National Yang Ming Chiao Tung University
Department of Electrical Engineering
Data Structures, Fall 2021

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Programming Assignment #1

Arrays

1 Problem Description

Matrix multiplication is a common operation in linear algebra for many applications, such as computational optimization, machine learning, circuit and system simulation, and other engineering applications.

Given two ***sparse*** integer matrices, $\mathbf{A_{m\times n}}$ and $\mathbf{B_{p\times q}}$, where $0 < m, n, p, q < 10^6$, the problem is to transpose and multiply the matrices according to the following sequence of conditions:

- If $n = p$, $\mathbf{C} = \mathbf{A} \times \mathbf{B}$.
- If $m = p$, $\mathbf{C} = \mathbf{A^T} \times \mathbf{B}$.
- If $n = q$, $\mathbf{C} = \mathbf{A} \times \mathbf{B^T}$.
- If $m = q$, $\mathbf{C} = \mathbf{A^T} \times \mathbf{B^T}$.

2 Input

The input file (e.g. "sample.in") to your program includes two matrices, $\mathbf{A_{m\times n}}$ and $\mathbf{B_{p\times q}}$, with the following format, and the dimensions of both matrices satisfy either one of the aforementioned conditions.

Input Format

A ;
a_{11} a_{11} ... a_{1n} ;
a_{21} a_{22} ... a_{2n} ;
⋮
a_{m1} a_{m2} ... a_{mn} ;
B ;
b_{11} b_{11} ... b_{1q} ;
b_{21} b_{22} ... b_{2q} ;
⋮
b_{p1} b_{p2} ... b_{pq} ;

Sample Input

A ;
1 0 −2 ;
0 3 0 ;
B ;
0 1 0 2 ;
3 0 4 0 ;

3 Output

Your program will generate the output file (e.g. "sample.out"), which contains the matrix with the following format resulting from the multiplication of both input matrices.

Output Format

$$\begin{array}{cccc} c_{11} & c_{11} & \cdots & c_{1y}\ ; \\ c_{21} & c_{22} & \cdots & c_{2y}\ ; \\ & & \vdots & \\ c_{x1} & c_{x2} & \cdots & c_{xy}\ ; \end{array}$$

Sample Output

$$\begin{array}{cccc} 0 & 1 & 0 & 2\ ; \\ 9 & 0 & 12 & 0\ ; \\ 0 & -2 & 0 & -4\ ; \end{array}$$

4 Command-line Parameter

In order to correctly test your program, you are asked to add the following command-line parameters to your program.

[executable file name] [input file name] [output file name]

(e.g., StudentID.exe sample.in sample.out)

5 Submission Information

Your program must be written in the C/C++ language, and can be compiled on the Linux platform. The source files of your program must be named with "[your student ID].h" and "[your student ID].cpp". The executable file name of your program must be "[your student ID].exe". To submit your program, please archive both executable and source files of your program into a single zip file, named "[your student ID].zip", and upload to E3.

6 Due Date

The zip file must be submitted through E3 before 23:59, October 12, 2021.

7 Grading Policy

The programming assignment will be graded based on the following rules:

- Pass sample input with compilable source code (50%)
- Pass five hidden test cases (50%)

The submitted source codes, which are copied from or copied by others, will not be graded. There will be 25% penalty per day for late submission.