銘傳大學八十九學年度資訊管理研究所碩士班招生考試

第三節

資料結構 試題

l. (16 points) Answer true or false. (2 points each question)

(a) In the Lempel-Ziv compression algorithm, the full dictionary is always kept even after the compression process, since otherwise we would not able to do the decoding or uncompression.

(b) Although a binary tree with n vertices has precisely n-l edges, this is sometimes not be for high degrees trees such as B-trees.

(c) Quick-sort and Heap-sort do not have the same worst case time complexity.

(d) 28824564 is O(1).

(e) The following algorithm runs in O(n) time.
Procedure Puzzle(n);
For i from 1 to n do
For j from 1 to 10 do
For k from n to n+5 do x=x+l

(f) Quick-sort and Heap-sort do not have the same worst-case time complexity.

(g) B-tree is not subject to the order of the incoming data.

(h) There is a Huffman code on four letters with code lengths 3, 2, 2, 2.

2. (28 points) Give short answers to the following questions. (4 points each question)

(a) Starting from an empty AVL-tree, insert l, then insert 3, then insert 2. Draw the trees resulting from each insertion, and indicate whether a single or double rotation is necessary.

(b) Give the name of a data structure which implements a dictionary (with insert, delete, and search operations) and guarantees O(log n) time for each of the three operations. Here n is the number of keys in the dictionary.

(c) Suppose you are asked to implement a general sorting program that must always run very fast, which algorithm will you use?

(d) Suppose you are asked to implement a sorting program that will always sort at most 10 keys, which algorithm will you use?

(e) Explain the purpose of the failure function computed on the pattern in

the Knuth-Morris-Pratt string matching algorithm.

(f) Describe the scheme of double hashing.

(g) In double hashing, we require the table size to be a prime number. Why?

3. (5 points).What is the value returned by the following function? Express your answer as a function of n.

```
function mystery(n)
    r=0;
    for i=1 to n-1 do
    for j=j+1 to n do
        for k=1 to j do
            r=r+1;
    return(r);
```

4. (9 points) Consider the following B-tree of order 5 in Figure 1. Draw the resulting B-trees after the following operations.

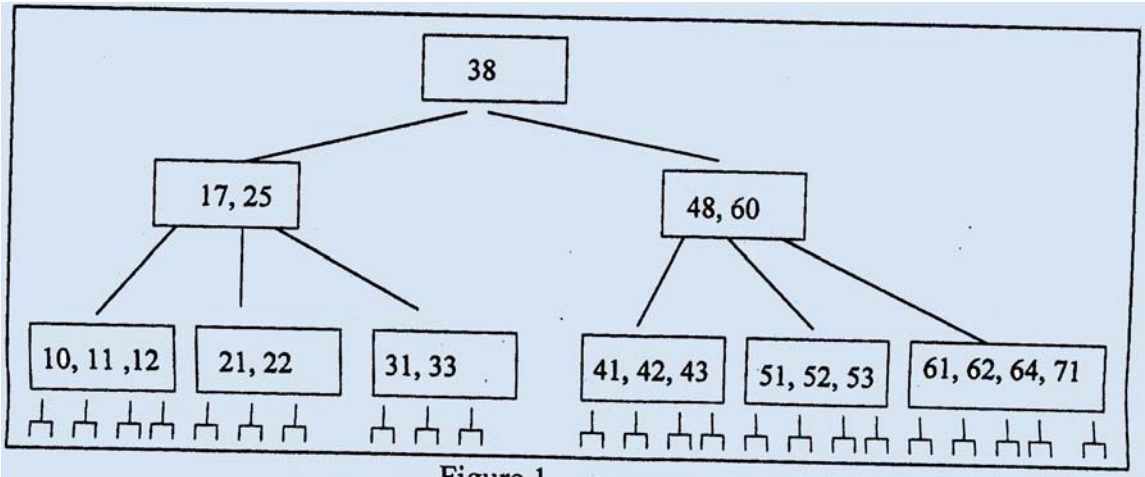

Figure 1

(a) Insert 65 to the B-tree in Figure 1.

