SLIATE

SRI LANKA INSTITUTE OF ADVANCED TECHNOLOGICAL EDUCATION

(Established in the Ministry of Higher Education, vide in Act No. 29 of 1995)

Higher National Diploma in Information Technology

First Year, Second Semester Examination – 2015

IT1211 / IT2003 - Data Structures and Algorithms

Instructions for Candidates:
Answer four (4) questions only.

No. of questions : 05
No. of pages : 04
Time: Two (2) hours

01.

i. What is an algorithm? Give two properties of an algorithm. (4 marks)

ii. What is the importance of studying data structures and algorithms? (3 marks)

iii. Differentiate linear and non – linear data structures using suitable examples. (4 marks)

iv. Write a function that determines whether a string is a palindrome (i.e. reads the same backward and forward; e.g. "level"). (6 marks)

v. Write a program to create following two matrices A, B and display the addition A+B on the screen. $A = \begin{bmatrix} 1 & 4 \\ 3 & 1 \end{bmatrix}$ $B = \begin{bmatrix} 1 & 6 \\ 2 & 0 \end{bmatrix}$ (8 marks)

(Total 25 marks)

02.

i. What does the acronym LIFO stand for? (1 mark)

ii. Define stack overflow and stack underflow. (4 marks)

iii. What is the main advantage of using linked list to implement a stack rather than an array? (4 marks)

iv. In the following sequence of characters, each letter represents an insertion and operator represents a deletion. If you perform their operation in an empty stack, show its content after each operation. (7 marks)

S I m p * + L e + +

v. A stack can be stored in an array, using an integer index to record the next free position in the array. Write algorithms to perform following operations for this stack representation.

a. Pop () (3 marks)

b. Push (x) (3 marks)

c. IsEmpty () (3 marks)

(Total 25 marks)

03.

i. Define Queue data structure. (2 marks)

ii. Briefly explain the following operations in Queue.

a. New / initializeQueue()

b. EnQueue / enQueue(x)

c. DeQueue / deQueue()

d. Empty? / isEmpty()

e. Full? / isFull() (5 marks)

iii. To implement a queue using circular array we need the following data fields:

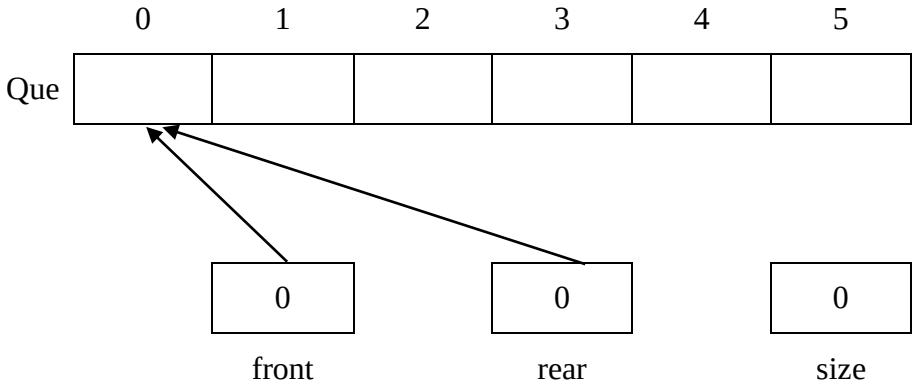
An array - Que[] (for example an integer array of size 6)

The array index of the front item – front (initial value 0)

The array index of the rear item – rear (initial value 0)

The number of elements currently in the queue – size (initial value 0)

The following figure shows the initial state of the array and other data.



Draw state of the array and other data after executing each of the following operations.

a. enQueue(10)

b. enQueue(17)

c. deQueue()

d. enQueue(3)

e. deQueue() (5 marks)

iv. Define a class Queue in C++ to implement the above queue with the given data fields and following methods.

- Constructor to initialize data members
- Enqueue (x)
- Dequeue () (9 marks)

v. Write the output of the following main() method.

```
void main()
{
        Queue q;
        q.enQueue(5);
        q.enQueue(9);
        q.enQueue(7);
        int x=q.deQueue();
        q.enQueue(2);
        q.enQueue(6);
        q.enQueue(3);
        cout<<q.deQueue();
}
```

(4 marks)

(Total 25 marks)

04.

i. Memory is allocated dynamically for linked list and trees. Briefly explain what dynamic memory allocation is. (3 Marks)

ii. List two (02) application areas of trees. (2 Marks)

iii. Suppose you have a singly-linked list declared as follows:

```
class  MyList
{
        private:
                struct ListNode          // Declare a structure for the list
                {
                        float value;
                        struct ListNode *next;
                };

                ListNode *head;             // List head pointer
         public:
                MyList (void)               // Constructor
                        { head = NULL; }

 };
```

Use the above declaration to write C++ implementations to accomplish the following tasks.

a. Add an element to the end of the list (4 marks)

b. To check whether the list is empty (3 marks)

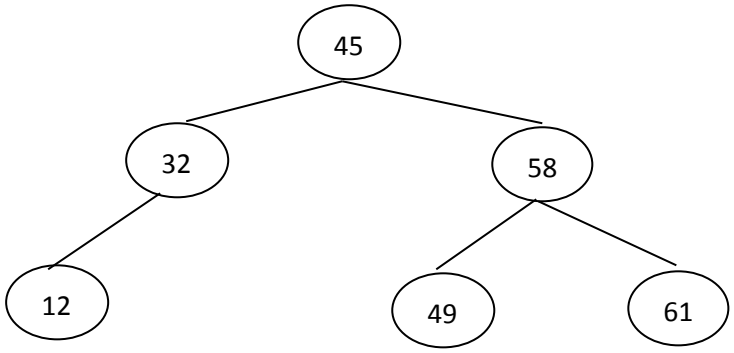
c. Display list. (4 marks)

iv. Graphically explain the following tree operations to the given binary search tree.

a. Inserting a new node - (74) (3 marks)

b. Searching a given key value – (49) (3 marks)

c. Deleting a node with one child – (32) (3 marks)



(Total 25 marks)

05.

i. Define Best, Worst and Average case efficiencies. (6 marks)

ii. Write C++ code to implement bubble sort. (4 marks)

iii. Sort the following unordered data set using Insertion sort. Explain each step graphically. (5 marks)

23, 8, 17, 5, 35, 15

iv. Write the algorithm for binary search. (4 marks)

v. Consider the following sorted data set. Search 25 using binary search algorithm indicating the sequence of array elements at each step. (6 marks)

10,15,25,30,33,34,36

(Total 25 marks)