Exercise 1:

- V= [0.5, 0.8, 0.9]
- M = [1.0, 0.3, 0.65; 0.5, 0.8, 0.9; 1.0, 0.3, 0.65]

Using NumPy:

- Create the vector V.
- Create the matrix M, M transpose, Matrix G = M^T*M.
- Extract vector 1, row 1, sub matrix (0-2,0-2), then the max, min, sum, and average of each.
- Extract from M: (a) diagonal matrix. (b) identity matrix, (c) values bigger than 0.5.
- Insert a new row to M, and then insert a new column to M using random values.
- Calculate Euclidean distance of each two vectors of M using G.
- Verify if V is in M.
- Create a random sample of data (X values, and Y values) as to have 10 values of X in the range [0; 11], and Y has a linear form Y= aX + b (a in [1.5; 1.8], and b in [4; 4.5].
    - Check **Linspace.**
- Check if a matrix N is sub matrix of another matrix M.
- Create matrix of size (5,5) containing: (a) ones, (b) zeros, and (c) random values.

Exercise 2

Calculate Maclaurin series with NumPy

$$e^x = \sum_{n=0}^{\infty} \frac{x^n}{n!} = 1 + x + \frac{x^2}{2} + \frac{x^3}{6} \dots$$

Exercise 3:

Let us consider the data set of Amazon Ratings from Kaggle.

- https://www.kaggle.com/datasets/skillsmuggler/amazon-ratings

In next:

- Load the data.
- Filter rows to pick up the 10 highest sold products.
- Transform the data so we have days instead of timestamps.
- Draw a line graph representing the averaging rating of the products.
- Draw a multi-line graph representing the selling number of each product by day.

Exercise 4:

For a given data matrix *M*.

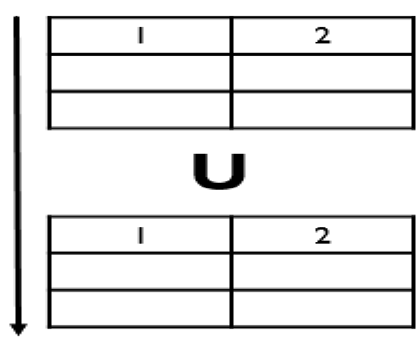
- **Compute the centered matrix M_C:**
  - Create an identity matrix I_n of shape (n, n), and the ones matrix J_n of shape (n, n) containing only 1s, then calculate the centering matrix $Cn = I_n - 1/n * J_n$, where represents the number of rows of *M*.
  - Calculate the centered matrix $\boldsymbol{M_c} = X * C_n$
- **Reduce the data:**
  - Calculate the diagonal matrix $\mathbf{diag_n}$ of length n (containing in the diagonal n 1 value, e.g., $diag_3 = [1,0,0;0,1,0;0,0,1]$.).
  - Divide $\boldsymbol{diag_n}$ by n and get $\boldsymbol{Ndiag_n}$.
  - Calculate variance matrix $Var_M = M_c^T Ndiag_n M_c$
  - Get the variance vector from Var_V, (the variance of each variable by retrieving the diagonal of Var_M).
  - Calculate the inverse matrix of $IVar_V = Var_v^{-1}$.
  - Calculate the reduced matrix $M_r = M_c IVar_v$
- **Calculate the covariance matrix:**
  - $Cov = M_r^T Ndiag_n M_r$
- **Calculate the eigenvalues, and the eigenvectors of Cov.**
- **Filter the eigenvectors, and keep only the vectors, which explain 90% of the variance.**
- **Project M into the new dimensions.**

Exercise 5:

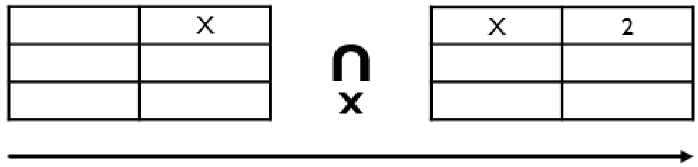
Write equivalent pandas instructions for the next cases:

1)

