elements 4, 15, 6, 3, 21, and 2, insert these elements in the given order into an empty **max-heap** data structure. Please show the final result. (10%)

3. Use the **master method** to give tight asymptotic bounds for the following recurrences.
   (a) $T(n) = 4T(n/2) + n$ (5%)
   (b) $T(n) = 4T(n/2) + n^2$ (5%)

4. Let (u, v) be a minimum-weight edge in a graph G. Show that (u, v) belongs to some minimum spanning tree to G. (10%)

5. The diameter of a tree T=(V,E) is the largest of all shortest-path distances in the tree. Given an efficient algorithm to compute the diameter of a tree and analyze the running time of your algorithm. (20%)

6. Give an algorithm that determines whether or not a given undirected graph G = (V, E) contains a cycle. Your algorithm should run in O(V) time, independent of |E|.(20%)