
Assignment 3

Question 1:
Create a 3×3 matrix of integers from 1-9, then calculate its transpose, determinant, and trace.

Output

Transpose:
[[1 4 7]
 [2 5 8]
 [3 6 9]]

Determinant: 0.0

Trace: 15

Question 2:
Given two matrices, perform addition, subtraction, matrix multiplication, and element-wise multiplication.
A = [3, 1]
    [2, 4]

B = [2, 5]
    [1, 3]

Output:
A + B =
[[5 6]
 [3 7]]

A - B =
[[1 -4]
 [1 1]]

A × B (matrix product) =
[[7 18]
 [8 22]]

A * B (element-wise) =

[[6 5]
 [2 12]]

Question 3: Solving Linear Equations
Solve the system of linear equations using NumPy:

2x + y + z = 10
3x + 2y + 3z = 18
x + 4y + 9z = 16

Solution:
x = 4.0
y = 2.0
z = 0.0

Verification (A × solution):
[10. 18. 16.]

Question 4:
Given a dataset matrix, calculate the mean and standard deviation of each column, normalise the data, and find the correlation between columns.

A= [5.1, 3.5, 1.4]
[4.9, 3.0, 1.4]
[4.7, 3.2, 1.3]
[4.6, 3.1, 1.5]
[5.0, 3.6, 1.4]

Output:
Column means: [4.86 3.28 1.4]

Column standard deviations: [0.19595918 0.24899799 0.07071068]

Normalized data:
[[1.22474487 0.88354899 0.   ]
 [0.20412414 -1.12451549 0.   ]
 [-0.8164966 -0.32128999 -1.41421356]
 [-1.32679698 -0.72290748 1.41421356]

```
 [ 0.71443449  1.28516397  0.        ]]
```

Correlation matrix:

```
[[ 1.         0.65089018 -0.10566282]
 [ 0.65089018  1.         -0.00920389]
 [-0.10566282 -0.00920389  1.        ]]
```

Question 5:

Calculate eigenvalues and eigenvectors of a given matrix, then reconstruct the original matrix.

```
     [4, 2, 2]
A= [2, 5, 1]
     [2, 1, 6]
```

Eigenvalues:

```
[2.34563298 4.         8.65436702]
```

Eigenvectors (as columns):

```
[[-0.5697282   0.81741256  0.08519846]
 [-0.43976496 -0.28616193  0.85065781]
 [-0.69597618 -0.5         -0.5185347 ]]
```

Matrix reconstruction:

```
[[4. 2. 2.]
 [2. 5. 1.]
 [2. 1. 6.]]
```

Verification of Av = λv for eigenvector 3

```
Av: [ 0.73731518  7.36364422 -4.48732634]
λv: [ 0.73731518  7.36364422 -4.48732634]
```

Question 6:

Calculate the covariance matrix for the following set of 2D data points:
(1,2), (2,3), (3,5), (4,7), (5,8).

---

output:
Means: x = 3.0 , y = 5.0

Covariance matrix (manual calculation): [[2.5 3.5]
[3.5 6.5]]

Question 7:
Calculate the correlation matrix for the data in Question 6 and interpret the results.

Interpretation

corr_xy > 0.8:
The correlation coefficient indicating a strong positive linear relationship.
corr_xy > 0.5:
"The correlation coefficient indicates a moderately positive linear relationship.
corr_xy > 0:
The correlation coefficient indicates a weak positive linear relationship.
corr_xy == 0:
The correlation coefficient indicates no linear relationship.
Else:
The correlation coefficient indicates a negative linear relationship.