

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.
- Please email your solution, as a file attachment, to Sateesh.Mane@qc.cuny.edu.
- Please submit one zip archive with all your files in it.
 1. The zip archive should have either of the names (CS361 or CS761):
`StudentId_first_last_CS361_hw8.zip`
`StudentId_first_last_CS761_hw8.zip`
 2. The archive should contain one “text file” named “hw8.[txt/docx/pdf]” and one cpp file per question named “Q1.cpp” and “Q2.cpp” etc.
 3. Note that not all homework assignments may require a text file.
 4. Note that not all questions may require a cpp file.

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 $M_3 = M_1M_2$.**
- **State the number of rows and columns in the matrix M_3 .**

$$M_1 = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{pmatrix}, \quad M_2 = \begin{pmatrix} 1 & 2 \\ 3 & 4 \\ 5 & 6 \end{pmatrix}, \quad M_3 = M_1M_2. \quad (8.1.1)$$

$$M_1 = \begin{pmatrix} 1 & -1 \\ 2 & -1 \end{pmatrix}, \quad M_2 = \begin{pmatrix} 1 & -2 & 4 \\ -8 & 5 & -3 \end{pmatrix}, \quad M_3 = M_1M_2. \quad (8.1.2)$$

$$M_1 = \begin{pmatrix} 1 & -1 \\ -2 & 0 \end{pmatrix}, \quad M_2 = \begin{pmatrix} -2 & -3 \\ 4 & 5 \end{pmatrix}, \quad M_3 = M_1M_2. \quad (8.1.3)$$

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.

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

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

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

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

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

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

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**.