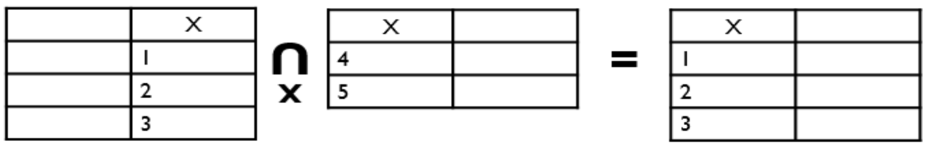
2)



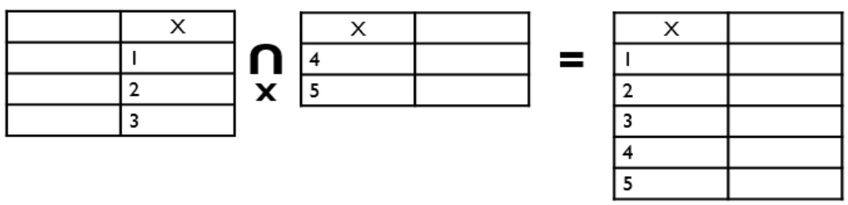
3)


X
∩
x
X
2

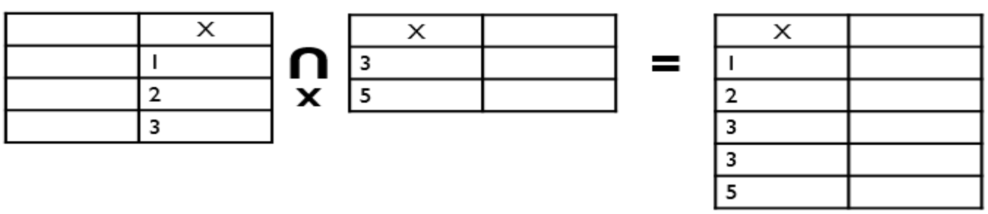
4)


X
1
2
3
∩
x
X
4
5
=
X
1
2
3

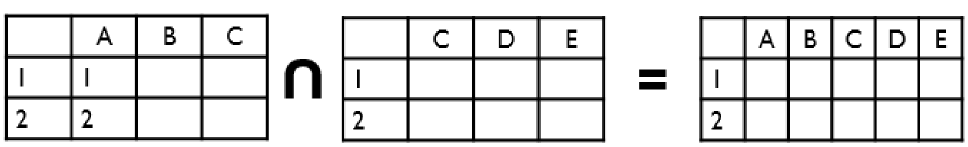
5)


X
1
2
3
∩
x
X
4
5
=
X
1
2
3
4
5

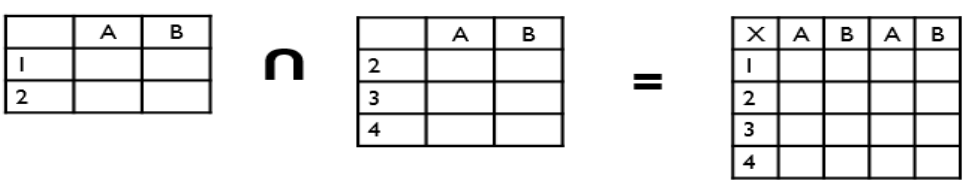
6)


X
1
2
3
∩
x
X
3
5
=
X
1
2
3
3
5

7)


A B C
1 1
2 2
∩
C D E
1
2
=
A B C D E
1
2

8)


A B
1
2
∩
A B
2
3
4
=
X A B A B
1
2
3
4

9)

	A	B
1	1	1
2	2	2
3	2	1

∩

	A	B	C
4	1	1	0
5	1	2	1
6	2	2	1

=

X	A	B	C
1	1	1	0
2	1	2	1
3	2	1	NAN

10)

	A	B
1	1	1
2	2	2
3	2	1

∩

	A	B	C
4	1	1	0
5	1	2	1
6	2	2	1

=

X	A	B	C
1	1	1	0
2	1	2	1

11)

	A	B
1	N	3
2	0	4
3	N	5

Fill
N

	A	B
1	1	3
2	1	N
3	3	3

=

	A	B
1	1	3
2	0	4
3	3	5

12)

C1
1
2
3

S

+

1
2
3

S

+

C2
1
2
3

S

=

	A	B	C
1			
2			
3			

DF