Practice S06P01: Matrix Multiplication

http://www.comp.nus.edu.sg/~cs1010/4_misc/practice.html

Week of release: Week 6

Objective: 2D array

Task statement:

Write a program **MatrixOps.c** to compute the sum and product of two matrices. You may assume that a matrix has at most 10 rows and 10 columns.

The skeleton program provided contains the completed **sumMatrix()** function. You need to complete the **prodMatrix()** function.

1. Matrix Addition

To add two matrices, both matrices must have the same size (same number of rows and columns). To compute C = A + B, where A, B, C are matrices,

$$C_{i,j} = A_{i,j} + B_{i,j}$$

The following shows two examples.

$$\begin{pmatrix} 1 & 2 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 1 \end{pmatrix} + \begin{pmatrix} -1 & 0 & 0 \\ 2 & 1 & 0 \\ 0 & 2 & -1 \end{pmatrix} = \begin{pmatrix} 0 & 2 & 0 \\ 2 & 2 & 1 \\ 1 & 2 & 0 \end{pmatrix}$$

$$\begin{pmatrix} 10 & 21 & 7 & 9 \\ 4 & 6 & 14 & 5 \end{pmatrix} + \begin{pmatrix} 3 & 7 & 18 & 20 \\ 6 & 5 & 8 & 15 \end{pmatrix} = \begin{pmatrix} 13 & 28 & 25 & 29 \\ 10 & 11 & 22 & 20 \end{pmatrix}$$

2. Matrix Multiplication

To multiply two matrices A and B, the number of columns in A, let's call it n, must be the same as the number of rows in B. The resulting matrix has the same number of rows as A and number of columns as B. Hence, multiplying a $k \times n$ matrix with an $n \times p$ matrix gives a $k \times p$ product matrix.

To compute C = A $\times$ B, where A, B, C are matrices,

$$C_{i,j} = (A_{i,0} \times B_{0,j}) + (A_{i,1} \times B_{1,j}) + \ldots + (A_{i,n-1} \times B_{n-1,j})$$

The following shows two examples.

$$\begin{pmatrix} 1 & 2 & 0 \\ 0 & 1 & 1 \\ 1 & 0 & 1 \end{pmatrix} \times \begin{pmatrix} -1 & 0 & 0 \\ 2 & 1 & 0 \\ 0 & 2 & -1 \end{pmatrix} = \begin{pmatrix} 3 & 2 & 0 \\ 2 & 3 & -1 \\ -1 & 2 & -1 \end{pmatrix}$$

$$\begin{pmatrix} 2 & 1 & 3 & 2 \\ 3 & 0 & 2 & 1 \end{pmatrix} \times \begin{pmatrix} 3 & 2 & 1 \\ 2 & 2 & 3 \\ 1 & 3 & 0 \\ 2 & 1 & 3 \end{pmatrix} = \begin{pmatrix} 15 & 17 & 11 \\ 13 & 13 & 6 \end{pmatrix}$$

Sample runs:

```
Matrix A:
Enter number of rows and columns: 3 3
Enter values for matrix:
1 2 0
0 1 1
1 0 1
Matrix B:
Enter number of rows and columns: 3 3
Enter values for matrix:
-1 0 0
2 1 0
0 2 -1
Sum matrix:
0.00     2.00     0.00
2.00     2.00     1.00
1.00     2.00     0.00
Product matrix:
3.00     2.00     0.00
2.00     3.00     -1.00
-1.00    2.00     -1.00
```

```
Matrix A:
Enter number of rows and columns: 2 4
Enter values for matrix:
2 1 3 2
3 0 2 1
Matrix B:
Enter number of rows and columns: 4 3
Enter values for matrix:
3 2 1
2 2 3
1 3 0
2 1 3
Unmatched dimensions; cannot be added.
Product matrix:
15.00    17.00    11.00
13.00    13.00    6.00
```