→ Please Recheck Q-1 (b) [My Ans gives the required output + extra output]

No change.

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Group 02

MINOR I : CSL201
(Data Structures)

Max. Time - 1 hr   Max. Marks 40   Date: 9/Feb/2014

NOTE:

i. *Write your name, entry number and group in all the sheets.*
ii. *Answer all questions in the space provided and continue on the back page of the question if required.*
iii. *Answer given elsewhere will be ignored.*
iv. *For rough work use blank page at the end and space in right margin of each sheet.*
v. *No marks for only answers. Show the working if required.*

Q1 - 9	Q2 - 11	Q3 - 11	Q4 - 9	Total - 40
3	6	5	9	23

(3)

Q1. (9)

a. Solve the following recurrence relation to compute the complexity of an algorithm.

$$T(n) = a, \text{ when } n = 0$$
$$= b + c * n + T(n-1), \text{ otherwise}$$

Here 'n' is the size of the input, a ,b & c are constants and T(n) represents the running time of an algorithm on an input of size n. (2)

$b \to (n-1)$

$c \to 2+3+\cdots+n$

$\frac{(n)(n+1)}{2} - 1$

$= \frac{n^2+n-2}{2}$

$T(n) = (n-1)b + \left(\frac{n^2+n-2}{2}\right)c + T(1)$

$= (n-1)b + \left(\frac{n^2+n-2}{2}\right)c + b + c + T(0)$

$= (n)b + \left(\frac{n^2+n}{2}\right)c + a$

$\therefore T(n) = n*b + \left[\frac{n(n+1)}{2}\right]*c + a$

$O(n^2)$

$T(0) = a$

$T(1) = b + c + a$

$T(2) = b + c*2 + (a+b+c)$

$= 2b + 3c + a$

$T(n) = b + c*n + T(n-1)$

$= b + c*n + [b + c*(n-1) + T(n-2)]$

$= b + c*n + [b + c*(n-1) + [b + c*(n-1) + T(n-2)]]$

$= b + c*n + [b + c*(n-1) + b + c*(n-2) + b + c*(n-3) + \cdots + b + c*(n-(n-2)) + T(1)]$

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b. You are given a sparse matrix M (n X m) containing real values with first element stored at M(1, 1). It contains 't' number of non zero elements. Assume that it is represented using an array A[0 .. t] of structure containing three fields {r, c, value}. At 0^{th} index of A, number of rows, number of columns and number of non-zero elements are stored. Non-zero elements are stored from 1 to t indices of A in increasing order of row and then column. Write an algorithm to compute number of non zero elements in i^{th} row and j^{th} column of M using array A. (7)

$$M = \begin{bmatrix} 1,1 & 1,2 \cdots & 1,m \\ 2,1 & & \\ \vdots & & \\ n,1 & n,2 & n,m \end{bmatrix}$$

A [0 . . . . t]

	r	c	value
A[0]	n	m	t
A[1]	–	–	–
A[2]	–	–	–
⋮			
A[t]	–	–	–

```
for i = 1 to n : { S[i] = 0 }
for i = 1 to m : { R[i] = 0 }
for K = 1 to t
        { S[A[K,1]] = S[A[K,1]] + 1 }

for l = 1 to t
        { R[A[l,2]] = R[A[l,2]] + 1 }
```

S[i] – gives no. of non zero elements in i^{th} row

R[j] – gives no. of non zero elements in j^{th} column

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You were not supposed to [illegible] no of non zero elements [illegible] rows and columns

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Group O2
Q2. (II)

a. Represent a lower triangular (elements above main diagonal of a square matrix are zero) matrix L(n X n) row wise using one dimensional array X. starting with 1 index. Assume the first element of a matrix is stored at L(1, 1) and in an array at X(1). Answer the following questions.

(6)

i. What is the maximum dimension of X? (1)

$$\left(\frac{n^2+n}{2}\right)$$

1

ii. Compute the address of L(i, j), (i ≥ j) in an array X. (3)

$$\frac{(i-1)(i)(2i-1)}{6} + j$$

$$L[i,j] = L[i,1] + (j-1)$$

$$= \left[\frac{(i)(i-1)}{2} + 1\right] + (j-1)$$

$$L(i,j) = \frac{(i)(i-1)}{2} + j$$ — Address in X

3

$$\frac{2\times3\times5}{6} + 3$$

$$L(i,j) = L(i,1) + (j-1)$$

$$\left[\frac{(i-1)(i)(2i-1)}{6} + 1\right] + j - 1$$

$$L[3,1] \quad \frac{1\times2\times3}{6} + 1 + (j-1)$$

Rough

$$L(n \times n) = \begin{bmatrix} \ & 0 & 0 & 0 \\ & \ddots & & \\ & & & \end{bmatrix}$$

