**Koneru Lakshmaiah Education Foundation**

**(Deemed to be University)**

**FRESHMAN ENGINEERING DEPARTMENT**

**A Project Based Lab Report**

**On**

**SPARSE MATRIX**

**SUBMITTED BY:**

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**CERTIFICATE**

This is to certify that the project based laboratory report entitled “SPARSE MATRIX” submitted by **K.MOHAN SAI** bearing Regd. No. 180030360 to the **Department of Basic Engineering Sciences-1, KL University** in partial fulfillment of the requirements for the completion of a project based Laboratory in “TECHNICAL SKILLS-2(CODING)”course in I B Tech 2nd Semester, is a bonafide record of the work carried out by him/her under my supervision during the academic year 2018 – 2 019.

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**ABSTRACT**

**Our project is based on the sparse matrix . Sparse matrix is matrix in which most of the elements are zeroes . We use linked list to represent the sparse matrix . We represent row , column , value of a sparse matrix using linked list.**

**Sparse matrices also have significant advantages in terms of computational efficiency. Unlike operations with full matrices, operations with sparse matrices do not perform unnecessary low-level arithmetic, such as zero-adds (x+0 is always x). The resulting efficiencies can lead to dramatic improvements in execution time for programs working with large amounts of sparse data**

**INDEX**

|  |  |  |
| --- | --- | --- |
| **S.NO** | **TITLE** | **PAGE NO** |
| 1 | Introduction | 6 |
| 2 | Aim of the Project | 7 |
| 2.1 | Advantages & Disadvantages | 7 |
| 2.2 | Future Implementation | 7 |
| 3 | Software & Hardware Details | 8 |
| 4 | Data Flow Diagram | 9 |
| 5 | Implementation | 11-19 |
| 6 | Algorithm | 10 |
| 7 | Integration and System Testing | 20-21 |
| 8 | Conclusion | 22 |

**1.INTRODUCTION**

A [matrix](https://www.geeksforgeeks.org/data-structures/#Matrix) is a two-dimensional data object made of m rows and n columns, therefore having total m x n values. If most of the elements of the matrix have **0 value**, then it is called a sparse matrix.

* **Storage:**There are lesser non-zero elements than zeros and thus lesser memory can be used to store only those elements.
* **Computing time:** Computing time can be saved by logically designing a data structure traversing only non-zero elements.

In linked list, each node has four fields. These four fields are defined as:

* **Row:**Index of row, where non-zero element is located
* **Column:**Index of column, where non-zero element is located
* **Value:**Value of the non zero element located at index – (row,column)
* **Next node:**Address of the next node

2.AIM

**Representation of sparse matrix using linked list**

**Advantages:-**

**Using sparse matrices to store data that contains a large number of zero-valued elements can both save a significant amount of memory and speed up the processing of that data. sparse is an attribute that you can assign to any two-dimensional MATLAB® matrix that is composed of double or logical elements.**

**The sparse attribute allows MATLAB to:**

**\* Store only the nonzero elements of the matrix, together with their indices.**

**\* Reduce computation time by eliminating operations on zero elements.**

**Disadvantages:-**

**A matrix is an array of numbers in brackets that contain rows (horizontal) and columns (vertical). If there are n rows and m columns, we say the matrix is nxm. Matrices can contain things other than numbers, such as polynomials. Furthermore, those with numbers may contain real or complex numbers**

**Future enhancements:-**

By implementation of spares matrix we can minimize the space of the matrix.

**3. SYSTEM REQUIREMENTS**

* **SOFTWARE REQUIREMENTS:**

The major software requirements of the project are as follows:

Language : Turbo-C

Operating system**:**Windows Xp or later.

