

Project 8

Matrix Multiplication*

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I. OBJECTIVE

Write a program that calculates the matrix multiplication with all the situation considering. You can see the detail in the end of chapter 4 of *OPERATING SYSTEM CONCEPTS WITH JAVA(Seventh Edition)*, page 162.

II. ALGORITHM

II.1 Matrix Multiplication

For two matrixes to multiple, the number of column of the first matrix should be equal to that of row of the second matrix. That is to say, the multiplication can occur when they are like $[A]_{m \times n} \times [B]_{n \times q}$.

The multiplication rule can be described as follows:

$$\begin{bmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{bmatrix} \times \begin{bmatrix} b_{11} & b_{12} & \cdots & b_{1q} \\ b_{21} & b_{22} & \cdots & b_{2q} \\ \vdots & \vdots & \ddots & \vdots \\ b_{n1} & b_{n2} & \cdots & b_{nq} \end{bmatrix} = \begin{bmatrix} c_{11} & c_{12} & \cdots & c_{1q} \\ c_{21} & c_{22} & \cdots & c_{2q} \\ \vdots & \vdots & \ddots & \vdots \\ c_{m1} & c_{m2} & \cdots & c_{mq} \end{bmatrix} \quad (1)$$

where

$$c_{ij} = \sum_{r=1}^n a_{ir}b_{rj} = a_{i1}b_{1j} + a_{i2}b_{2j} + \cdots + a_{in}b_{nj}, \quad i = 1, 2, \cdots, m; \quad j = 1, 2, \cdots, q \quad (2)$$

II.2 Multi-thread

In each thread, they will execute to calculate one element of Matrix C with the above formula. That is to say, there will exist $m \times q$ threads. And after all the sub-thread have been terminated, the main thread will output the result. To implement it, *join()* is needed and each the *CalMatrix* class should extend *Thread* and overload the *run()*.

*Designed by L^AT_EX

II.3 More details

To input the matrix, several rules to check the input is important, which will make sure the program will execute normally. So I add many check sections in my program. I think it will be full of consideration.

To get the result, I keep two decimal places as default, which uses *DecimalFormat* in *java.text.DecimalFormat*.

III. RESULTS AND CONCLUSIONS

III.1 Environment

- Windows 8
- NetBeans IDE 7.3

III.2 Manual

When we start the program, the first is to input the number of row and column of the first matrix. Then we have to input the matrix. For one row, the numbers have to be divided by " ", while for the next row, you have to input the **ENTER button!** The next is to input the second matrix like the first one. And the result will show to you.

III.3 Screenshots of the result

Use JVM to compile and execute the program in Figure 1.

```

Please input ROW_A, COL_A(The limit is 9*9):
3 2
Please input Matrix A:
1.2 3.6
3.7 5.6 8.9
Wrong Matrix Format!
Re-input:
1.2 3.6
3.7 5.6
8.9 4.7
Please input ROW_B, COL_B(The limit is 9*9):
2
Wrong Matrix!
1 4
ROW_B must be equal to COL_A
Re-input:
2 5
Please input Matrix B:
1 3.7 4.3 11.5 5
3.5 6 9 3.4 2
With A * B, here is Matrix C:
13.80 26.04 37.56 26.04 13.20
23.30 47.29 66.31 61.59 29.70
25.35 61.13 80.57 118.33 53.90
Continue?(y/n)
n
成功构造 (总时间: 1 分钟 7 秒)

```

Figure 1: Screenshots of Matrix Multiplication

III.4 Thoughts

JAVA multi-thread is very useful.