SPARSE MATRIX

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.

Why to use Sparse Matrix instead of simple 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..

Example:

0 0 3 0 4

0 0 5 7 0

0 0 0 0 0

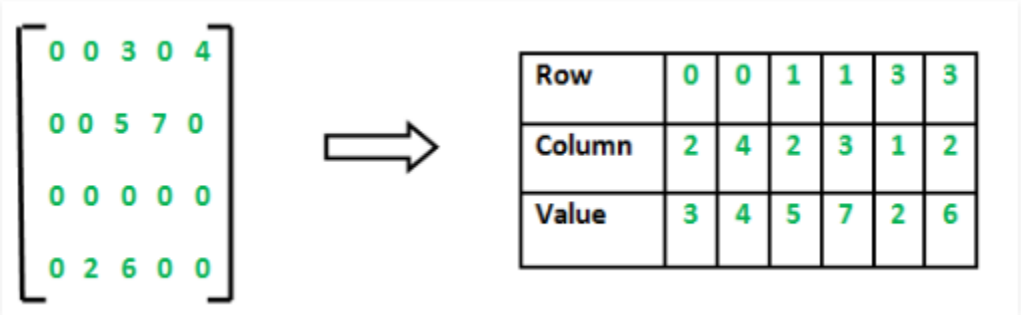
0 2 6 0 0

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

1. Array representation
2. Linked list representation

Method 1: Using Arrays
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)



```
#include<stdio.h>

int main()
{
   // Assume 4x5 sparse matrix
   int sparseMatrix[4][5] =
   {
      {0 , 0 , 3 , 0 , 4 },
      {0 , 0 , 5 , 7 , 0 },
      {0 , 0 , 0 , 0 , 0 },
      {0 , 2 , 6 , 0 , 0 }
   };

   int size = 0;
   for (int i = 0; i < 4; i++)
      for (int j = 0; j < 5; j++)
         if (sparseMatrix[i][j] != 0)
            size++;

   // number of columns in compactMatrix (size) must be
   // equal to number of non - zero elements in
   // sparseMatrix
   int compactMatrix[3][size];

   // Making of new matrix
   int k = 0;
   for (int i = 0; i < 4; i++)
      for (int j = 0; j < 5; j++)
         if (sparseMatrix[i][j] != 0)
         {
            compactMatrix[0][k] = i;
            compactMatrix[1][k] = j;
            compactMatrix[2][k] = sparseMatrix[i][j];
            k++;
         }

   for (int i=0; i<3; i++)
   {
      for (int j=0; j<size; j++)
         printf("%d ", compactMatrix[i][j]);

      printf("\n");
   }
   return 0;
}
```

Output:

```
0 0 1 1 3 3
2 4 2 3 1 2
```

3 4 5 7 2 6