DATA ANALYSIS AND MATRIX OPERATIONS.

$$M_1 = \begin{bmatrix} 2 & 5 & 6 \\ 6 & 8 & 3 \end{bmatrix}$$

- **Data Type of M_1** = Numerical Data (integers).
- **Mean of M_1** = (2 + 5 + 6 + 6 + 8 + 3) / 6

  = 30 / 6

  = 5
- **Mode of M_1** = 6 (because it is the most occurring value).
- **Median of M_1** = [2, 3, 5, 6, 6, 8]

  = (5 + 6) / 2

  = 11 / 2

  = 5.5

$$M_2 = \begin{bmatrix} 7 & 4 & 1 \\ 8 & 5 & 2 \end{bmatrix}$$

- **$M_1 + M_2$ =** $\begin{bmatrix} 9 & 9 & 7 \\ 14 & 13 & 5 \end{bmatrix}$

- **$M_1 - M_2$ =** $\begin{bmatrix} -5 & 1 & 5 \\ -2 & 3 & 1 \end{bmatrix}$

- **M_1^T =** $\begin{bmatrix} 2 & 6 \\ 5 & 8 \\ 6 & 3 \end{bmatrix}$

- **M1 x** $[4] = \begin{bmatrix} 8 & 20 & 24 \\ 24 & 32 & 12 \end{bmatrix}$

Real World Application of Matrices in Data Analysis

Image Processing

Matrices are fundamental in data analysis, particularly in organizing, manipulating, and analysing structured datasets.

In image processing, matrices are used for:

1. Image Representation:

   Images are represented as matrices where each element corresponds to a pixel's intensity value.

   For grayscale images, each pixel is a single numerical value (0 to 255 for 8-bit images).

   For colour images, each pixel is represented by three matrices (red, green, and blue channels).

   For instance, a 3x3 grayscale image:

$$\begin{bmatrix} 0 & 100 & 255 \\ 50 & 150 & 200 \\ 75 & 125 & 175 \end{bmatrix}$$

2. Data Analysis Techniques:

   Also including **compression** (where Singular Value Decomposition reduces the size of an image while retaining its significant features), **filtering** (where convolution matrices/kernels are applied to enhance or detect specific features, such as edges or blurs), and **transformation** (like Fourier Transform which uses matrices to shift data into a frequency domain for noise reduction or pattern recognition).

3. Practical Image Applications:

   Including **facial recognition** (where matrices help store and process features extracted from facial images, aiding in comparing patterns), **medical imaging** (CT scans, MRIs, and X-rays, all use matrices for image reconstruction and enhancement), and **object detection** (algorithms like Convolutional Neural Networks use matrices to process images and identify objects).

   Below, is an example of how a smoothing filter (e.g., an averaging kernel) is applied to reduce the noise of an image:

- Kernel (3x3 matrix):

$$\frac{1}{9}\begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$$

- This kernel is convolved with the image matrix to compute smoothed pixel values.

In general, matrices are indispensable in data analysis, especially in fields like image processing, where they facilitate tasks such as pattern recognition, compression, and enhancement.