EXPERIMENT - 5

Data Structures

Aim

Implementation of stack using linked list.

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EXPERIMENT – 5

AIM: Implement sparse matrix using array.

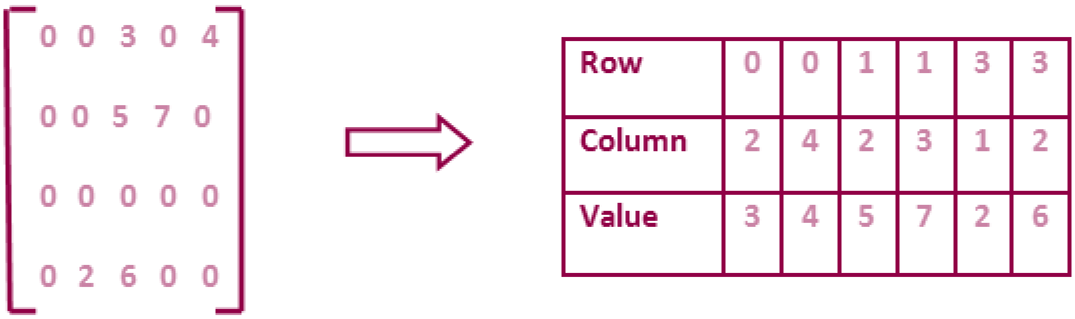
THEORY

A 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.

Representing a sparse matrix by a 2D array leads to wastage of lots of memory as zeroes in the matrix are of no use in most of the cases. So, instead of storing zeroes with non-zero elements, we only store non-zero elements. This means storing non-zero elements with triples- (Row, Column, value).

2D array is used to represent a sparse matrix in which there are three rows named 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)



$$\begin{bmatrix} 0 & 0 & 3 & 0 & 4 \\ 0 & 0 & 5 & 7 & 0 \\ 0 & 0 & 0 & 0 & 0 \\ 0 & 2 & 6 & 0 & 0 \end{bmatrix}$$