* **HARDWARE REQUIREMENTS:**

The hardware requirements that map towards the software are as follows:

RAM : 8GB

PROCESSOR: 32 BIT

**4.DATA FLOW DIAGRAM**

Enter 1st matrix

Enter 2nd matrix

Print menu

Enter your choice

If choice ==1

addition

If choice ==2

substraction

If choice ==3

multiplication

If choice ==4

exit

Enter valid input

**5.ALGORITHM**

**STEP 1: start**

**STEP 2: enter the first matrix**

**STEP 3: enter the second matrix**

**STEP 4: print menu (list of operations to be performed)**

**STEP 5: enter your choice**

**STEP 6: if choice is 1**

**Addition**

**Go to step 5**

**STEP 7: if choice is 2**

**substraction**

**Go to step 5**

**STEP 8: if choice is 3**

**multiplication**

**Go to step 5**

**STEP 9: if choice is 4**

**Exit**

**STEP 10: else print invalid input**

**STEP 11: stop**

**6. IMPLEMENTATION**

#include<stdio.h>

#include<stdlib.h>

void create1(int,int,int);

void create2(int,int,int);

void display1();

void display2();

void createa(int,int,int);

void creates(int,int,int);

void displaya();

void displays();

void createm(int,int,int);

void displaym();

typedef struct node

{

int value;

int row;

int col;

struct node \*nxt;

}m;

m \*head1=NULL,\*head2=NULL,\*tail1=NULL,\*tail2=NULL,\*r1,\*r2,\*r,\*ra,\*temp,\*s,\*heada=NULL,\*taila=NULL,\*tails=NULL,\*heads=NULL,\*rs,\*headm=NULL,\*tailm=NULL,\*rm;

int main()

{

int m1,m2,n1,n2,i,j,ch=0,k,sum=0;

printf("ENTER YOUR FIRST MATRIX SIZE\n");

scanf("%d %d",&m1,&n1);

printf("ENTER YOUR SECOND MATRIX SIZE\n");

scanf("%d %d",&m2,&n2);

int a[m1][n1],b[m2][n2],c[m1][n1],m[m1][n1];

unsigned int s[m1][n1];

printf("ENTER YOUR FIRST MATRIX ELEMENTS\n");

for(i=0;i<m1;i++)

{

for(j=0;j<n1;j++)

{

scanf("%d",&a[i][j]);

if(a[i][j]!=0)

{

create1(a[i][j],i,j);

}

}

}

printf("ENTER YOUR SECOND MATRIX ELEMENTS\n");

for(i=0;i<m2;i++)

{

for(j=0;j<n2;j++)

{

scanf("%d",&b[i][j]);

if(b[i][j]!=0)

{

create2(b[i][j],i,j);

}

}

}

printf("YOUR FIRST MATRIX IS\n");

display1();

printf("YOUR SECOND MATRIX IS\n");

display2();

do

{

printf("ENTER YOUR CHOICE OF OPERATION\n");

printf("1.ADDITION\n");

printf("2.SUBTRACTION\n");

printf("3.MULTIPLICATION\n");

printf("4.EXIT\n");

scanf("%d",&ch);

switch(ch)

{

    case 1:

for(i=0;i<m1;i++)

{

    for(j=0;j<n1;j++)

    {

        c[i][j]=a[i][j]+b[i][j];

        if(c[i][j]!=0)

        {

            createa(c[i][j],i,j);

        }

    }

}

displaya();

break;

case 2:

for(i=0;i<m1;i++)

{

    for(j=0;j<n1;j++)

    {

        s[i][j]=a[i][j]-b[i][j];

        if(s[i][j]!=0)

        creates(s[i][j],i,j);

    }

}

displays();

break;

case 3:

if(m1==n2 && m2==n1)

    {

       for (i = 0; i < m1; i++) {

      for (j = 0; j < n2; j++) {

        for (k = 0; k < m2; k++) {

          sum = sum + a[i][k]\*b[k][j];

        }

        m[i][j] = sum;

        sum = 0;

      }

    }

    }

    else

    printf("THE MATRIX MULTIPLICATION IS NOT POSSIBLE\n");

    for(i=0;i<m1;i++)

    {

        for(j=0;j<n1;j++)

        {

            if(m[i][j]!=0)

            createm(m[i][j],i,j);

        }

    }

    displaym();

    break;

    case 4:exit(0);

    break;

default : printf("WRONG OPTION\n");

}

}while(ch>=1 && ch<=4);

}

void create1(int x,int mr,int mc)

{

r1=(m\*) malloc(sizeof(m));

r1->value=x;

r1->row=mr;

r1->col=mc;

r1->nxt=NULL;

if(head1==NULL)

