Dept. of Computer Science and Engineering, undergraduate
National Sun Yat-sen University
Advanced Programming and Practice - Final Exam., June 20, 2013, 9:10–12:00

1. Explain each of the following terms. (20%)
   (a) *convex hull problem*
   (b) *sum of subset problem*
   (c) *best-first search*
   (d) *matrix-chain multiplication problem*
   (e) *permutation ranking problem*

2. (a) Given an undirected graph, what is the *Euler cycle*? What is the main difference between the Euler cycle and the *Hamiltonian cycle*? (5%)
   (b) What is the definition of the *knapsack problem*? What is the main difference between the *knapsack problem* and the *0/1 knapsack problem*? (5%)

3. (a) What are the general steps of the *divide-and-conquer* algorithm?(5%)
   (b) Is the *binary search* method a divide-and-conquer algorithm? Describe your points. (5%)

4. Suppose there are two strings $A =$ "*vintner*" and $B =$ "*writers*".
   (a) What is the length of the *longest common subsequence* (LCS) of A and B? (5%)
   (b) Assume that the edit cost of each insertion, deletion or replacement is 1. What is the minimum edit cost between A and B? (5%)
   (c) Let L denote the LCS length and E denote the minimum edit cost. Please derive a general relation formula between L, E, m and n, where m and n denote the lengths of any two strings A and B, respectively. (5%)

5. (a) Please present an algorithm for constructing the *minimum spanning tree* of a given connected, undirected and weighted graph.(10%)
   (b) Analyze the time complexity of your algorithm. (5%)

6. For given any sequence of four numbers, we can apply the simple *bubble sort* to them to get a sorted sequence in six comparison operations. Please design a special sorting algorithm for four numbers. Your algorithm should sort any sequence of four numbers in five comparison operations. Here, data movements are not counted. (15%)

7. We are given a set S of line segments $\{S_1, S_2, \cdots, S_n\}$ that each S_i is represented by a left point L_i and a right point R_i, denoted as $S_i = [L_i, R_i]$. Here we assume that each L_i or R_i is an integer point (positive or negative) on the X-axis with y-value being 0. In addition, no segment is contained in another segment. The *minimum coverage* problem is to find a subset T of S such that T covers a range $[k, m]$ and $|T|$ is minimized, where $|T|$ denotes the number of elements in T. That is, the union of T contains $[k, m]$. Please design an algorithm for solving this problem with $O(n \log n)$ time. (15%)