

## Assignment: 8

Name: Ujjwal Kumar Jha

Registration No. 20194196

Group: C<sub>2</sub>

### 1. WAP to implement Sparse Matrix using a. Triplet representation.

```
#include <stdio.h>
#include <stdlib.h>
int **sp,**trip,m,n,count;
int main(){
printf("Please enter the number of row and column of the matrix you wanna create:
\n");
scanf("%d%d",&m,&n);

int i,j;
sp=(int **)malloc(m*sizeof(int *));
for(i=0;i<m;i++){
    *(sp+i)=(int *)malloc(sizeof(int));
printf("\nPlease Enter the elements of sparse matrix you wanna create:\n");
for(i=0;i<m;i++){
    for(j=0;j<n;j++){
        printf("please provide the input data for [%d][%d]\t",i+1,j+1);
        scanf("%d",&sp[i][j]);}

int k=0;
count=0;
for(i=0;i<m;i++){
    for(j=0;j<n;j++){
        if(sp[i][j]!=0)
            count++;
trip=(int **)malloc((count+1)*sizeof(int));
for(i=0;i<(count+1);i++)
```

```

*(trip+i)=(int *)malloc(3*sizeof(int));
trip[0][0]=m;
trip[0][1]=n;
trip[0][2]=count;
for(i=0;i<m;i++)
for(j=0;j<n;j++)
if(sp[i][j]!=0){
    trip[k][0]=i+1;
    trip[k][1]=j+1;
    trip[k][2]=sp[i][j];k++;
}
printf("\nJust Have a look to triplet representation of the matrix you have created:\n");
printf("Row\tColumn\tValue at that point\n");
for(i=0;i<(count);i++){
    for(j=0;j<3;j++)
        printf("%d\t",trip[i][j]);
printf("\n");
}
}
}

```

The screenshot shows the Visual Studio Code interface with a C program being executed. The terminal window displays the following output:

```

Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

Try the new cross-platform PowerShell https://aka.ms/pscore6

PS C:\Users\inspiron\Desktop\DS 8> gcc 1a.c
PS C:\Users\inspiron\Desktop\DS 8> ./a.exe
Please enter the number of row and column of the matrix you wanna create:
4
4

Please Enter the elements of sparse matrix you wanna create:
please provide the input data for [1][1] 9
please provide the input data for [1][2] 0
please provide the input data for [1][3] 0
please provide the input data for [1][4] 0
please provide the input data for [2][1] 8
please provide the input data for [2][2] 0
please provide the input data for [2][3] 0
please provide the input data for [2][4] 0
please provide the input data for [3][1] 5
please provide the input data for [3][2] 0
please provide the input data for [3][3] 0
please provide the input data for [3][4] 0
please provide the input data for [4][1] 5
please provide the input data for [4][2] 0
please provide the input data for [4][3] 0
please provide the input data for [4][4] 0

Just Have a look to triplet representation of the matrix you have created:
Row    Column  Value at that point
1      1      9
2      1      8
3      1      5
4      1      5

```

The bottom status bar of Visual Studio Code shows the file path as 'Ln 1, Col 1 Spaces: 4 UTF-8 CRLF C Win32'.