{

head1=tail1=r1;

}

else

{

tail1->nxt=r1;

tail1=r1;

}

}

void create2(int x,int mr,int mc)

{

r2=(m\*) malloc(sizeof(m));

r2->value=x;

r2->row=mr;

r2->col=mc;

r2->nxt=NULL;

if(head2==NULL)

{

head2=tail2=r2;

}

else

{

tail2->nxt=r2;

tail2=r2;

}

}

void display1()

{

temp=r=s=head1;

printf("row    :");

while(temp!=NULL)

{

printf("%d ",temp->row);

temp=temp->nxt;

}

printf("\n");

printf("column :");

while(r!=NULL)

{

printf("%d ",r->col);

r=r->nxt;

}

printf("\n");

printf("value  :");

while(s!=NULL)

{

printf("%d ",s->value);

s=s->nxt;

}

printf("\n");

}

void display2()

{

temp=r=s=head2;

printf("row    :");

while(temp!=NULL)

{

printf("%d ",temp->row);

temp=temp->nxt;

}

printf("\n");

printf("column :");

while(r!=NULL)

{

printf("%d ",r->col);

r=r->nxt;

}

printf("\n");

printf("value  :");

while(s!=NULL)

{

printf("%d ",s->value);

s=s->nxt;

}

printf("\n");

}

void createa(int x,int mr,int mc)

{

    ra=(m\*) malloc(sizeof(m));

    ra->value=x;

    ra->row=mr;

    ra->col=mc;

    ra->nxt=NULL;

    if(heada==NULL)

    {

        heada=taila=ra;

    }

    else

    {

        taila->nxt=ra;

        taila=ra;

    }

}

void displaya()

{

    temp=r=s=heada;

    printf("YOUR NEW MATRIX AFTER ADDITON OPERATION IS\n");

    printf("row    :");

    while(temp!=NULL)

    {

        printf("%d ",temp->row);

        temp=temp->nxt;

    }

    printf("\n");

    printf("column :");

    while(r!=NULL)

    {

        printf("%d ",r->col);

        r=r->nxt;

    }

    printf("\n");

    printf("value  :");

    while(s!=NULL)

    {

        printf("%d ",s->value);

        s=s->nxt;

    }

    printf("\n");

}

void creates(int x,int mr,int mc)

{

    rs=(m\*)malloc(sizeof(m));

    rs->value=x;

    rs->row=mr;

    rs->col=mc;

    rs->nxt=NULL;

    if(heads==NULL)

    {

        heads=tails=rs;

    }

    else

    {

        tails->nxt=rs;

        tails=rs;

    }

}

void displays()

{

    temp=r=s=heads;

    printf("YOUR NEW MATRIX AFTER SUBTRACTION\n");

    printf("row    :");

    while(temp!=NULL)

    {

        printf("%d ",temp->row);

        temp=temp->nxt;

    }

    printf("\n");

    printf("column :");

    while(r!=NULL)

    {

        printf("%d ",r->col);

        r=r->nxt;

    }

    printf("\n");

    printf("value  :");

    while(s!=NULL)

    {

        printf("%d ",s->value);

        s=s->nxt;

    }

    printf("\n");

}

void createm(int x,int mr,int mc)

{

    rm=(m\*)malloc(sizeof(m));

    rm->value=x;

    rm->row=mr;

    rm->col=mc;

    rm->nxt=NULL;

    if(headm==NULL)

    headm=tailm=rm;

    else

    {

        tailm->nxt=rm;

        tailm=rm;

    }

}

void displaym()

{

    temp=r=s=headm;

    printf("YOUR NEW MATRIX AFTER MULTIPLICATION OPERATION\n");

    printf("row    :");

    while(temp!=NULL)

    {

        printf("%d ",temp->row);

        temp=temp->nxt;

    }

    printf("\n");

    printf("column :");

    while(r!=NULL)

    {

        printf("%d ",r->col);

        r=r->nxt;

    }

    printf("\n");

    printf("value  :");

    while(s!=NULL)

    {

        printf("%d ",s->value);

        s=s->nxt;

