國立台灣科技大學九十六學年度碩士班招生試題

系所組別： 電子工程系碩士班甲組

科　　目： 資料結構

總分100分

1. (10%) Answer the following short questions:
   (a) Stack is a data structure. Define it in a concise way.
   (b) Write an algorithm to determine whether the parentheses in an expression are properly nested.
2. (20%) This is a problem about a binary search tree:
   (a) Construct a binary search tree using the following sequence of data in order: $52, 40, 26, 22, 24, 46, 45, 72, 58, 65, 68, 54, 51$.
   (b) Write a function to search a key from a binary search tree.
   (c) Use the binary search tree built in (a) as an example to explain how a binary search tree can be used to sort a sequence.
   (d) What is the worst-case performance of binary search trees? Give an example please.
3. (20%) Consider the graph shown in Figure 1:

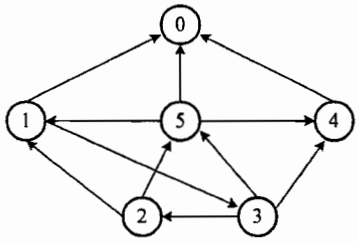

Figure 1: Figure for problem 3.

   (a) Obtain the in-degree and out-degree of each vertex.
   (b) Represent the graph using adjacency list.
   (c) Represent the graph using adjacency matrix.
   (d) For an undirected graph, G, with n vertices and e edges, show that:

$$\sum_{i=0}^{n-1} d_i = 2e$$

   where d_i is the degree of vertex i.

國立台灣科技大學九十六學年度碩士班招生試題

系所組別： 電子工程系碩士班甲組

科　　目： 資料結構

4. (10%)

(a) Describe the properties of a B-tree. (4%)

(b) Suppose we insert the keys 1, 2, 3, ... in ascending order into an initially empty B-tree of order 3 (or 2-3 tree). Which key causes the leaves to be on level 4 for the first time. (6%)

5. (10%)

(a) Use Huffman's algorithm to construct an optimal binary prefix code for the letters in the following table. (6%)

Letter	A	C	E	R	S	T	U
Probability	0.11	0.22	0.16	0.12	0.15	0.10	0.14

(b) Encode the string TRACE using the binary code in (a). (4%)

6. (10%)

(a) What is a heap? (3%)

(b) How does heapsort work? (3%)

(c) What is the running time of heapsort for presorted input? (4%)

7 (10%)

In a chaining hash table, suppose that the nodes in each chain are kept in order by key. Assume that any given element is equally likely to hash into any of chains. Analyze the average number of probes that would be done, for both successful and unsuccessful searches. Compare your answers with the corresponding numbers for the case of unordered chains.

8. (10%)

Using C/ C++ language, write a function that takes an integer array and the array size as arguments and rearranges all the numbers so that all negative values precede all nonnegative ones. (The items need not be sorted completely.) Your function should use the minimum possible number of exchanges.