## b. Multi-linked Representation:

```
#include <stdio.h>
#include <malloc.h>
#define node struct node
node
{
    int row,col,value;
    node *nextrow,*nextcol;
};
node *head=NULL;
void create_MLlist(int m,int n)
{
    node *newnode,*ptr;
    int i=0;
    if(head==NULL)
    {
        head=(node *)malloc(sizeof(node));
        head->row=-1;
        head->col=-1;
    }
    ptr=head;
    while(n--)
    {
        newnode=(node *)malloc(sizeof(node));
        newnode->col=i++;
        newnode->row=-1;
        newnode->nextrow=newnode;
        ptr->nextcol=newnode;
        newnode->nextcol=head;
        ptr=newnode;
    }
    i=0;
    ptr=head;
    while(m--)
    {
        newnode=(node *)malloc(sizeof(node));
        newnode->row=i++;
        newnode->col=-1;
        newnode->nextcol=newnode;
        ptr->nextrow=newnode;
        newnode->nextrow=head;
        ptr=newnode;
    }
}
```

```

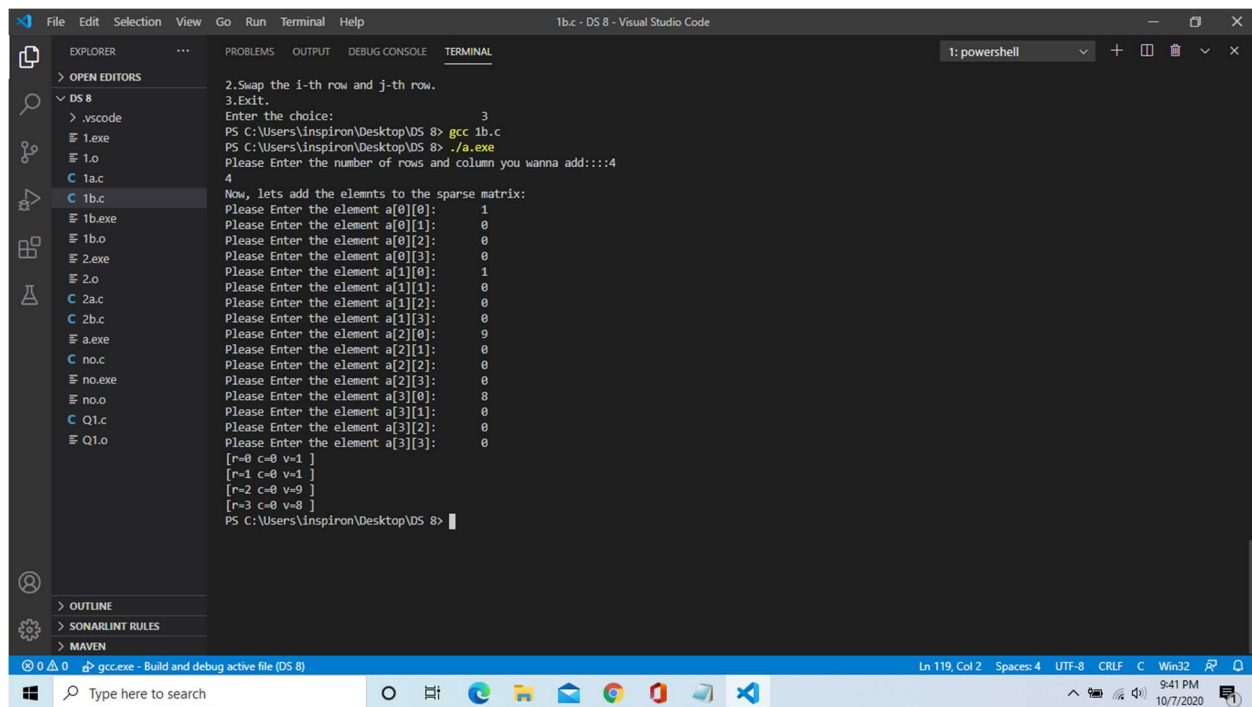
node *above(node *head,int r,int c)
{
    node *p=head,*q;
    while(p->col!=c)
    p=p->nextcol;
    do
    {
        q=p;
        p=p->nextrow;
    }while(p->row<r && p->row!=-1);
    return q;
}
node *left(node *head,int r,int c)
{
    node *p=head,*q;
    while(p->row!=r)
    p=p->nextrow;
    do{
        q=p;
        p=p->nextcol;
    }while(p->col<c && p->col!=-1);
    return q;
}
void insertion(int r,int c,int v)
{
    node *a,*l,*newnode;
    a=above(head,r,c);
    l=left(head,r,c);
    newnode=(node *)malloc(sizeof(node));
    newnode->row=r;
    newnode->col=c;
    newnode->value=v;
    newnode->nextrow=a->nextrow;
    newnode->nextcol=l->nextcol;
    a->nextrow=newnode;
    l->nextcol=newnode;
}
void display()
{
    node *ptr=head->nextrow,*q=ptr->nextcol;
    while(ptr->row!=-1)
    {
        while(q->col!=-1)
        {
            printf("[r=%d c=%d v=%d ]  ",q->row,q->col,q->value);

```

```

        q=q->nextcol;
    }
    printf("\n");
    ptr=ptr->nextrow;
    q=ptr->nextcol;
}
}
int main()
{
    int r,c,opt;
    printf("Please Enter the number of rows and column you wanna add:::");
    scanf("%d %d",&r,&c);
    create_MLlist(r,c);
    printf("Now, lets add the elemnts to the sparse matrix:\n");
    int i,j,x,y;
    int a[r][c];
    for(i=0;i<r;i++)
    {
        for(j=0;j<c;j++)
        {
            printf("Please Enter the element a[%d][%d]:\t",i,j);
            scanf("%d",&a[i][j]);
            if(a[i][j]!=0)
            {
                insertion(i,j,a[i][j]);
            }
        }
    }
    display();
}

