

University of Swaziland
DEPARTMENT OF COMPUTER SCIENCE
Supplementary Examination

JULY 2014

Title of paper : Data structures

Course number : CS342

Time Allowed : Three(3) hours

Instructions :

- *Each question is worth 20 marks*
- *Answer any five (5) questions*

This paper may not be opened until permission has been granted by the invigilator

Question 1

(i) Consider the following record declaration.

```
Var P : Record
    PIN      : string[6]
    Firstname : sting[15]
    Lastname  : string[20]
    Age       : Integer;
End;
```

Assume each character requires 1 byte, each integer requires 4 bytes and the base address of P is 500. A string is an array of characters.

- (a) Show sample allocation of record P in RAM. 5 marks
- (b) How many bytes are used to store record P. 3 marks
- (c) What is the base address of each field of P. 6 marks

(ii) Let L be a list of N real numbers. What is the total number of bytes required to store L assuming a linked list implementation of L. 6 marks

Question 2

Assuming that each character requires 1 byte, each integer requires 4 bytes, each pointer requires 4 bytes and each real number requires 8 bytes.

(i) Let B[1..5, 1..3] be a 2-dim array of integer numbers. Whose values are as follows:

```
B =  30   5   0
     7   8   9
     33  4  12
     22  2   7
     300 150 -20
```

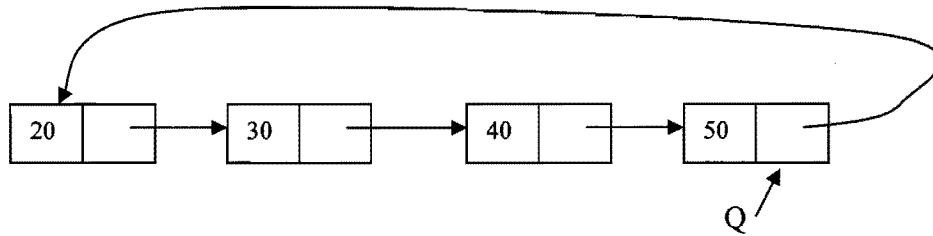
Let the base address of B be 500.

- (a) Show the memory allocation of B using column major order? 5 marks
- (b) Show the memory allocation of B using row major order? 5 marks
- (c) How many bytes are required to store array B in the row major order? 3 marks
- (d) Which one requires more storage space, column major or row major order? 2 marks

(ii) Write the general array mapping function for a 2-dim array. Assuming column major order. 5 marks

Question 3

A circular queue may be implemented using pointers as shown in the following diagram.



The leftmost node is in the front of the queue, and the rightmost node is in the back of the queue. Pointer Q points to the back of the queue. Elements are added on the back of the queue and removed from the front of the queue. Using C++/C#/Java notation, describe how the queue may be implemented. You must define the structure and the operations on the queue. For each operation, write the pseudocode and estimate its running time using big-oh notation. 20 marks

Question 4

- (i) Construct an *ordered binary tree* T for the following values.

100 50 100 20 40 60 250 15 70 75 65 20 150
300 170 350 38 39

Assume values are inserted in the given order.

7 marks

- (ii) What is the root node of tree T constructed above? 1 mark
- (iii) What is the height of tree T? 1 mark
- (iv) What is the depth of node 70 in tree T? 1 mark
- (v) What is the path from the root node to node 39? 1 mark
- (vi) List all node values in T assuming preorder traversal? 2 marks
- (vii) List all node values in T assuming level order traversal? 2 marks
- (viii) Trace the execution of iterative preorder traversal algorithm on tree T.

5 marks

Question 5

Construct an *ordered B-tree* T of order 5 for the following values.

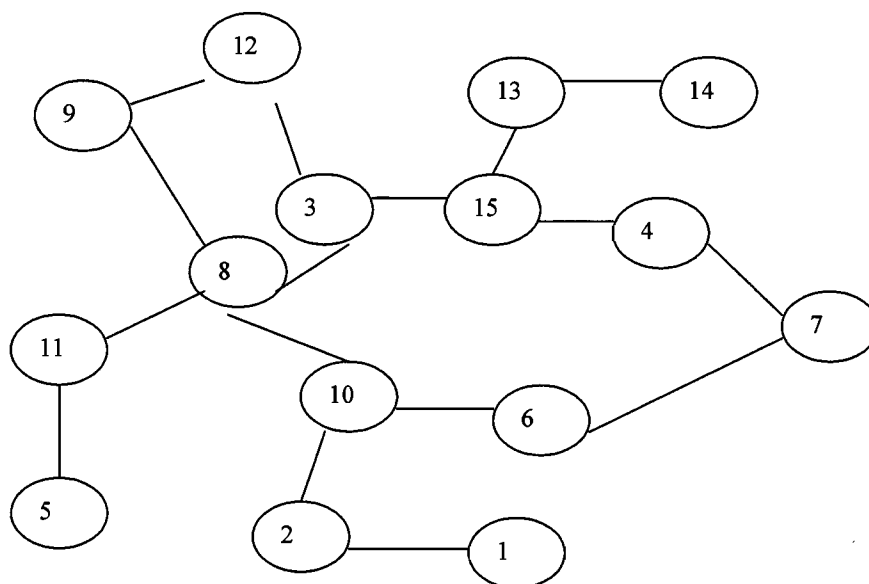
105	500	150	20	400	60	25	15	70	75	65	200
150	300	170	38	350	39	60	50	34	120	10	68

Assume values are inserted in the given order.

20 marks

Question 6

Consider the following graph G.



- (i) Show the adjacency matrix representation of the above graph. G. *5 marks*
- (ii) Show the adjacency list representation of the above graph G. *5 marks*
- (iii) Trace the execution of the Breadth First Search (BFS) algorithm on the above graph starting from node 10. Assume adjacent nodes are visited in chronological order. *10 marks*