

1. (5%) We define that a  $k$ -ary tree is a tree with the degree  $k$ . If a full  $k$ -ary tree has  $L$  leaves, how many internal nodes does the tree have?
2. (5%) Describe advantages using doubly linked list (compared to singly linked lists).
3. (5%) Transfer a prefix expression to an infix expression.  
 $+ 9 / * 4 ^ 8 ^ 2 3 + 7 5$
4. (10%) In a doubly linked list, each node contains a *rlink* pointer pointing to its next node and a *llink* pointer pointing to its previous node. Assume a node  $x$  (not null) is in the list. If you need to insert a node  $y$  right after the node  $x$ , what instructions you should perform? (Note: You can use any programming language you prefer.)
5. (10%) Prove or disprove the statement below.  
Using both preorder and postorder sequences can define a unique binary tree.
6. (15%) Devise an algorithm to perform a circular queue. Your algorithm should include *insert* and *delete* functions. You should also implement functions to check if the circular queue is *full* or *empty*.
7. (15%) Which data structure(s) will you use in implementing an algorithm to solve the following problems?
  - (7-1) Non-recursive solution to the eight-queen problem.
  - (7-2) Compute the exact value of  $n!$  where  $n$  is an arbitrary integer.
  - (7-3) Sorting 300000 records; the length of each record ranges from 12000 characters to 15000 characters. Key length is 10 bytes.
  - (7-4) Find the words which appear in both two given English articles.
  - (7-5) The traveling salesperson problem.

Please choose from the following and briefly explain your choice.

- [A] heap      [B] queue      [C] hash table      [D] linked list  
[E] file      [F] stack      [G] binary tree      [H] graph/network

(背面仍有題目,請繼續作答)

8. (8%) Show that if  $f(n) = \sum_{i=0}^m a_i n^i = a_m n^m + a_{(m-1)} n^{(m-1)} + \dots + a_2 n^2 + a_1 n + a_0$  where  $a_m > 0$ , then  $f(n) = \Omega(n^m)$ .

9. (5%) Prove or disprove the statement below:

Given two non-negative functions  $f(n)$  and  $g(n)$ . If  $f(n) = \Theta(g(n))$ , then  $g(n) = \Theta(f(n))$ .

10. (12%) Given the graph  $G$  in Figure 1, please answer the following:

(10-1) How would you represent  $G$  in a program? Explain your reason. (4%)

(10-2) Give the strongly connected components of  $G$ . (4%)

(10-3) What is BFS(K) spanning tree(s) of  $G$ . (4%)

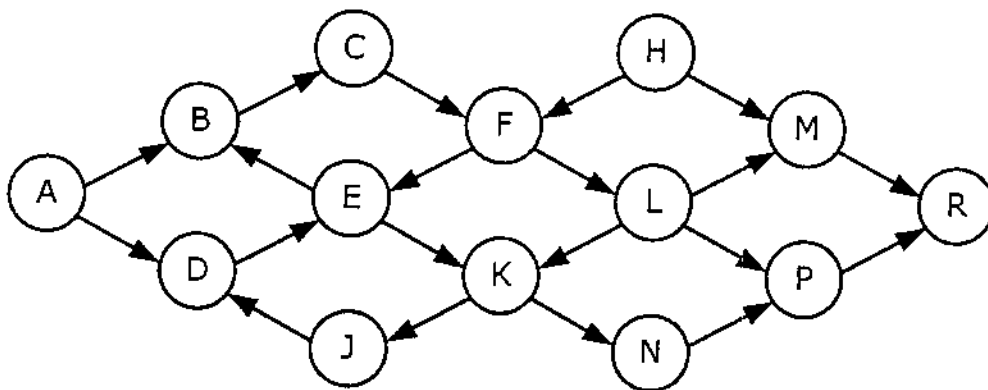


Figure 1

11. (10%) Explain briefly the following terms:

(11-1) Articulation point

(11-2) Level-order traversal

(11-3) Radix sort

(11-4) Threaded binary tree

(11-5) Bipartite graph