UNIVERSITI SAINS MALAYSIA

Peperiksaan Semester Pertama
Sidang Akademik 1994/95

Oktober/November 1994

CSC201 - Struktur Data & Algoritma
CSP201 - Algoritma & Struktur Data II

Masa: [3 jam]

ARAHAN KEPADA CALON:

- Sila pastikan bahawa kertas peperiksaan ini mengandungi **TUJUH** muka surat yang bercetak sebelum anda memulakan peperiksaan ini.
- Jawab **SEMUA** soalan. Anda boleh memilih untuk menjawab **SEBAHAGIAN** daripada soalan di dalam Bahasa Inggeris atau menjawab keseluruhan soalan di dalam Bahasa Malaysia.

ENGLISH VERSION OF THE QUESTION PAPER

1. A. Big O notation.

(a) Give the definition of the big O notation.

(b) What is its application for algorithms?

(c) Are the following statements right or false? Justify rapidly.

(i) 2n is O(n)

(ii) $\log_a n$ is $O(\log_b n)$

(iii) n is $O(n^2)$

(iv) n^2 is O(n)

B. Retrieval.

(a) Let A be a completely balanced binary tree (all possible nodes present until a certain level) with an integer value on each node.

On each node, value(any node in left subtree) < value(node) < value(any node in right subtree).

(i) How do you call such a data structure?

(ii) Give a good algorithm to retrieve an integer from A.

(iii) What is the average number of comparisons needed to retrieve an integer from A? Justify.

(b) Let B be a completely balanced binary tree with an integer value on each node. On each node, value(node) < value(left daughter) and value(node) < value(right daughter).

(i) How do you call such a data structure?

(ii) Give a good algorithm to retrieve an integer from B.

(iii) What is the average number of comparisons needed to retrieve an integer from B? Justify.

B. Ackermann's function is a function of two variables. Here is its formal definition.

$$f(0,n) = n + 1$$
$$f(m,0) = f(m-1,1)$$
$$f(m,n) = f(m-1,f(m,n-1))$$

(a) Write a recursive program in C to compute this function for any (m,n).

(b) What is its asymptotic behavior in time and space?

(c) Write a program in C without recursion for this function.

(d) What is its asymptotic behavior in time and space?

[43/100]

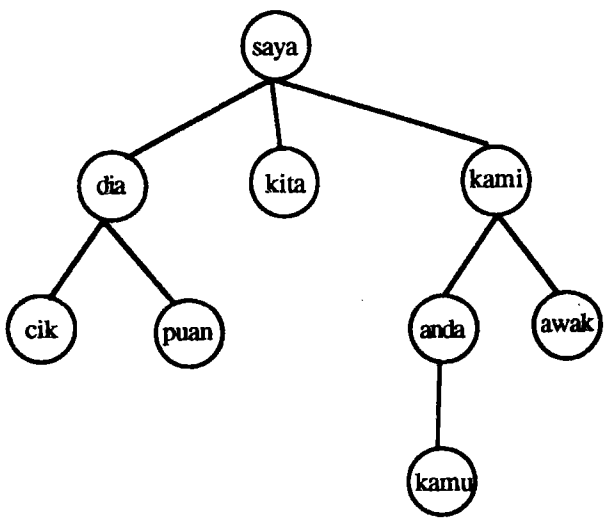
2. A. Traversal of trees.

(a) What is preorder traversal? Give an algorithm.

(b) What is postorder traversal? Give an algorithm.

(c) What is inorder traversal? For which kind of trees is it used? Give an algorithm.

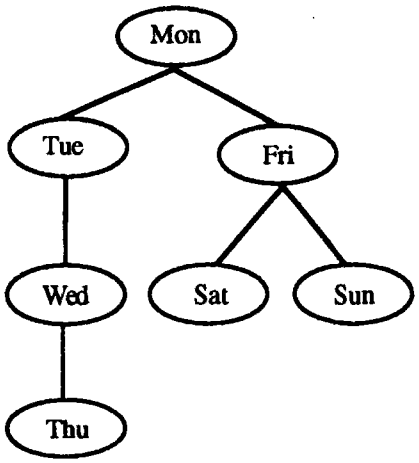
(d) Give the output of preorder and postorder traversals on the following tree.

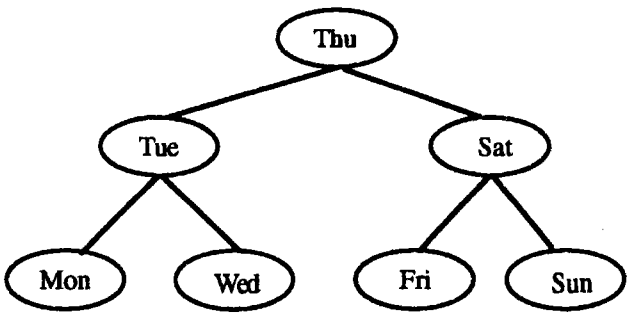


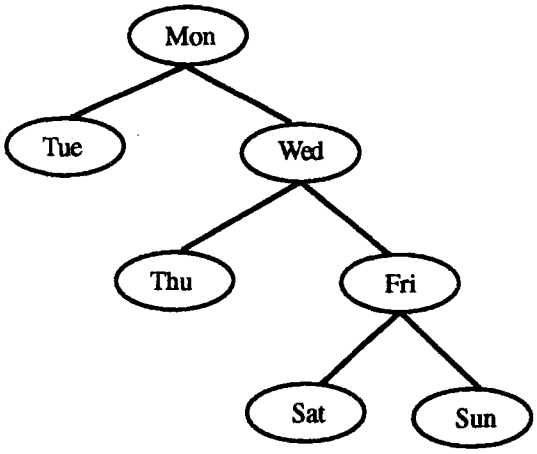
B. AVL trees.

