**Topic – Transpose of Sparse Matrix with algorithm O(n\*c) taking Input From a Text File**

* **Problem Statement**

**Part-a**

a) Write a  c program to represent a sparse matrix taking the data from a file.  
The file format is as follows:  
  
6 5 6  
2 2 -76  
2 3 -12  
3 1 -30  
4 1 -6  
4 3 -5  
5 2 -10  
  
The first line represent : number of rows, number of columns and number of non zero elements in spare matrix respectively.  
Here, number of rows: 6, number of columns: 5, number of non zero elements: 6  
  
The next 6 lines gives the position of non zero element in matrix with the non zero value.  
the rows and columns are given in ascending order in the file.  
  
i.e, 2 2 -76 means the non zero value -76 is stored in 2, 2 position.  
  
Next, Write the transpose algorithm that runs in O( n \* c) time, where n: total number of nonzero values in matrix and c: total number of columns. Note that, the transposed matrix must have its rows and columns within rows in ascending order.

**Input example:** /\* Here user will mention the whole directory path of the file sparse.txt as a command line argument in command prompt\*/

Taking input from file sparse.txt which contains

6 5 6  
2 2 -76  
2 3 -12  
3 1 -30  
4 1 -6  
4 3 -5  
5 2 -10

**Output example:**

The sparse matrix taken from file is:

Row Column Nonzero values

6 5 6

2 2 -76

2 3 -12

3 1 -30

4 1 -6

4 3 -5

5 2 -10

The transpose of the sparse matrix is:

Row Column Nonzero values

5 6 6

1 3 -30

1 4 -6

2 2 -76

2 5 -10

3 2 -12

3 4 -5

* **Proposed C Code**

**/\* ---------- sparse-part-a.c--------------- \*/**

**#include<stdio.h>**

**#include<stdlib.h>**

**typedef struct sparse\_matrix**

**{**

**int row;**

**int col;**

**int nonzero;**

**}sparse; /\* structure for representing rows,colulmns and nonzero values in sparse matrix \*/**

**int main(int argc,char\* argv[])**

**{**

**FILE\* fptr = NULL;**

**fptr = fopen(argv[1],"r");**

**/\* The sparse.txt file contains the data for the sparse matrix which is given as arguement in command prompt \*/**

**if ( fptr == NULL )/\* if file is not found then standard error message is given as output \*/**

**{**

**fprintf(stderr,"File is not found\n");**

**exit(1);**

**}**

**int row\_count,col\_count,nonzero\_count;**

**/\* the counts of row,col,non zero elements are taken from file \*/**

**fscanf(fptr,"%d",&row\_count);**

**fscanf(fptr,"%d",&col\_count);**

**fscanf(fptr,"%d",&nonzero\_count);**

**/\* Array arr of structure sparse is taken to represent sparse matrix \*/**

**sparse\* arr = (sparse\*)malloc((nonzero\_count+1)\*sizeof(sparse));**

**/\* Array transpose of structure transpose is taken to represent the transpose of sparse matrix \*/**

**sparse\* transpose = (sparse\*)malloc((nonzero\_count+1)\*sizeof(sparse));**

**arr[0].row = row\_count;**

**arr[0].col = col\_count;**

**arr[0].nonzero = nonzero\_count;**

**/\* the data from file is taken in arr with ascending order of rows \*/**

**for ( int i = 1 ; i <= nonzero\_count ; i++ )**

**{**

**fscanf(fptr,"%d",&arr[i].row);**

**fscanf(fptr,"%d",&arr[i].col);**

**fscanf(fptr,"%d",&arr[i].nonzero);**

**}**

**printf("The sparse matrix taken from file is: \n");**

**printf("Row\tColumn\tNonzero values\n");**

**for ( int i = 0 ; i <= nonzero\_count ; i++ )/\* printing the representation of sparse matrix \*/**

**{**

**printf("%3d\t%3d\t%3d\n",arr[i].row,arr[i].col,arr[i].nonzero);**

**}**

**/\* The col\_count of arr and row\_count of transpose are same and vice-versa \*/**

**transpose[0].row = col\_count;**

**transpose[0].col = row\_count;**

**transpose[0].nonzero = nonzero\_count;**

**for ( int column = 0 , i = 1 ; column < col\_count ; column++ )/\* Traversing the outer loop for total column counts\*/**

**{**

**for ( int j = 1 ; j <= nonzero\_count ; j++ )/\* Traversing the inner loop for total nonzero element counts\*/**

**{**

**if ( arr[j].col == column )/\* Transposing by checking for each column of arr starting from 0 \*/**

**{**

**transpose[i].row = arr[j].col;**

**transpose[i].col = arr[j].row;**

**transpose[i].nonzero = arr[j].nonzero;**

**i++;**

**}**

**}**

**}**

**printf("The transpose of the sparse matrix is: \n");/\* Printing the transpose of sparse matrix \*/**

**printf("Row\tColumn\tNonzero values\n");**

**for ( int i = 0 ; i <= nonzero\_count ; i++ )**

**{**

**printf("%3d\t%3d\t%3d\n",transpose[i].row,transpose[i].col,transpose[i].nonzero);**

**}**

**fclose(fptr);/\* closing the file \*/**

**free(arr);/\* freeing the memory \*/**

**free(transpose);**

**return 0;**

**}**

**/\*------------------------------------------------------------------------------------------------------------------------- \*/**

* **Conclusion**

**The proposed algorithm of the transpose of sparse matrix problem part-a has a runtime of O(n\*c) where n is the number of nonzero elements and c is the number of columns of the sparse matrix.**

* **Limitations : This program will take commands from the user as per the question. If the source code and the text file are not in same folder then we have to mention the whole path of directories i.e the whole location of the text file as the second command or argv[1] after mentioning the .exe file while running the program from the program’s current directory in command prompt. Also the algorithm does not have linear time complexity.**
* **Assumptions: The text file should contain the rows and colums of the non zero elements of the sparse matrix such that they are in increasing order.**