```



```
File Edit Selection View Go Run Terminal Help
1b.c - DS 8 - Visual Studio Code

EXPLORER
> OPEN EDITORS
DS 8
  .vscode
  1.exe
  1.o
  1.a.c
  1b.c
  1b.exe
  1b.o
  2.exe
  2.o
  2.a.c
  2b.c
  a.exe
  no.c
  no.exe
  no.o
  Q1.c
  Q1.o

PROBLEMS OUTPUT DEBUG CONSOLE TERMINAL
1: powershell

2.Swap the i-th row and j-th row.
3.Exit.
Enter the choice: 3
PS C:\Users\inspiron\Desktop\DS 8> gcc 1b.c
PS C:\Users\inspiron\Desktop\DS 8> ./a.exe
Please Enter the number of rows and column you wanna add:::4
4
Now, lets add the elemnts to the sparse matrix:
Please Enter the element a[0][0]: 1
Please Enter the element a[0][1]: 0
Please Enter the element a[0][2]: 0
Please Enter the element a[0][3]: 0
Please Enter the element a[1][0]: 1
Please Enter the element a[1][1]: 0
Please Enter the element a[1][2]: 0
Please Enter the element a[1][3]: 0
Please Enter the element a[2][0]: 9
Please Enter the element a[2][1]: 0
Please Enter the element a[2][2]: 0
Please Enter the element a[2][3]: 0
Please Enter the element a[3][0]: 8
Please Enter the element a[3][1]: 0
Please Enter the element a[3][2]: 0
Please Enter the element a[3][3]: 0
[n=4 c=4 v=1 ]
[n=4 c=4 v=1 ]
[n=2 c=4 v=9 ]
[n=3 c=4 v=8 ]
PS C:\Users\inspiron\Desktop\DS 8>
```

## 2. WAP to implement the following for both the representations.

- Delete the i-th row from the Sparse Matrix.
- Swap the i-th row and j-th row of the Sparse Matrix.

### i. Triplet Representation:

```
#include <stdio.h>
int main()
{
    int r,c,opt;
    printf("Please Enter the number of rows and column you wanna add::");
    scanf("%d %d",&r,&c);
    printf("Now, lets add the elemnts to the sparse matrix:\n");
    int i,j,n=0,x=0,y,I,J;
    int a[r][c];
    for(i=0;i<r;i++)
    {
        for(j=0;j<c;j++)
```

```

    {
        printf("Please Enter the element a[%d][%d]:\t",i,j);
        scanf("%d",&a[i][j]);
        if(a[i][j]!=0)
        {
            n++;
        }
    }
}
int t[n][3];
for(i=0;i<r;i++)
{
    for(j=0;j<c;j++)
    {
        if(a[i][j]!=0)
        {
            t[x][0]=i;
            t[x][1]=j;
            t[x][2]=a[i][j];
            x++;
        }
    }
}
do
{
    printf("\n*****Main Menu*****");
    printf("\n1.Delete the i-th row.");
    printf("\n2.Swap the i-th row and j-th row.");
    printf("\n3.Exit.");
    printf("\nEnter the choice:");
    scanf("%d",&opt);
    switch(opt)
    {
        case 1:
            printf("\nPlease Enter the row number (i) you wanna delete:");
            scanf("%d",&x);
            for(i=0;i<n;i++)
            {
                if(x==t[i][0])
                {
                    for(j=i+1;j<n;j++)
                    {
                        t[j-1][0]=t[j][0];
                        t[j-1][1]=t[j][1];
                        t[j-1][2]=t[j][2];
                    }
                }
            }
        }
    }
}

```

```

        }
        n=n-1;
        i=i-1;
    }
}
printf("\nJust have a look at the matrix After deletion->\n");
for(i=0;i<n;i++)
{
    for(j=0;j<3;j++)
        printf("%d ",t[i][j]);
    printf("\n");
}
break;
case 2:
    printf("\nPlease Enter the values (i) & (j) you wanna swap:");
    scanf("%d %d",&x,&y);
    I=x<y?x:y;
    J=x>y?x:y;
    for(i=0;i<n;i++)
    {
        if(t[i][0]==I)
        {
            t[i][0]=J;
        }
        else if(t[i][0]>I)
            break;
    }
    for(j=i;j<n;j++)
    {
        if(t[j][0]==J)
        {
            t[j][0]=I;
        }
    }
    //Sorting
    for(i=0;i<n-1;i++)
    {
        for(j=0;j<n-i-1;j++)
        {
            if (t[j][0] > t[j+1][0])
            {
                int tr=t[j+1][0];
                int tc=t[j+1][1];
                int tv=t[j+1][2];
                t[j+1][0]=t[j][0];

