Data Structures

**Part A (5 \* 2 =10)**

1. Consider the following stack of city names where STACK is allocated with a total of 6 memory cells. STACK: LONDON, BERLIN, ROME, PARIS, \_\_\_\_\_\_\_\_\_\_,\_\_\_\_\_\_\_\_. Describe the STACK and the value of the top for each of the following operations, when it is executed sequentially. Initially top pointing to PARIS.
2. PUSH(STACK, Athens)
3. POP(STACK,ITEM)
4. POP(STACK,ITEM)
5. PUSH(STACK, Madrid)
6. When the below code is executed for a queue data structure and suppose that QUEUE q is represented by a linked list. Draw the state of the front and rear and queue q after each operation is executed sequentially.
7. q.insert(1)
8. q.insert(3)
9. q.delete()
10. q.insert(4)
11. Suppose that you have a linked list which contains only one node and you are invoking a method which deleted the node on the list. Write the statement which checks this condition and performs the operation.

Note: Assume there are Head and Tail nodes pointing to the first node in the linked list.

1. Recursively reverse the array and draw the trace of the recursive call.
2. For the following array B, compute the dimension of B and the address of B [7][2]. Array: B is a row-major matrix, column index: 0:5, Row Index: 0:15, Base address: 1003, Size of the memory location: 4 bytes.

**Part B (5 \*4 =20)**

1. Suppose a priority queue is maintained as a one-way list with the priority number and the info part as the data field. Write a procedure to add an ITEM with priority number N to the queue and to remove an element from the queue.
2. Perform the following operations in a queue of size 7 sequentially:
3. Enqueue 12
4. Enqueue 3
5. Enqueue 45
6. Enqueue 1
7. Enqueue 10
8. Dequeue
9. Dequeue
10. Enqueue 78
11. Dequeue
12. Dequeue
13. Suppose the following stack of integers is in memory where STACK id allocated N=6 memory cells. TOP=3 STACK: 5, 2, 3, \_, \_, \_\_. Find the output of the following program segment.

CALL POP (STACK, ITEMA)

CALL POP (STACK, ITEMB)

CALL PUSH (STACK, ITEMB+2)

CALL PUSH (STACK,8)

CALL PUSH (STACK, ITEMA, ITEMB)

Repeat while TOP! = 0

CALL POP (STACK, ITEM)

Write ITEM

1. Write a recursive function to generate Fibonacci series.

**Part C (2 \*10 =20)**

1. Write an algorithm for evaluating a postfix expression
2. Convert the expression ((5+3 ) \* (9-8) /(4\*(3+6)) to postfix and evaluate the postfix using the stack.
3. Write a procedure for the following:

a) Finds the number of nodes in the list.

b) Finds the number of times a given ITEM occurs in the list

c) Finds the number of non-zero elements in the list.,

d) Deletes the kth element in the list.

e) Insert at the end of the list.

**Part A (3 \* 10 = 30)**

1. Evaluate the following postfix expression with a single digit operands 8 2 3 ^ / 2 3 \* + 5 1 \* - . Find the top element of the stack after the first \* is evaluated. What is the result of evaluating the above expression?
2. Suppose a queue us maintained by a circular array with N = 12 memory cells. Find the number of elements in the queue if
3. FROINT = 4, REAR = 8
4. FRONT = 10, REAR = 3.
5. After deleting two elements when FRONT = 10, REAR = 3.
6. Write a Remove Duplicates () function which takes a list sorted in increasing order and deleted any duplicate nodes from the list. Ideally, the list should only be traversed one.
7. Write pseudo code for performing the following operations on a doubly linked list.
8. Insert at the beginning
9. Finding the length of the lists.

**Part B (5 \* 4 = 20)**

1. For the following pseudocode of a recursive program modular which computes **a mod b** given a, b as inputs, trace the following recursion during the execution of the call mod (23, 7).

Procedure modular (a,b)

If (a<b) then mod : = a

else

{

x1:= a – b

y1:= modular (x1, b)

mod=:= y1

}

end mod

1. A linear list is maintained circularly in an array C (1: n) with F and R set up as for circular queues.
2. Obtain a formula in terms of F, R and n for the number of elements in the list.
3. Write an algorithm to delete the kth element.
4. Write an algorithm to insert an element Y immediately after the Kth element.

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1. A deck of card contains 52 playing cards. Assuming that the deck of cards is organised sequentially in a singly linked list containing 52 nodes, create a new method shuffle() that shuffles the deck of the cards , Explain your method clearly. **(5 marks)**
2. What does the following function do? Explain your answer by tracing this function for n = 10. **(5 marks)**

Void fun (int n)

{

Int Queue q;

q.enqueue(0);

q.enqueue(1);

for ( int I =0: i<n; i++)

{

int a = q.dequeue();

int b = q.dequeue();

q.enqueue(b);

q.enqueue(a+b);

print (a);

}

}

1. Write the postfix expression form of the given infix expression (A+ B – C \* (XY /(Z \* K))-d) using stack, Show your work in a table when each character is processed. **(5 marks)**
2. Write a procedure that will reverse a linked list while traversing it only once. At the conclusion, each node should point to the node that was previously its predecessor: the head should point to the node that was formerly at the ends, and the node that was formerly first should have a null link. Trace your algorithm to demonstrate its correctness over a linked list with atleast 4 nodes. (5 marks)
3. What is the significance of asymptotic notations?
4. Assume that the array a contains n values, that the method randomValue takes constant number c of computational steps to produce each output value, and that the method good Sort takes n log n computational steps to sort the array. Determine the Big-Oh complexity for the following fragment of code taking into account the above computational steps, demonstrate the steps.

For (int i =0; i<n; i++)

{

For (j=0; i<n; j++)

A[j] = randomValue(i);

goodSort(a);

}

1. Which functions grows faster? Explain your answer.
2. N log n
3. N^1.5