Informatik I

Exercise session 6

Autumn 2019

Homework

- Questions?

Vector v of length n:

Matrix and Vector in Java

Vector v of length n:

```java
double[] v = new double[n];
```

Matrix M with n rows and m columns:

Matrix and Vector in Java

Vector v of length n:

```java
double[] v = new double[n];
```

Matrix M with n rows and m columns:

```java
double M[][] = new double[n][m];
```

(a vector of length n of vectors of length m)

Task

Write a program that reads an $n \times m$ matrix of integers from the input. The input is top to bottom, left to right: elements of the first column, followed by elements of the second column, etc. Print the matrix in the typical orientation (a row on the matrix on each row of the output).

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1. Allocate an $n \times m$ matrix.
2. For each column j (m in total), row i (n in total), read an integer from input and store it in the matrix.

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1. Allocate an $n \times m$ matrix.
2. For each column j (m in total), row i (n in total), read an integer from input and store it in the matrix.
3. For each row i (n in total), column j (m in total), print `M[i][j]`. Print a new line at the end of each row.

Matrix-Matrix-Multiplication

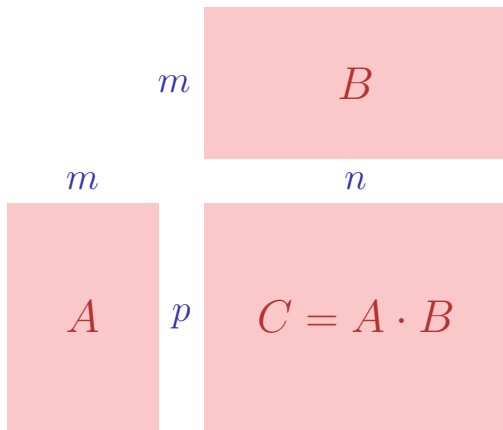Let an $n \times m$ matrix A and an $m \times p$ matrix B be given

$$A = \begin{bmatrix} A_{11} & A_{12} & \cdots & A_{1m} \\ A_{21} & A_{22} & \cdots & A_{2m} \\ \vdots & \vdots & \ddots & \vdots \\ A_{n1} & A_{n2} & \cdots & A_{nm} \end{bmatrix} \qquad B = \begin{bmatrix} B_{11} & B_{12} & \cdots & B_{1p} \\ B_{21} & B_{22} & \cdots & B_{2p} \\ \vdots & \vdots & \ddots & \vdots \\ B_{m1} & B_{m2} & \cdots & B_{mp} \end{bmatrix}$$

Matrix-Matrix-Multiplication

The matrix product of $n \times m$ matrix A and $m \times p$ matrix B is a new $n \times p$ matrix C

$$A \cdot B = B =: \begin{bmatrix} C_{11} & C_{12} & \cdots & C_{1p} \\ C_{21} & C_{22} & \cdots & C_{2p} \\ \vdots & \vdots & \ddots & \vdots \\ C_{n1} & C_{n2} & \cdots & C_{np} \end{bmatrix}$$

Matrix-Matrix-Multiplication

Matrix-Matrix-Multiplication

$$C_{ij} = \sum_{k=1}^{m} A_{ik} \cdot B_{kj} \qquad 1 \le i \le p, \, 1 \le j \le n$$

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2. Now think about the output: what kind of format do you use for output?

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3. Write funtions for In- and Output and test them. Always test small parts. What do you write first: input or output function?

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4. Write the core function for matrix multiplication.

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2. Now think about the output: what kind of format do you use for output?
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4. Write the core function for matrix multiplication.
5. Test your function with some test cases. How do you choose the cases?

Now use your working function in our setup for image transformation: consider the Main method and add your matrix-matrix- multiplication function accordingly.