

# Homework 2: Matrices

## Section 1: Analytical Problems

### Problem 1: Matrix Multiplication

Given:

$$A = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix}, \quad B = \begin{bmatrix} 7 & 8 & 9 & 10 \\ 11 & 12 & 13 & 14 \\ 15 & 16 & 17 & 18 \end{bmatrix}$$

1. Find the dimensions of matrices  $A$  and  $B$ .
2. Compute  $A \times B$  manually, showing all steps.
3. Explain why  $B \times A$  cannot be computed.

### Problem 2: Matrix Operations

Given:

$$C = \begin{bmatrix} 2 & 4 \\ 1 & 3 \end{bmatrix}, \quad D = \begin{bmatrix} 0 & 1 \\ -1 & 2 \end{bmatrix}$$

Compute:

1.  $C + D$
2.  $C - D$
3.  $2C - 3D$
4.  $C \times D$

### Problem 3: Special Matrices

For each of the following matrices, determine whether they are triangular (upper/lower), diagonal, identity, or symmetric:

$$M_1 = \begin{bmatrix} 3 & 0 & 0 \\ 2 & 5 & 0 \\ 1 & 4 & 6 \end{bmatrix}, \quad M_2 = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 3 \end{bmatrix}, \quad M_3 = \begin{bmatrix} 1 & 2 & 3 \\ 2 & 4 & 5 \\ 3 & 5 & 6 \end{bmatrix}$$

## Section 2: Python-Based Exercises

### Problem 6: Multiplication of Rectangular Matrices in Python

Using NumPy, perform the following matrix operations:

1. Create matrices  $A$  and  $B$  from Problem 1.
2. Compute  $A \times B$  using Python.
3. Verify whether  $B \times A$  is possible and explain the result.

### Problem 7: Identifying Special Matrices in Python

Write a Python function to check whether a matrix is:

- Upper triangular
- Lower triangular
- Diagonal
- Symmetric

### Problem 8: Matrix Multiplication

Code matrix multiplication using for loops. Confirm your results against using the numpy `@` operator. This exercise will help you solidify your understanding of matrix multiplication, but in practice, it's always better to use `@` instead of writing out a double for loop.

## Submission Instructions

- Submit written solutions to the analytical problems as a PDF.
- Upload Python scripts or Jupyter notebooks for the coding exercises.
- Include screenshots of outputs for verification.