$2\times2 = 3$, $3\times3 = 6$, $4\times4 = 10$

$$n^2 - [(n-1) + (n-2) + \dots + 1]$$

$$n^2 - \frac{(n-1)(n)}{2}$$

$$\frac{2n^2 - n^2 + n}{2}$$

$$\frac{n^2+n}{2}$$

$$[3\times3] = \begin{bmatrix} 1 & 0 & 0 \\ 2 & 3 & 0 \\ 4 & 5 & 6 \end{bmatrix}$$

$$1^2 + 2^2 + \dots (i-1)^2$$

$$\frac{n(n+1)(2n+1)}{6}$$

$$\frac{1\times2\times3}{6}$$

X = [1 2 3 4 5 6]

L(1,1) = X(1)

L(2,1) = X(2)

L(3,2) = 5

L(3,3) = 6

L(i,1) + (j-1)

$L(2\times2) = \begin{bmatrix} 1 & 0 \\ 2 & 3 \end{bmatrix}$

X = [1 2 3]

L(1,1) = X(1)

L(2,1) = X(2)

L(2,2) = X(3)

$$\frac{(i-1)(i)}{2} + 1$$

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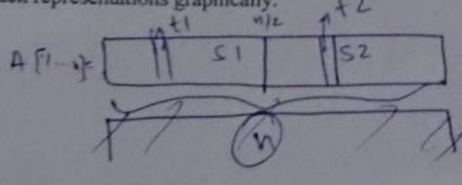
b. Give an optimal way of representing two stacks s1 and s2 in one dimensional array of integers of size n as A[1 .. n] in such a way that neither stacks overflows unless the total number of elements in both the stacks together are 'n'. Assume t1 and t2 are tops of stacks s1 and s2 respectively.

i. Show the stack representations graphically. (2)



ii. Initialize tops of both the stacks. (1)

t2 = −1

$t_1 = \frac{n}{2} - 1$

iii. Write function PUSH for handling both the stacks. (4)

```
void push(satck s, int v)
{ if s=s1 then

      if

}
```

nino the required output

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Q3. (11)

a. What is the postfix representation corresponding to infix expression a * b ^ c / d * (p - q * r)? Show the contents of stack. No marks for only answer. (5)

5

$ a*b^c/d*(p-q*r) $

((a* (b^c))/d)*(p-(q

Next Token	Stack	Output
$	$	nil
a	$	a
*	$ *	a
b	$ *	ab
^ // Priority(^)>Prio(*)	$ * ^	ab
c	$ * ^	abc
/	$ /	abc^*
d	$ /	abc^*d
*	$ *	abc^*d/
(	$ *(	abc^*d/
p	$*(	abc^*d/p
-	$ (-	abc^*d/p*
q	$ -	abc^*d/p*q
*	$ - *	abc^*d/p*q
r	$ - *	abc^*d/p*q r
)	$ - *)	abc^*d/p*q^
$	$	abc^*d/p*q^* -

3.5

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b. Write a pseudo function to insert a node with value 20 in the doubly linked list having elements stored in increasing order with the following pseudo structure definition. (6)

```
struct node_type {
                 struct node* left;
                 int         info;
                 struct node* right
                 };

node_type  p;


void insert(node_type p, int x)
{

    node_type *temp;          // l is start of linked list
     temp = l;
    while ( p -> info < x)
            temp = temp -> next
                   next is not defined
       p -> next  = temp



  main()
  { insert ( p, 20);

  }
```

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Q4. (9)

What will be the output of the following C++ program? Show the working of the execution.

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```
#include <iostream.h>
class test
{  private:    int x, y;
   public:
      void g_data (int a, int b)  {x = a; y = b;};
      void p_data (void)
           {    cout <<"The value of x = "<< x << '\n';
                cout << "The value of y =  "<< y << '\n';
           }
      int gnum (void) {return x + y;}
};
class test1 :  public test
{  private:     int  val;
   public:      void mul (int i, int j)
                  {  g_data(i,j); val =gnum();
                     p_data();
                     cout<<"value of val =  "<<val + val<<'\n';
                  }
};

main( )
{
      test p; test1 t;
      p . g_data(1,2);
      p . p_data();
      t . mul (3 , 6);
}
```

Output:

The value of x = 1
The value of y = 2
The value of x = 3
The value of y = 6
value of val = 18

p is an object of class test
t is an object of class test1
p . g_data(1,2)
x = 1 ; y = 2
p . p_data()
t . mul (3, 6)
i = 3 j = 6
g_data (3, 6) => x = 3 y = 6
val = gnum() = 3+6 = 9
p_data();
val + val = 9+9 = 18

9

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