(b) Delete 21 from the original B-tree in Figure 1.

(c) Delete 33 from the original B-tree in Figure 1.

5. (12 points)Multiple choice(3 points each)

(1) What is the worst-case running time of Pop(x) for an array-based stack?

(a) O(1) (b) O(log n) (c) O(nlog n) (d) O(n)

(2) What is the worst-case running time of Find(x) on a binary tree?

(a) O(1) (b) O(log n) (c) O(nlog n) (d) O(n)

(3) What is the worst-case running time of Remove(x) for a linked list?

(a) O(1) (b) O(log n) (c) O(n) (d) $O(n^2)$

(4) What is the postfix form of this expression: A*(B-C)/D+E

(a) AB*C-D/E+ (b) ABC-D/*E+

(c) ABC-*D/E+ (d) ABC-DE*/+

6. (10 points) For each hash table below, show the result of inserting the following sequence of key values, in the given order, into an initially empty hash table of that type: 26,17,20,9,34,32,15,21. In both cases, assume a hash table size of 11and a hash function h(x)=x mod 11.

(a) Static hash table that uses chaining(5 points)

(b) Open addressing hash table that uses linear probing(5 points)

7. (10 points) Consider the following C++ function definition. This function is intended to compare three floating point numbers and return the maximum value encountered. Unfortunately, it is incorrect. Test the function by hand to find the problem, and show what changes you would make to correct the error.

(A)

```
//function definition (test A)
float max(float A, float B, float C)
    {
    float val;
    if(A>=B)
        val=A;
    else
        val=B;
    return(val);
    }
```

(B)

```
//function definition (test B)
float max(float A, float B, float C)
    {
    if ((A>B)&&(A>C))
        return(A);
    else
        if((B>A)&&(B>C))
```

```
        return(B);
    else
        return(C);
}
```

8. (10 points) Consider the graph in Figure 2. Assume that the edges are ordered alphabetically. That is, when facing with alternatives, choose the edges in alphabetical order.

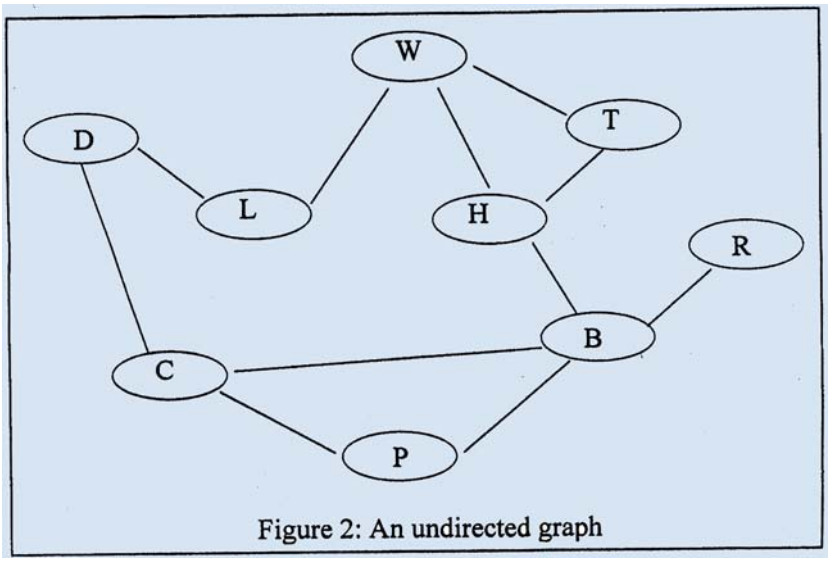

Figure 2: An undirected graph

(a) List the nodes of graph in Figure 2 by depth-first search starting from W.

(b) List the nodes of graph in Figure 2 by breadth-first search starting from W.

(c) Suppose that in the above graph, all edges have weight 1 except that edges (B, C) and (P, C) each have weight 2. Draw a Minimum spanning tree for the above graph.

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