    }

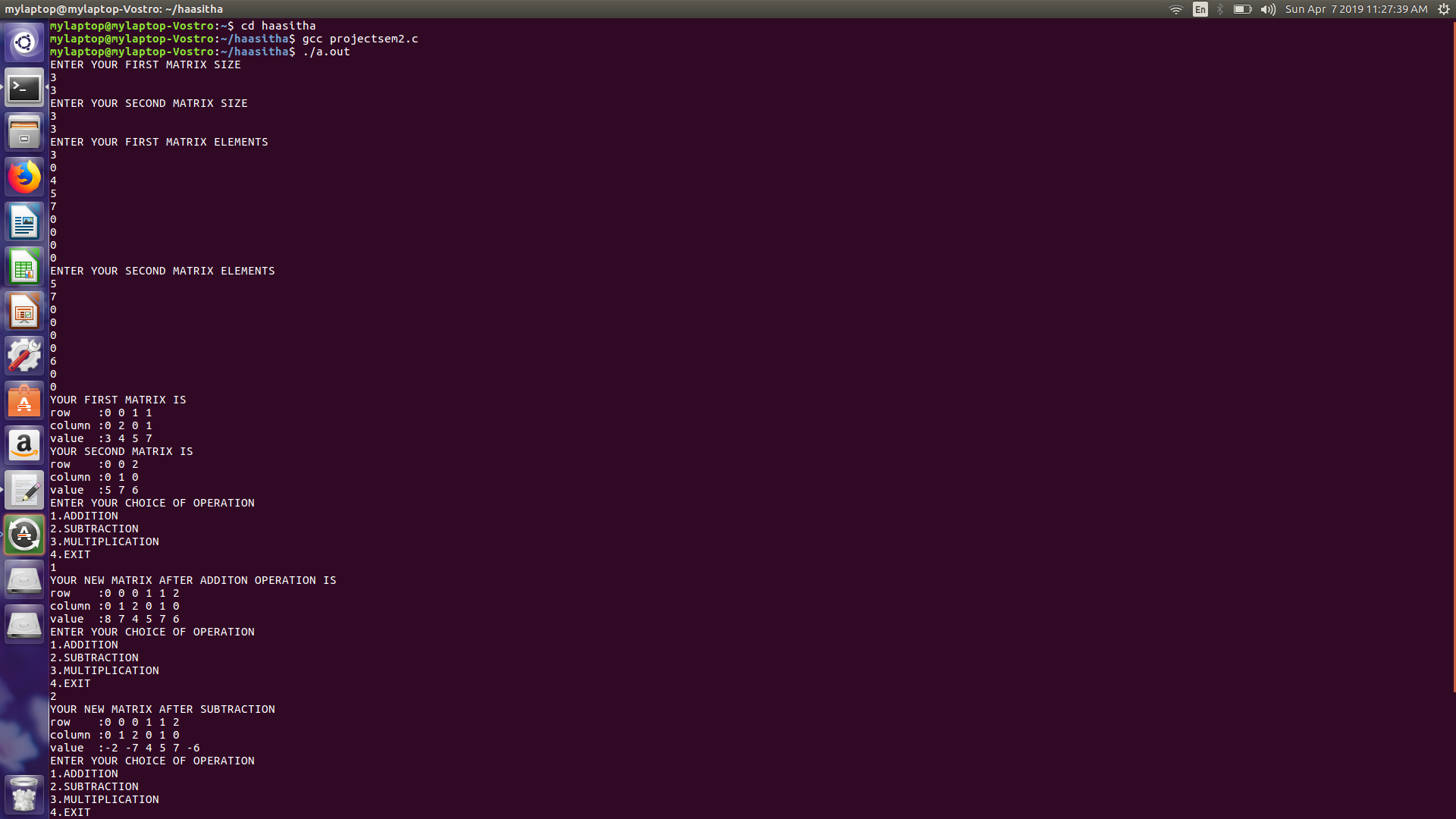
    printf("\n");

