MATHEMATICS

LAB ASSIGNMENTS

***Set 1***

Question 1:

Define a vector

import numpy as np

print("Enter the values of vector : ")

list = [int(input()) for i in range(3)]

vector1 = np.array(list)

print("The vector defined is : ",vector1)

Output :

Enter the values of vector :

1

2

3

The vector defined is : [1 2 3]

Question 2:

Add two vectors using NumPy Arrays

import numpy as np

print("Enter the  values of first vector : ")

list1 = [int(input()) for i in range(3)]

print("Enter the values of second vector : ")

list2 = [int(input()) for i in range(3)]

vector1 = np.array(list1)

vector2 = np.array(list2)

print("The resultant vector is : ", vector1 + vector2)

Output :

Enter the values of first vector :

1

2

3

Enter the values of second vector :

4

5

6

The resultant vector is : [5 7 9]

Question 3

Subtract two vectors using NumPy Arrays

import numpy as np

print("Enter the  values of first vector : ")

list1 = [int(input()) for i in range(3)]

print("Enter the values of second vector : ")

list2 = [int(input()) for i in range(3)]

vector1 = np.array(list1)

vector2 = np.array(list2)

print("The resultant vector is : ", vector1 - vector2)

Output :

Enter the values of first vector :

1

2

3

Enter the values of second vector :

1

4

5

The resultant vector is : [ 0 -2 -2]

Question 4

Multiply two vectors using NumPy Arrays

import numpy as np

print("Enter the  values of first vector : ")

list1 = [int(input()) for i in range(3)]

print("Enter the values of second vector : ")

list2 = [int(input()) for i in range(3)]

vector1 = np.array(list1)

vector2 = np.array(list2)

print("The resultant vector is : ", vector1 \* vector2)

Output :

Enter the values of first vector :

1

2

3

Enter the values of second vector :

4

5

6

The resultant vector is : [ 4 10 18]

Question 5

Divide two vectors using NumPy Arrays

import numpy as np

print("Enter the  values of first vector : ")

list1 = [int(input()) for i in range(3)]

print("Enter the values of second vector : ")

list2 = [int(input()) for i in range(3)]

vector1 = np.array(list1)

vector2 = np.array(list2)

print("The resultant vector is : ", vector1 / vector2)

Output :

Enter the values of first vector :

1

2

3

Enter the values of second vector :

4

5

6

The resultant vector is : [0.25 0.4 0.5 ]

Question 6

Find dot product of two vectors

import numpy as np

print("Enter the  values of first vector : ")

list1 = [int(input()) for i in range(3)]

print("Enter the values of second vector : ")

list2 = [int(input()) for i in range(3)]

vector1 = np.array(list1)

vector2 = np.array(list2)

resultVector = np.dot(vector1,vector2)

print("The resultant vector is : ", resultVector)

Output :

Enter the values of first vector :

1

2

3

Enter the values of second vector :

4

5

6

The resultant vector is : 32

Question 7

Perform vector Scalar Multiplication

import numpy as np

print("Enter the  values of first vector : ")

list1 = [int(input()) for i in range(3)]

scalar = int(input("Enter the scalar value"))

vector1 = np.array(list1)

resultVector = vector1 \* scalar

print("The resultant vector is : ", resultVector)

Output :

Enter the values of first vector :

1

2

3

Enter the scalar value : 4

The resultant vector is : [ 4 8 12]

Question 8

Calculate L1, L2, Max Norms of a vector.

import numpy as np

from numpy.linalg import norm

from math import inf

print("Enter the values of  vector : ")

list1 = [int(input()) for i in range(3)]

vector1 = np.array(list1)

resultVector1 = norm(list1, 1)

resultVector2 = norm(list1, 2)

resultVector3 = norm(list1, inf)

print("The L1 norm of vector is : ", resultVector1)

print("The L2 norm of vector is : ", resultVector2)

print("The Max norm of vector is : ", resultVector3)

Output :

Enter the values of vector :

1

2

3

The L1 norm of vector is : 6.0

The L2 norm of vector is : 3.7416573867739413

The Max norm of vector is : 3.0

***Set-2***

Question 1

Define Matrix

rows = int(input("enter the number of rows in Matrix "))

columns = int(input("enter the number of columns in Matrix "))

print(f"Enter the elements of the {rows}x{columns} matrix")

a = [[int(input("=>")) for j in range(columns)] for i in range(rows)]

#To print matrix in conventional order of matrix

for row in a :

  for element in row:

    print(element,end=" ")

  print('')

Output :

Enter the elements of the 3x3 matrix

=>1

=>2

=>3

=>4

=>5

=>6

=>7

=>8

=>9

1 2 3

4 5 6

7 8 9

Question 2

Add two matrices

import numpy as np

rows = int(input("Enter the number of rows in  Matrices : "))

columns = int(input("Enter the number of columns in Matrices : "))

print(f"Enter the elements of the first {rows}x{columns} matrix")

matrix\_1 = [[int(input("=>")) for j in range(columns)] for i in range(rows)]

print(f"Enter the elements of the second {rows}x{columns} matrix")

matrix\_2 = [[int(input("=>")) for j in range(columns)] for i in range(rows)]

matrix\_1 = np.array(matrix\_1)

matrix\_2 = np.array(matrix\_2)

print("first Matrix \n",matrix\_1)

print("Second Matrix \n", matrix\_2)

print("Sum of Matrices\n",matrix\_1 + matrix\_2)