Row	0	0	1	1	3	3
Column	2	4	2	3	1	2
Value	3	4	5	7	2	6

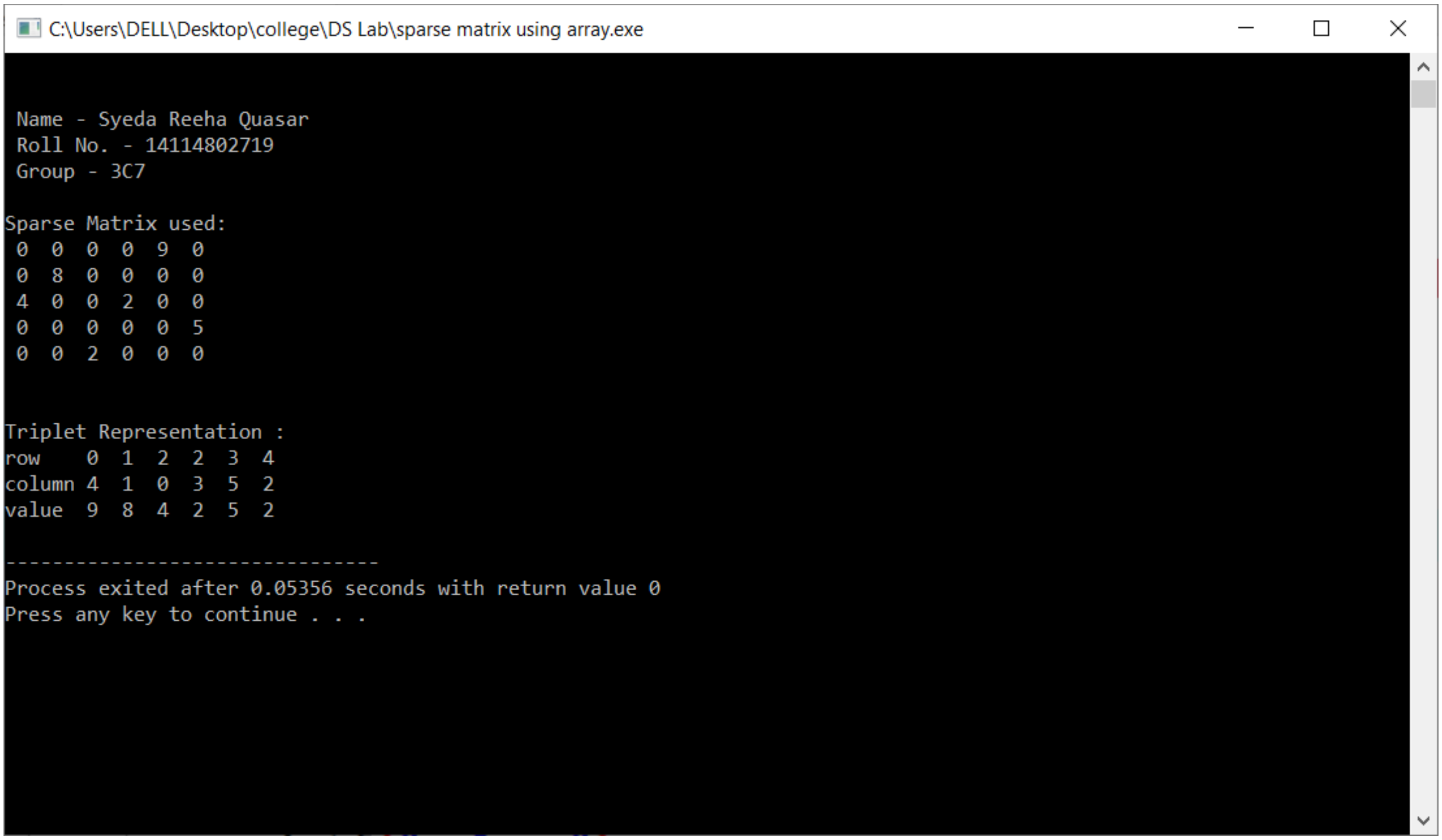
Source code:

```
#include<stdio.h>


int main(){
        // my info
        printf("\n\n Name - Syeda Reeha Quasar \n Roll No. - 14114802719 \n Group - 3C7 \n\n");
```

```
// sparse matrix of class 5x6 with 6 non-zero values
int sparseMatrix[5][6] =
{
    {0 , 0 , 0 , 0 , 9, 0 },
    {0 , 8 , 0 , 0 , 0, 0 },
    {4 , 0 , 0 , 2 , 0, 0 },
    {0 , 0 , 0 , 0 , 0, 5 },
    {0 , 0 , 2 , 0 , 0, 0 }
};

// Finding total non-zero values in the sparse matrix
printf("Sparse Matrix used:\n");
int size = 0;
for (int row = 0; row < 5; row++) {
    for (int column = 0; column < 6; column++) {
        printf(" %d ", sparseMatrix[row][column]);
        if (sparseMatrix[row][column] != 0) {
            size++;
        }
        }
        printf("\n");
        }

// Defining result Matrix
int resultMatrix[3][size];

// Generating result matrix
int k = 0;
for (int row = 0; row < 5; row++)
```

```
        for (int column = 0; column < 6; column++)
            if (sparseMatrix[row][column] != 0)
            {
                resultMatrix[0][k] = row;
                resultMatrix[1][k] = column;
                resultMatrix[2][k] = sparseMatrix[row][column];
                k++;
            }

    // Displaying result matrix
    printf("\n\nTriplet Representation : \n");
    for (int row=0; row<3; row++) {
            if (row == 0) {
                                    printf("row   ");
                        }
                        else if (row == 1) {
                                    printf("column");
                        }
                        else {
                                    printf("value ");
                        }
        for (int column = 0; column<size; column++) {
            printf(" %d ", resultMatrix[row][column]);
                        }
        printf("\n");
    }

    return 0;
}
```

OUTPUT



C:\Users\DELL\Desktop\college\DS Lab\sparse matrix using array.exe

```
 Name - Syeda Reeha Quasar
 Roll No. - 14114802719
 Group - 3C7

Sparse Matrix used:
 0  0  0  0  9  0
 0  8  0  0  0  0
 4  0  0  2  0  0
 0  0  0  0  0  5
 0  0  2  0  0  0


Triplet Representation :
row     0  1  2  2  3  4
column 4  1  0  3  5  2
value  9  8  4  2  5  2

--------------------------------
Process exited after 0.05356 seconds with return value 0
Press any key to continue . . .
```

Viva Questions

Q1. What are different ways of representing sparse matrix in memory?

Ans1.

Sparse Matrix Representations can be done in many ways following are two common representations:

1. Array representation / Triplet Representation
2. Linked list representation

Other representations:

As a Dictionary where row and column numbers are used as keys and values are matrix entries. This method saves space but sequential access of items is costly.

As a list of list. The idea is to make a list of rows and every item of list contains values. We can keep list items sorted by column numbers.

Q2. What is the advantage of representing only non-zero values in sparse matrix?

Ans2.

Storing only the nonzero elements of the matrix, together with their indices. Reduce computation time by eliminating operations on zero elements.

- Memory: less memory is needed to store the matrix, since the zero elements are not stored
- Efficiency: using a sparse matrix can speed up process

Q3. Which data structure is used to implement a matrix?

Ans3.

An array is used to implement matrix.

Q4. What are various types of representation of matrix?

Ans4.

Matrix representation is a method used by a computer language to store matrices of more than one dimension in memory. Fortran and C use different schemes for their native arrays. Fortran uses "Column Major", in which all the elements for a given column are stored contiguously in memory. C uses "Row Major", which stores all the elements for a given row contiguously in memory. LAPACK defines various matrix representations in memory. There is also Sparse matrix representation and Morton-order matrix representation.

Mainly:

1) Row-Major
2) Column-Major