ALGORITHMS

(一)single choice(36 points), for each question, 3 points(correct) and -1 point(incorrect).

1. The recurrence $T(n)=3T(\lfloor n/4 \rfloor)+n$ has the solution ①$O(\log n)$ ② $O(n)$ ③ $O(n\log n)$ ④ $O(n^2)$ ⑤other.
2. Which one is the polynomial-time problem? ①subset-sum problem ②0-1 knapsack problem ③vertex-cover problem ④clique problem ⑤hamiltonian-cycle problem
3. The number of data exchange for (5, 3, 1, 4, 7, 8, 2, 6) in quicksort is ①5 ②6 ③7 ④8 ⑤9.
4. Suppose that the cost of data exchange is 2 and the cost of data comparison is 1. What algorithm has the worst (largest) cost for (6, 5, 3, 1, 7, 0, 2, 4)? ①bubble sort ② insertion sort ③ selection sort ④ quicksort ⑤ radix sort.
5. Let S_1 and S_2 be the sequences traveling the figure 1 using depth-first and width-first algorithms, respectively. For example, S_1=a, b, c,…. Note that two algorithms are rooted at a. The number of differences between S_1 and S_2 is ①5 ②6 ③7 ④8 ⑤9.
6. Working module q=11, how many spurious hits does the Rabin-Karp Matcher encounter in the text T=3141592653589793 when looking for the pattern 26. ①0 ②1 ③2 ④3 ⑤other
7. Construct the top-down 2-3-4 tree when the keys A S E A R C H I N G E X A M P L E are inserted into an initially empty tree. Then represent this 2-3-4 tree as a red-black tree. The number of red links in this red-black tree is ①2 ②3 ③4 ④5 ⑤other.
8. In the string matching problem, Let N_1 and N_2 be the numbers of character comparison using Knuth-Morris-Pratt algorithm and Boyer-Moore algorithm for string=10011101001001001001011110 and pattern=10010111. The value N_1-N_2 is ①2 ②3 ③4 ④5 ⑤other.
9. In minimum-spanning-tree problem, Let S_1 and S_2 be the sequences for figure 1 using Kruskal's algorithm and Prim's algorithm (root at a), respectively. For example, S_1=(g,h), (f,g),…. The number of differences between S_1 and S_2 is ①2 ②3 ③4 ④5 ⑤6.
10. Consider inserting the keys 10,22,31,4,15,28,17,88,59 into a hash table of length m=11(index 0..10) using open addressing with the primary hash function $h_1(k)= k \bmod m$. let n_1 and n_2 be the locations of 59 using linear probing and using double hashing with $h_2(k)=1+(k \bmod (m-1))$, respectively. The value of n_1+n_2 is ①5 ②9 ③12 ④15 ⑤other.
11. The minimum number of multiplications to compute X^{55} is ①7 ②8 ③9 ④10 ⑤11
12. Suppose that the original coding of a letter is a five-bit binary representation. What percentage of saving for string "ABBCCCDDDDEEEEEFFFFFF" using Huffman encoding? Pick the nearest value. ①30% ②40% ③50% ④60% ⑤70%.

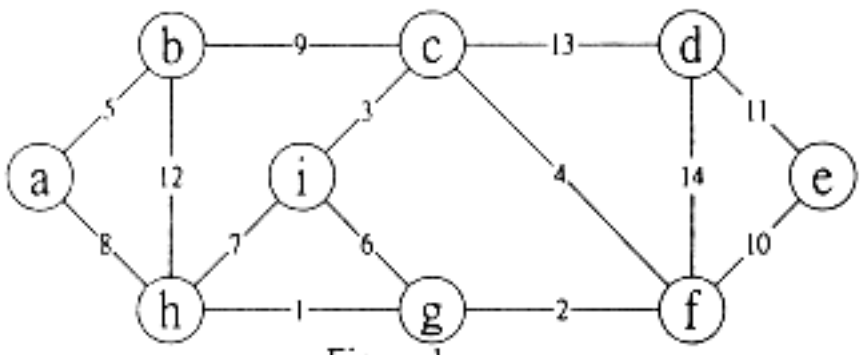

Figure 1.

(二)(8 points) Show how to sort n integer in the range 1 to n^2 in $O(n)$ time.

(三)(6 points) Show the differences between dynamic programming program and greedy algorithm.

(背面仍有題目,請繼續作答)

Data Structure (50%)

(四) (25%) Answer the following questions.

(a) Describe three key points for designing a good hashing function.

(b) Given the following set of 7-digit phone numbers: {9847585, 8921644, 9315778, 2757575, 3635251, 3081780}. Suppose we want to manage the above phone numbers by hashing functions. Explain how to hash the given phone numbers by using "division method" and "folding method", respectively. You should make the collisions as few as possible in hashing.

(c) Describe two kinds of methods for handling overflow problems in hashing. Explain how they work by examples.

(d) What is perfect hashing ? Under what conditions can it be used ? Explain how it works by using an example.

(五)(15%)

(a) Suppose a binary tree is implicitly specified by the inorder sequence FGDEAB and preorder sequence GFEDBA. Give all possible binary trees with the above inorder and preorder sequences.

(b) Describe the data structure of a threaded binary tree.

(c) What are the main advantages of a threaded binary tree compared to binary tree ?

(d) Write an algorithm which inserts a new node as the left child of a node in a threaded binay tree.

(六)(10%) Given an undirected graph G = (V, E) with k vertices. A weight w_i is associated with each edge e_i in E.

(a) Give Kruskal's algorithm for finding the minimum cost spanning tree of G. Show also the time complexity of the algorithm.

(b) What kind of representation should be used for graph G if we want to determine whether two specified vertices V_i and V_j are adjacent in constant time ? What is the memory space needed for this representation ?