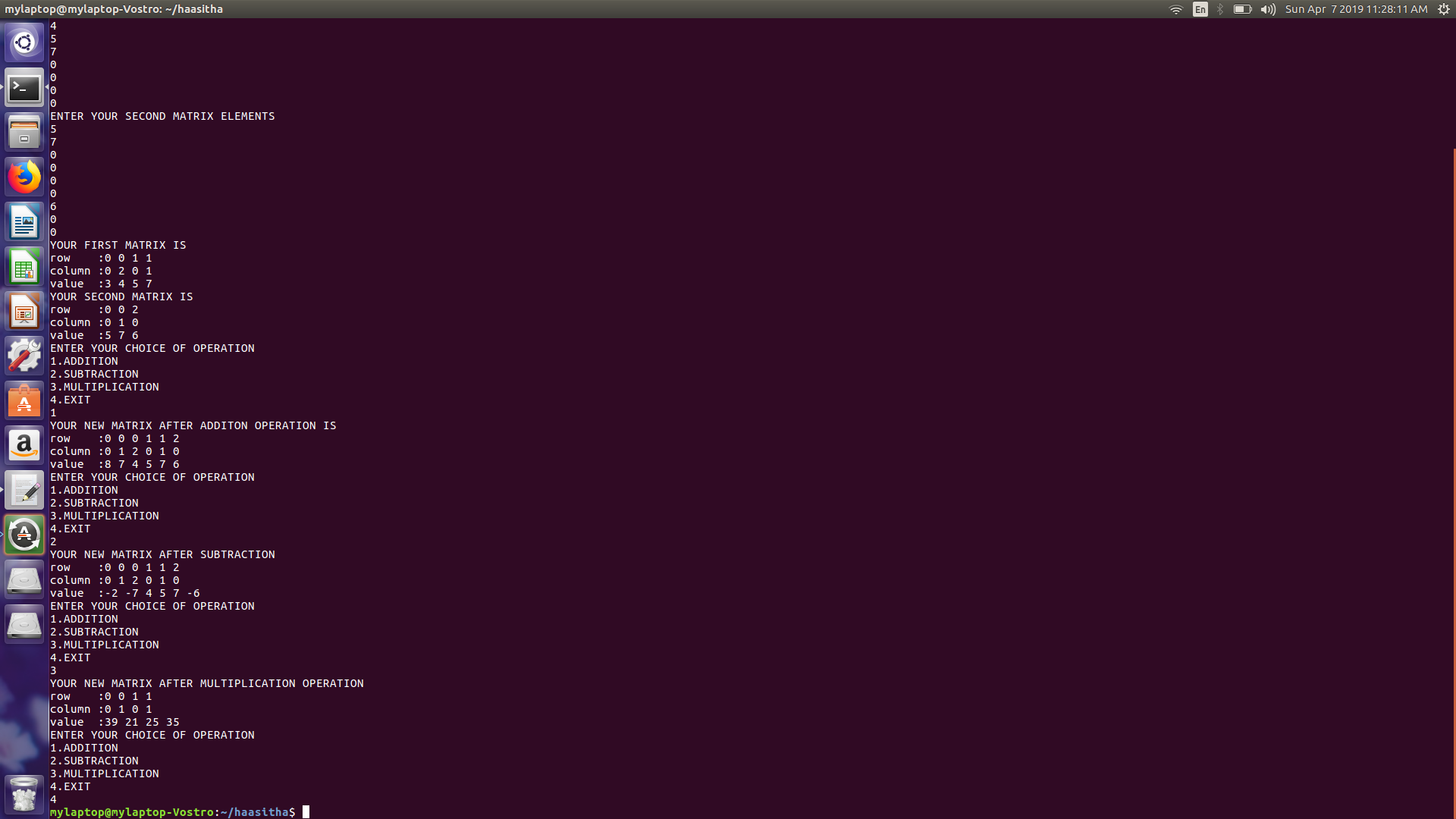
}

7.**INTEGRATION AND SYSTEM TESTING**

OUTPUTS

Screen Shots:



****

**8.CONCLUSION**

The only advantage of using a sparse matrix is that, if your matrix is mainly composed by zero elements, you could save space memorising just the non-zero elements. This lead to an implementation that is essentially a list of lists and will let you lose the O(1) time complexity of access of each elements.