(a) Give the definition of AVL trees.

(b) Here are three trees. Which are AVL trees, which are not. Justify.

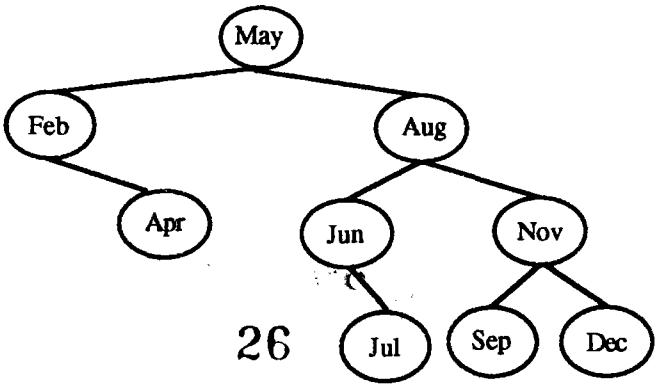






(c) Give an algorithm to insert a new value into an AVL tree.

(d) Show step by step what happens when you insert Oct in the following AVL tree which reflects the ordering of months in the year.

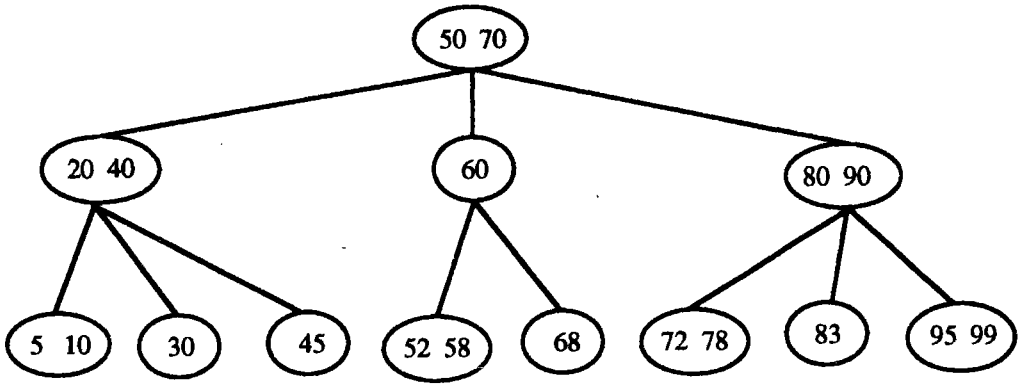


(e) Give an algorithm to delete a value from an AVL tree.

(f) Show step by step what happens when you delete Aug from the original AVL tree (without Oct).

C. B-trees.

Here is a B-tree of order 3.



(a) Show step by step what happens when the following keys are inserted into the original tree.

53, 66, 76, 97

(b) Show step by step what happens when the following keys are deleted from the original tree.

30,68,70

D. Binary trees.

Give the number of possible binary trees that can be built with n nodes.

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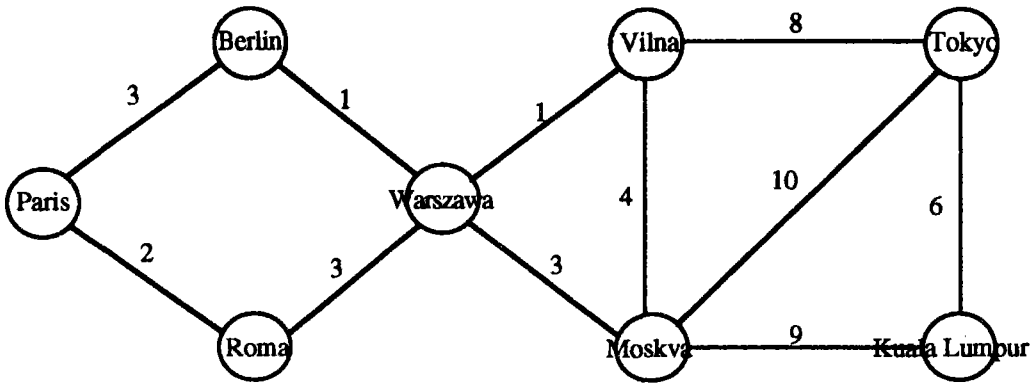
3. A. Here is a graph.



(a) Give a matrix representation of this graph.

(b) Suppose the number on the arcs represent path lengths between the nodes.

(i) Give an algorithm to find the shortest path between two nodes.

(ii) Simulate the algorithm step by step for the shortest path between Paris and Tokyo.

(c) A graph can be represented by a list of triples giving:
the row and the column in the matrix and the path length.

(i) Use this representation for the previous graph.

(ii) Give an algorithm to produce this representation from the matrix representation.

B. General graphs.

Give the number of connected graphs that can be built with n nodes and n-1 arcs.

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4. Consider a hash table of 13 entries for which collisions are solved by chaining.

Here is a list of values:

10, 100, 32, 45, 58, 126, 3, 29, 200, 400, 0.

(a) Show the result of entering these values in that order in the hash table with the hashing function: modulo 13.

(b) Show the result of entering these values in that order in the hash table with the hashing function: sum of digits modulo 13.

(c) Give a perfect hashing function for these data. Show the result.

[8/100]

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