```



```

        t[j+1][1]=t[j][1];
        t[j+1][2]=t[j][2];
        t[j][0]=tr;
        t[j][1]=tc;
        t[j][2]=tv;
    }
}
}
printf("\nHave A look at the matrix After Swaping->\n");
for(i=0;i<n;i++)
{
    for(j=0;j<3;j++)
        printf("%d ",t[i][j]);
    printf("\n");
}
break;
}
}while(opt!=3);
}

```

The screenshot shows the Visual Studio Code interface with a C program being executed. The terminal window displays the following output:

```

*****Main Menu*****
1.Delete the i-th row.
2.Swap the i-th row and j-th row.
3.Exit.
Enter the choice:1

Please Enter the row number (i) you wanna delete:3

Just have a look at the matrix After deletion->
0 0 1
1 0 9
2 0 4

*****Main Menu*****
1.Delete the i-th row.
2.Swap the i-th row and j-th row.
3.Exit.
Enter the choice:2

Please Enter the values (i) & (j) you wanna swap:2
3

Have A look at the matrix After Swaping->
0 0 1
1 0 9
3 0 4

*****Main Menu*****
1.Delete the i-th row.
2.Swap the i-th row and j-th row.
3.Exit.
Enter the choice:

```

The code editor shows the source file '2.c' with a cursor at line 15, column 58. The status bar at the bottom indicates the file is '2.c - DS 8 - Visual Studio Code' and the current position is 'Ln 15, Col 58'.

## ii. Multi linked representation:

```
#include <stdio.h>
#include <malloc.h>
#define node struct node
node
{
    int row,col,value;
    node *nextrow,*nextcol;
};
node *head=NULL;
void create_MLlist(int m,int n)
{
    node *newnode,*ptr;
    int i=0;
    if(head==NULL)
    {
        head=(node *)malloc(sizeof(node));
        head->row=-1;
        head->col=-1;
    }
    ptr=head;
    while(n--)
    {
        newnode=(node *)malloc(sizeof(node));
        newnode->col=i++;
        newnode->row=-1;
        newnode->nextrow=newnode;
        ptr->nextcol=newnode;
        newnode->nextcol=head;
        ptr=newnode;
    }
    i=0;
    ptr=head;
    while(m--)
    {
        newnode=(node *)malloc(sizeof(node));
        newnode->row=i++;
        newnode->col=-1;
        newnode->nextcol=newnode;
        ptr->nextrow=newnode;
        newnode->nextrow=head;
        ptr=newnode;
    }
}
```

```

    }
}
node *above(node *head,int r,int c)
{
    node *p=head,*q;
    while(p->col!=c)
        p=p->nextcol;
    do
    {
        q=p;
        p=p->nextrow;
    }while(p->row<r && p->row!=-1);
    return q;
}
node *left(node *head,int r,int c)
{
    node *p=head,*q;
    while(p->row!=r)
        p=p->nextrow;
    do{
        q=p;
        p=p->nextcol;
    }while(p->col<c && p->col!=-1);
    return q;
}
void insertion(int r,int c,int v)
{
    node *a,*l,*newnode;
    a=above(head,r,c);
    l=left(head,r,c);
    newnode=(node *)malloc(sizeof(node));
    newnode->row=r;
    newnode->col=c;
    newnode->value=v;
    newnode->nextrow=a->nextrow;
    newnode->nextcol=l->nextcol;
    a->nextrow=newnode;
    l->nextcol=newnode;
}
void deletion(int r,int c)
{
    node *p,*a,*l;
    a=above(head,r,c);
    l=left(head,r,c);
    p=a->nextrow;

```

```

    a->nextrow=p->nextrow;
    l->nextcol=p->nextcol;
    free(p);
}
void delete_ith_row(int r)
{
    node *p=head,*q;
    while(p->row!=r)
        p=p->nextrow;
    q=p->nextcol;
    while(p!=q)
    {
        deletion(q->row,q->col);
        q=p->nextcol;
    }
}

void swap_ithrow_with_jthrow(int ri,int rj)
{
    node *p=head->nextrow,*pi,*pj;
    while(p->row!=-1)
    {
        if(p->row==ri)
            pi=p;
        if(p->row==rj)
            pj=p;
        p=p->nextrow;
    }
    pi=pi->nextcol;
    pj=pj->nextcol;
    while(pi->col!=-1 && pj->col!=-1)
    {
        if(pi->col==pj->col)
        {
            int t=pi->value;
            pi->value=pj->value;
            pj->value=t;
            pi=pi->nextcol;
            pj=pj->nextcol;
        }
        else if(pi->col<pj->col)
        {
            insertion(pj->row,pi->col,pi->value);
            int r=pi->row;
            int c=pi->col;

