Queens College, CUNY, Department of Computer Science

Numerical Methods

CSCI 361 / 761

Spring 2018

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8 Homework lecture 8

- **The purpose of assigning this homework is to check that you all know what matrices are.**

- **It is a short exercise with simple questions about matrices.**
- **I don't want to be caught by surprise when we begin on linear algebra (solutions of matrix equations).**
- **If necessary I can devote a lecture to "remedial mathematics" about matrices.**
- **However I cannot seriously teach about matrices from scratch.**
- **Matrices are things you are all supposed to know, part of the class prerequisites.**
- **There are no questions in this homework about matrix determinants, but you are also expected to know what they are.**

- **As experience has demonstrated, if you do not understand the above expressions/questions, THEN ASK.**
- **If you do not understand the words/sentences in Lecture 6, etc. THEN ASK.**
- **Send me an email, explain what you do not understand.**
- **Do not just keep quiet and produce nonsense in exams.**

8.1 Matrices: basic properties

- **Question: For each case below, state the number of rows and columns in each matrix M_1 and M_2.**
- **Calculate the matrix product $M_3 = M_1 M_2$.**
- **State the number of rows and columns in the matrix M_3.**

$$M_1 = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{pmatrix}, \qquad M_2 = \begin{pmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{pmatrix}, \qquad M_3 = M_1 M_2 . \tag{8.1.1}$$

$$M_1 = \begin{pmatrix} 1 & -1 \\ 2 & -1 \end{pmatrix}, \qquad M_2 = \begin{pmatrix} 1 & -2 & 4 \\ -8 & 5 & -3 \end{pmatrix}, \qquad M_3 = M_1 M_2 . \tag{8.1.2}$$

$$M_1 = \begin{pmatrix} 1 & -1 \\ -2 & 0 \end{pmatrix}, \qquad M_2 = \begin{pmatrix} -2 & -3 \\ 4 & 5 \end{pmatrix}, \qquad M_3 = M_1 M_2 . \tag{8.1.3}$$

8.2 Matrices: square matrices

- **Question: For each case below, state if the matrix is (a) diagonal, (b) symmetric, (c) antisymmetric, (d) upper triangular, (e) lower triangular, (f) none of the above. Check all that apply.**

- **Question: Also for each case below, calculate the trace of the matrix.**

$$M_1 = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix} . \tag{8.2.1}$$

$$M_2 = \begin{pmatrix} 1 & 0 & 0 \\ 4 & 5 & 0 \\ 7 & 8 & 9 \end{pmatrix} . \tag{8.2.2}$$

$$M_3 = \begin{pmatrix} 1 & 2 & 4 & 8 \\ 2 & -3 & -6 & 9 \\ 4 & -6 & -1 & 7 \\ 8 & 9 & 7 & -5 \end{pmatrix} . \tag{8.2.3}$$

$$M_4 = \begin{pmatrix} 1 & 0 & 0 \\ 0 & -2 & 0 \\ 0 & 0 & 4 \end{pmatrix} . \tag{8.2.4}$$

$$M_5 = \begin{pmatrix} 0 & 3 & -2 \\ -3 & 0 & 1 \\ 2 & -1 & 0 \end{pmatrix} . \tag{8.2.5}$$

$$M_6 = \begin{pmatrix} 1 & 2 & 3 \\ 0 & 4 & 5 \\ 0 & 0 & 6 \end{pmatrix} . \tag{8.2.6}$$

8.3 Matrices: transpose

- **Question: State the number of rows and columns in the matrix M below. Calculate the transpose matrix M^T. Calculate the matrix product $N = MM^T$. State the number of rows and columns in the matrix N.**

$$
\begin{aligned}
M &= \begin{pmatrix} 1 & -2 & -3 & 4 \\ 1 & 2 & 4 & 8 \end{pmatrix}\,, \\
N &= MM^T\,.
\end{aligned}
\tag{8.3.1}
$$

- **Question: Is N a square matrix?**

- **Question: Is N a symmetric matrix?**

8.4 Matrices: **(optional question)**

- For a **square matrix** M, prove that $S = M + M^T$ is a **symmetric matrix.**
- For a **square matrix** N, prove that $A = N - N^T$ is an **antisymmetric matrix.**