

**E0 251: Programming Assignment 1**  
**Due before 11.59 PM on 20-08-2019**

Please mail the source code with a README file and 5 test cases for each problem (code and test data in separate files) [ullas@iisc.ac.in](mailto:ullas@iisc.ac.in) and [protikpaul@iisc.ac.in](mailto:protikpaul@iisc.ac.in) . Please make a ZIP file of all the files and then mail the ZIP file. Any extra instructions regarding submission (if necessary) will be sent by Ullas and Protik.

1. Write and test C functions for the following. Maximum size of the matrix is 150 x 100.
  - a) Write a random integer sparse matrix generator that takes the size of the matrix (m and n), density of non-zero entries (as a % of the total number of elements in the matrix), and percentage of negative numbers in the matrix. The generator must distribute the non-zero elements randomly among the rows and columns of the matrix. You must write the sparse matrix in the COO format and keep it in memory for further processing.
  - b) Transform the COO format matrix to CSR and CSC formats and keep both of them in memory for further operations.
  - c) Write a function to multiply two matrices A and B, one in CSR format and another in CSC format. The result should be in COO format.
  - d) Perform row transformations on the CSC format matrix. Consider the parameters to the function:  $r_1, k_1, r_2, k_2$ , where  $r_i$  are the row numbers and  $k_i$  are the multiplication factors. The result matrix should also be in CSC format. The computation to be carried out in abstract format is:

$$A[r_2] = k_1 * A[r_1] + k_2 * A[r_2]$$

i.e., the row  $r_2$  of A is to be replaced by the sum as indicated above. You should be able to handle all sparse matrices of size smaller than 150 x 100. You should not construct the whole matrix in memory from the CSR representation before doing the row transformations.

- e) Write a function to print COO/CSR/CSC format matrices, when sizes are smaller than 20x20.

**COPYING EITHER FROM INTERNET OR FROM A FRIEND IS A CRIME AND WILL BE DEALT WITH SEVERELY. BOTH PARTIES INVOLVED IN COPYING WILL BE PUNISHED. IISc PROVIDES SOFTWARE TOOLS TO CHECK COPYING.**