```

```

        pi=pi->nextcol;
        deletion(r,c);
    }
    else
    {
        insertion(pi->row,pj->col,pj->value);
        int r=pj->row;
        int c=pj->col;
        pj=pj->nextcol;
        deletion(r,c);
    }
}
while(pi->col!=-1)
{
    insertion(pj->row,pi->col,pi->value);
    int r=pi->row;
    int c=pi->col;
    pi=pi->nextcol;
    deletion(r,c);
}
while(pj->col!=-1)
{
    insertion(pi->row,pj->col,pj->value);
    int r=pj->row;
    int c=pj->col;
    pj=pj->nextcol;
    deletion(r,c);
}
}

void display()
{
    node *ptr=head->nextrow,*q=ptr->nextcol;
    while(ptr->row!=-1)
    {
        while(q->col!=-1)
        {
            printf("[r=%d c=%d v=%d ]  ",q->row,q->col,q->value);
            q=q->nextcol;
        }
        printf("\n");
        ptr=ptr->nextrow;
        q=ptr->nextcol;
    }
}

```

```

}
int main()
{
    int r,c,opt;
    printf("Please Enter the number of rows and column you wanna add:::");
    scanf("%d %d",&r,&c);
    create_MLlist(r,c);
    printf("Now, lets add the elemnts to the sparse matrix:\n");
    int i,j,x,y;
    int a[r][c];
    for(i=0;i<r;i++)
    {
        for(j=0;j<c;j++)
        {
            printf("Please Enter the element a[%d][%d]:\t",i,j);
            scanf("%d",&a[i][j]);
            if(a[i][j]!=0)
            {
                insertion(i,j,a[i][j]);
            }
        }
    }
    do
    {
        printf("\n*****Main Menu*****");
        printf("\n1.Delete the i-th row.");
        printf("\n2.Swap the i-th row and j-th row.");
        printf("\n3.Exit.");
        printf("\nEnter the choice:");
        scanf("%d",&opt);
        switch(opt)
        {
            case 1:
                printf("\nPlease Enter the row number (i) you wanna delete::");
                scanf("%d",&x);
                delete_ith_row(x);
                printf("\nJust have a look at the matrix After deletion->\n");
                display();
                break;
            case 2:
                printf("\nPlease Enter the values (i) & (j) you wanna swap:");
                scanf("%d %d",&x,&y);
                swap_ithrow_with_jthrow(x,y);
                printf("\nHave A look at the matrix After Swaping->\n");

```

```

        display();
        break;
    }
}while(opt!=3);
}

```

```

File Edit Selection View Go Run Terminal Help
Zb.c - DS 8 - Visual Studio Code

EXPLORER
> OPEN EDITORS
DS 8
> .vscode
1.exe
1.o
1a.c
1b.c
1b.exe
1b.o
2.exe
2.o
2a.c
2b.c
a.exe
no.c
no.exe
no.o
Q1.c
Q1.o

TERMINAL
Please Enter the element a[3][2]: 0
Please Enter the element a[3][3]: 0

*****Main Menu*****
1.Delete the i-th row.
2.Swap the i-th row and j-th row.
3.Exit.
Enter the choice:1

Please Enter the row number (i) you wanna delete::3

Just have a look at the matrix After deletion->
[r=0 c=0 v=1 ] [r=0 c=1 v=1988079967 ] [r=0 c=2 v=9 ]
[r=1 c=2 v=4 ]
[r=2 c=0 v=7 ]

*****Main Menu*****
1.Delete the i-th row.
2.Swap the i-th row and j-th row.
3.Exit.
Enter the choice:2

Please Enter the values (i) & (j) you wanna swap:3
1

Have A look at the matrix After Swaping->
[r=0 c=0 v=1 ] [r=0 c=1 v=1988079967 ] [r=0 c=2 v=9 ]
[r=2 c=0 v=7 ]
[r=3 c=2 v=4 ]

*****Main Menu*****
1.Delete the i-th row.
2.Swap the i-th row and j-th row.
3.Exit.
Enter the choice:

```