

**Exercise 1: Basic Matrix Operations**

Define the following matrices and vectors.

$$A = \begin{pmatrix} -1 & 3 \\ 2 & 1 \end{pmatrix}, B = \begin{pmatrix} 5 & -4 \\ 1 & -3 \end{pmatrix}, C = \begin{pmatrix} 1 & 1 & 6 \\ 1 & -9 & -4 \end{pmatrix}, D = \begin{pmatrix} 1 & -4 \\ 1 & -3 \\ -2 & 3 \end{pmatrix},$$
$$\mathbf{x} = \begin{pmatrix} 2 \\ 0 \end{pmatrix}, \mathbf{y} = \begin{pmatrix} 0 \\ -1 \end{pmatrix}, \mathbf{z} = \begin{pmatrix} -2 \\ 4 \\ 1 \end{pmatrix}.$$

Calculate the following:

- (a)  $A - B$ ,
- (b)  $4\mathbf{x} - 2\mathbf{y}$ ,
- (c)  $A\mathbf{y}$ ,
- (d)  $A(\mathbf{y} + \mathbf{x})$ ,
- (e)  $D\mathbf{x}$ ,
- (f)  $D\mathbf{y} + \mathbf{z}$ ,
- (g)  $AB$ ,
- (h)  $BA$ ,
- (i)  $AC$ ,
- (j)  $CD$ .

Save the answers in ten separate .dat files, named **A1.dat**, **A2.dat**, ..., **A10.dat**.  
Are the answers in (g) and (h) the same? Why or why not?

Next, access and save the following elements:

- (k) The second column of  $C$ ,
- (l) Both columns of the last two rows of  $D$ ,
- (m) The first two columns of the second row of  $C$ .

Save the answers in three separate .dat files, named **A11.dat**, **A12.dat** and **A13.dat**.

**Exercise 2: Truncation Errors**

The following four expressions are exactly equal to zero:

$$x_1 = \left| 2000 - \sum_{k=1}^{20,000} 0.1 \right|, \quad x_2 = \left| 2000 - \sum_{k=1}^{16,000} 0.125 \right|,$$
$$x_3 = \left| 2000 - \sum_{k=1}^{10,000} 0.2 \right|, \quad x_4 = \left| 2000 - \sum_{k=1}^{8,000} 0.25 \right|$$

However, computers store floating-point numbers with a binary representation, so most decimals representations have a small truncation error. This error accumulates in the summation of a series. As a result,  $x_1$  through  $x_4$  might not be numerically identical to zero. To verify this effect, use MATLAB to compute  $x$  and  $y$ . Save  $[x_1, x_2, x_3, x_4]^T$  as a column vector in **A14.dat**. **Hint:** Use a **for** loop.

Can you explain the differences in these values?