CS410P

ASSIGNMENT 9P

Purpose

The purpose of this assignment is to apply matrix multiplication to solve a problem. You can use either numPy arrays or 2-D lists to solve this problem.

Scenario

The organizers of an in-house software engineering conference for a small consulting company are trying to minimize scheduling conflicts by scheduling the most popular presentations at different times. First the planners survey the ten participants to determine which of the five presentations they want to attend. They then construct a matrix **A** (let's call it the ***preference matrix***) in which a 1 in entry ***ij*** means that participant ***i*** wants to attend presentation ***j***.

	Presentation				
Participant	**1**	**2**	**3**	**4**	**5**
1	1	0	1	0	1
2	0	0	1	1	1
3	1	0	0	0	0
4	0	1	1	0	1
5	0	0	0	0	0
6	1	1	0	0	0
7	0	0	1	0	1
8	0	1	0	1	0
9	1	0	1	0	1
10	0	0	0	1	0

Next the planners calculate the transpose of matrix **A** which is $\mathbf{A^t}$ and the matrix product $\mathbf{A^t\ A}$.
The transpose of a matrix is formed by interchanging the matrix's rows and columns. Thus the transpose of matrix

$$\mathbf{X} = \begin{matrix} 2 & 4 \\ 6 & 8 \\ 10 & 12 \end{matrix} \qquad \mathbf{X^t} = \begin{matrix} 2 & 6 & 10 \\ 4 & 8 & 12 \end{matrix}$$

In the resulting matrix from the matrix product $\mathbf{A^t\ A}$ (from above), entry ***ij*** is the number of participants wishing to attend both presentation ***i*** and presentation ***j***.

$\mathbf{A^t\ A}$ =	4	1	2	0	2
	1	3	1	1	1
	2	1	5	1	5
	0	1	1	3	1
	2	1	5	1	5

Notice that $\mathbf{A^t\ A}$ is symmetric ($\mathbf{a_{ij} = a_{ji}}$ for all $\boldsymbol{i, j}$), so the entries below the main diagonal (entries $\boldsymbol{ij}$ where $\boldsymbol{i>j}$) need not be calculated. If we supply zeroes for the unnecessary entries, the resulting matrix is termed an *upper triangular matrix*. The entries on the main diagonal ($\mathbf{a_{ii}}$) represent the total participants wanting to attend presentation $\boldsymbol{i}$.

Write a program that inputs a matrix (preference matrix) from a data file of participant preferences. The first line of this file should contain the matrix dimensions: For the preference matrix shown above, this line would be:

10 5

Subsequent lines should be the rows of the matrix. After displaying the preference matrix $\mathbf{A}$, calculate and display $\mathbf{A^t\ A}$ and output sentences indicating how many participants wish to attend each presentation.

Finally, find in the upper triangular matrix of $\mathbf{A^t\ A}$, all the pairs of presentations that the conference committee should avoid scheduling opposite one another. You will output the pairs (of presentation) if there are more than **three** Participants attending the pair of presentations.

Input

The input data is coming from a data file. You should read the data into your 2-D array or list, after you read the first line which contains the size of the Participant Preference array.

Output

The output must first print out the preference matrix $\mathbf{A}$ that is read from the data file. Then it must print the resulting matrix $\mathbf{A^t\ A}$. Following this you must print the rest of the details outlined above.

Sample input and output is available in the public folder

Plots

I would like to see some meaningful plot(s) to show me the results in a graphical manner without enough details it. I am not specifying what kind of plots you need to have, but will let you figure out how best to show me the information in plots.

Requirements

Your program should be modular with as little repetition as possible. It is up to you create multiple files if you think that makes it cleaner. 10% of your grade is set aside for how well written your program is, including comments.