TP2: Vectors and Matrices

Exercise 1. *Create the following vectors in two different ways.*

$$V_1 = (5\ 2\ 3\ 7) \quad V_2 = \begin{pmatrix} -1 \\ 3 \\ 6 \\ -5 \\ 8 \end{pmatrix}$$

Exercise 2. *Execute and understand the following commands:*

```
V1*V2
V1*V2'
V1.*V2'
V3=[4  5  6  7  8]
V1+V3
V1/V3
V1./V3
V1^3
V1.^3
```

Exercise 3. *Let the three matrices A, B, and C be:*

1. *Calculate the following expressions:*

```
A*B-3              C*B+1+zeros(4,2)        C(1:2,:)^2
A.*B-3             A'.^B/2                 C(2:3,:).^2
A^2-ones(2)        C*eye(2)                C(end:-1:1,2).\24
```

2. *Create the matrix M which contains matrices A and B stacked on top of each other to define the 1st and 2nd columns, and matrix C to define the 3rd and 4th columns.*

$$M = \begin{pmatrix} 1 & 2 & -1 & 3 \\ 7 & 2 & 0 & 1 \\ 3 & -2 & -1 & -1 \\ 0 & 1 & 4 & 8 \end{pmatrix}$$

3. *Provide the Matlab result for each of the following commands:*

```
M(3,2) = 3              M(2,:)-7*M(1,:)                 M([1,3],:) = []
M(3,[2 4])              M(2,:) = M(2,:)-7*M(1,:)        M(:,1) = []
M(1:3,[2 4])'           M([1 3],[1 3]) = 10*ones(2)     size(M)*M

        M(end:-1:1,end:-2:1)
        M = [[M;M] ones(4,1)]
        tril(M,-1)+triu(M,2)
```

Exercise 4. *Execute and understand the following commands:*

```
U=ones(2,2)                     A=floor(10*rand(3,3))
N=zeros(2,3)                    B=2*ones(4,4);
Y=eye(4,4)                      C=[A(:,2),B(:,3)]
D=[B(1:2,:);A(2:3,:)]           M1=floor(10*rand(3,2))
diag(A)                         help floor
diag(A,1)                       floor(B)
diag(A,-1)                      help rand
diag([2,4,6,8])                 C=B.*B-4*A
help find                       find(M1==3)
find(M1>=3)                     D=B*B // or D=B^2
find(M1>5)                      M=floor(10*rand(3,3));
S=(M+M')/2;                     A=(M-M')/2;
(M*M')'-M*M'                    A+S;
```

Exercise 5. *Consider the following three vectors:* $X = (X_1, X_2, X_3, \ldots, X_{n-1}, X_n)$, $Y = (Y_1, Y_2, Y_3, \ldots, Y_{n-1})$ *and* $Z = (Z_1, Z_2, Z_3, \ldots, Z_{n-1})$
Propose Matlab instructions to design the matrices A, B, and C for n=30:

$$A = \begin{pmatrix} x_1 & z_1 & 0 & \cdots & 0 & 0 \\ y_1 & x_2 & z_2 & \cdots & 0 & 0 \\ 0 & y_2 & x_3 & \ddots & \cdots & 0 \\ \vdots & \ddots & \ddots & \ddots & \ddots & 0 \\ 0 & 0 & 0 & \ddots & x_{n-1} & z_{n-1} \\ 0 & 0 & 0 & \cdots & y_{n-1} & x_n \end{pmatrix} \quad B = \begin{pmatrix} 0 & 0 & \cdots & 0 & z_1 & x_1 \\ 0 & 0 & \cdots & z_2 & x_2 & y_1 \\ 0 & 0 & \ddots & x_3 & y_2 & 0 \\ \vdots & \ddots & \ddots & \ddots & \vdots & \vdots \\ z_{n-1} & x_{n-1} & \cdots & 0 & 0 & 0 \\ x_n & y_{n-1} & \cdots & 0 & 0 & 0 \end{pmatrix}$$

$$C = \begin{pmatrix} 1 & \frac{1}{2^2} & \frac{1}{3^2} & \cdots & \frac{1}{n^2} \\ -\frac{1}{2^2} & 1 & \frac{1}{2^2} & \cdots & \frac{1}{(n-1)^2} \\ -\frac{1}{3^2} & -\frac{1}{2^2} & 1 & \ddots & \frac{1}{(n-2)^2} \\ \vdots & \vdots & \ddots & \ddots & \vdots \\ -\frac{1}{(n-1)^2} & -\frac{1}{(n-2)^2} & \cdots & 1 & \frac{1}{2^2} \\ -\frac{1}{n^2} & -\frac{1}{(n-1)^2} & \cdots & -\frac{1}{2^2} & 1 \end{pmatrix}$$

Exercise 6. *For a matrix A, propose two general expressions for each of the following operations:*

1. *Delete the entire i-th row*
2. *Delete the entire j-th column*
3. *Add a row at the end of the matrix (a row vector x with* `length(x) = size(A,2)`*)*
4. *Add a column at the end of the matrix (a column vector y with* `length(y) = size(A,1)`*)*

Exercise 7.

a) The matrices A, B, C by enumeration and D, C by description

$$A = \begin{pmatrix} 1 & 4 \\ -2 & 5 \\ 3 & 0 \end{pmatrix}, \quad B = \begin{pmatrix} 1/2 & 1 & 3/2 \\ 1/3 & 2/3 & 1 \\ 1/4 & 1/2 & 3/4 \end{pmatrix}, \quad C = \begin{pmatrix} i & 0 & 1 \\ 0 & i+1 & 0 \\ 1 & 0 & i \end{pmatrix}, \quad D = \begin{pmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{pmatrix},$$

$$E = \begin{pmatrix} 90 & 85 & 70 & 65 \\ 30 & 40 & 50 & 60 \\ 80 & 70 & 60 & 50 \\ 1 & 7 & 14 & 21 \end{pmatrix}.$$

b) Provide the defined matrices as arguments to the functions length and size.

c) Conclude regarding the difference between these two functions.

d) Execute and understand the following commands:

```
>> C(2,2)=pi
>> C(:,3)=[1 :3]'
```