

## Problem 2: Matrix Multiplication (matrix)

Given an  $R_A \times C_A$  matrix  $A$  and an  $R_B \times C_B$  matrix  $B$ , with  $1 \leq R_A, R_B, C_A, C_B \leq 300$ , write a program that computes the matrix product  $C = AB$ . All entries in matrices  $A$  and  $B$  are integers with absolute value less than 1000, so you don't need to worry about overflow. If matrices  $A$  and  $B$  do not have the right dimensions to be multiplied, the product matrix  $C$  should have its number of rows and columns both set to zero.

Use the code at provided in the file `matrix.data.zip` as a basis for your program—the input/output needed is already written for you. Matrices will be stored as a structure which we'll typedef as `Matrix`. This structure will contain the size of our matrix along with a statically-sized two-dimensional array to store the entries.

```
#define MAXN 300
typedef struct Matrix_s {
    size_t R, C;
    int index[MAXN][MAXN];
} Matrix;
```

Of course, this is rather inefficient if we need to create a lot of matrices, since every single matrix struct holds `MAXN*MAXN` ints! For this problem, we only use three matrices, so it's fine for this use, but we'll see how to dynamically allocate a matrix in problem **matrix2**.

### Input Format

Line 1: Two space-separated integers,  $R_A$  and  $C_A$ .

Lines 2... $R_A + 1$ : Line  $i + 1$  contains  $C_A$  space-separated integers: row  $i$  of matrix  $A$ .

Line  $R_A + 2$ : Two space-separated integers,  $R_B$  and  $C_B$ .

Lines  $R_A + 3$ ... $R_A + R_B + 4$ : Line  $i + R_A + 3$  contains  $C_B$  space-separated integers: row  $i$  of matrix  $A$ .

### Sample Input (file `matrix.in`)

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

### Output Format

Line 1: Two space-separated integers  $R_C$  and  $C_C$ , the dimensions of the product matrix  $C$ .

Lines 2... $R_C + 1$ : Line  $i + 1$  contains  $C_C$  space-separated integers: row  $i$  of matrix  $C$ .

If  $A$  and  $B$  do not have the right dimensions to be multiplied, your output should just be one line containing 0 0.

### Sample Output (file matrix.out)

```
3 3
4 4 2
7 6 3
-4 -8 -4
```

### Output Explanation

We are given

$$A = \begin{pmatrix} 1 & 1 \\ 1 & 2 \\ -4 & 0 \end{pmatrix} \text{ and } B = \begin{pmatrix} 1 & 2 & 1 \\ 3 & 2 & 1 \end{pmatrix}$$

so the product is the  $3 \times 3$  matrix

$$AB = \begin{pmatrix} 1 & 1 \\ 1 & 2 \\ -4 & 0 \end{pmatrix} \begin{pmatrix} 1 & 2 & 1 \\ 3 & 2 & 1 \end{pmatrix} = \begin{pmatrix} 4 & 4 & 2 \\ 7 & 6 & 3 \\ -4 & -8 & -4 \end{pmatrix}.$$

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6.S096 Effective Programming in C and C++

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