Matrix Multiplication

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May 28, 2017

1 PROBLEM

1.1 DESCRIPTION

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.

2 ALGORITHM

2.1 MATRIX MULTIPLICATION

Matrix multiplication is able to be executed when the matrices are like $[A]_{m\times n} \times [B]_{n\times q}$ and can be described as follows:

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

where

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

2.2 MULTI-THREAD PROGRAMMING

We create $m \times q$ threads to calculate each element in the result matrix $[C]_{m\times q}$ using the formula above. After all sub-threads have been terminated, the main thread will print the result. Class *CalMatrix* is supposed to extend class *Thread* and override the method *run()*. Method *join()* is necessary in the main thread as well.

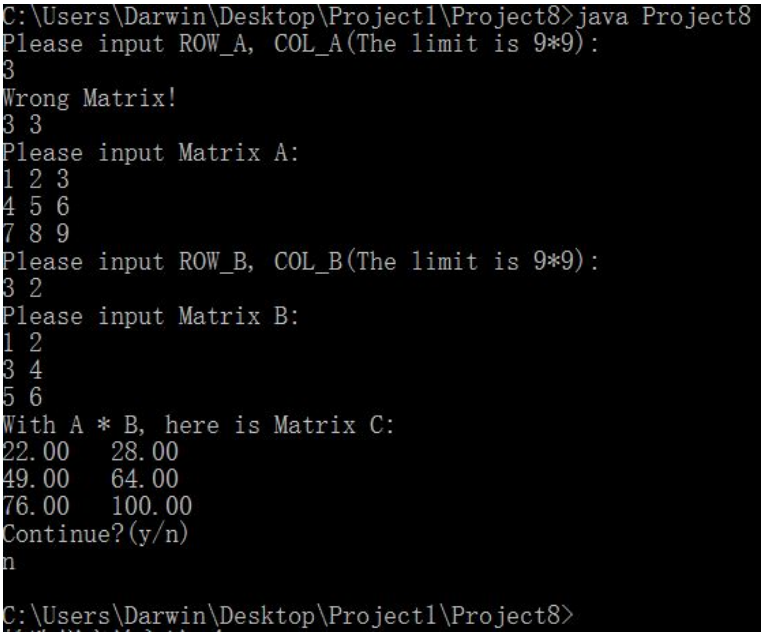

Figure 3.1: Screenshot of Matrix Multiplication

2.3 Robustness Consideration

The user input process requires great efforts to avoid illegal input and make sure the program execute normally. First we require user to input 4 integers to denote the rows and columns and create 2 zero matrices. The column number of $[A]$ needs to be the same as the row number of $[B]$ and thus a detection is needed. In the meantime we require the user to input a row at a time so if any illegal input exists the user is supposed to input this row again until he finishes input.

3 Results

3.1 Environment

- Windows 10
- Java Development Kit 1.8.0_131
- Eclipse

3.2 Screenshots of the Result

We use command line to compile and execute the program. The result is shown in Fig. 3.1.

3.3 Thoughts

It is the first time that I learn multi-thread programming. Although the algorithm is easy it still consumed me lots of time to master multi-thread programming, which benefits me a great deal.