Output :

Enter the elements of the first 2x2 matrix

=>1

=>2

=>3

=>4

Enter the elements of the second 2x2 matrix

=>5

=>6

=>7

=>8

first Matrix

[[1 2]

[3 4]]

Second Matrix

[[5 6]

[7 8]]

Sum of Matrices

[[ 6 8]

[10 12]]

Question 3

Subtract two matrices

rows = int(input("Enter the number of rows in  Matrices : "))

columns = int(input("Enter the number of columns in Matrices : "))

print(f"Enter the elements of the first {rows}x{columns} matrix")

matrix\_1 = [[int(input("=>")) for j in range(columns)] for i in range(rows)]

print(f"Enter the elements of the second {rows}x{columns} matrix")

matrix\_2 = [[int(input("=>")) for j in range(columns)] for i in range(rows)]

matrix\_1 = np.array(matrix\_1)

matrix\_2 = np.array(matrix\_2)

print("first Matrix \n",matrix\_1)

print("Second Matrix \n", matrix\_2)

print("Difference of Matrices\n",matrix\_1 - matrix\_2)

Output :

Enter the number of rows in Matrices : 2

Enter the number of columns in Matrices : 2

Enter the elements of the first 2x2 matrix

=>5

=>6

=>7

=>8

Enter the elements of the second 2x2 matrix

=>1

=>2

=>3

=>4

first Matrix

[[5 6]

[7 8]]

Second Matrix

[[1 2]

[3 4]]

Difference of Matrices

[[4 4]

[4 4]]

Question 4

Find the hadamard product of two matrices

import numpy as  np

rows = int(input("Enter the number of rows in  Matrices : "))

columns = int(input("Enter the number of columns in Matrices : "))

print(f"Enter the elements of the first {rows}x{columns} matrix")

matrix\_1 = [[int(input("=>")) for j in range(columns)] for i in range(rows)]

print(f"Enter the elements of the second {rows}x{columns} matrix")

matrix\_2 = [[int(input("=>")) for j in range(columns)] for i in range(rows)]

matrix\_1 = np.array(matrix\_1)

matrix\_2 = np.array(matrix\_2)

print("first Matrix \n",matrix\_1)

print("Second Matrix \n", matrix\_2)

print("Hadamard product of two matrices are:\n", matrix\_1 \* matrix\_2)

Output :

Enter the number of rows in Matrices : 2

Enter the number of columns in Matrices : 2

Enter the elements of the first 2x2 matrix

=>1

=>2

=>3

=>4

Enter the elements of the second 2x2 matrix

=>5

=>6

=>7

=>8

first Matrix

[[1 2]

[3 4]]

Second Matrix

[[5 6]

[7 8]]

Hadamard product of two matrices are:

[[ 5 12]

[21 32]]

Question 5

Divide two matrices

import numpy as  np

rows = int(input("Enter the number of rows in  Matrices : "))

columns = int(input("Enter the number of columns in Matrices : "))

print(f"Enter the elements of the first {rows}x{columns} matrix")

matrix\_1 = [[int(input("=>")) for j in range(columns)] for i in range(rows)]

print(f"Enter the elements of the second {rows}x{columns} matrix")

matrix\_2 = [[int(input("=>")) for j in range(columns)] for i in range(rows)]

matrix\_1 = np.array(matrix\_1)

matrix\_2 = np.array(matrix\_2)

print("first Matrix \n",matrix\_1)

print("Second Matrix \n", matrix\_2)

print("Resultant matrix after division is:\n", matrix\_1 / matrix\_2)

Output :

Enter the number of rows in Matrices : 2

Enter the number of columns in Matrices : 2

Enter the elements of the first 2x2 matrix

=>9

=>8

=>7

=>6

Enter the elements of the second 2x2 matrix

=>5

=>4

=>3

=>2

first Matrix

[[9 8]

[7 6]]

Second Matrix

[[5 4]

[3 2]]

Resultant matrix after division is:

[[1.8 2. ]

[2.33333333 3. ]]

Question 6

Find the product of two matrices

import numpy as np

rows = int(input("Enter the number of rows in first Matrix : "))

columns = int(input("Enter the number of columns in first Matrix : "))

column\_2 = int(input("Enter the number of columns in Second Matrix : "))

print(f"Enter the elements of the first {rows} x {columns} matrix")

matrix\_1 = [[int(input("=>")) for j in range(columns)] for i in range(rows)]

print(f"Enter the elements of the second {columns} x {column\_2} matrix")

matrix\_2 = [[int(input("=>")) for j in range(column\_2)] for i in range(columns)]

matrix\_1 = np.array(matrix\_1)

matrix\_2 = np.array(matrix\_2)

print("first Matrix \n",matrix\_1)

print("Second Matrix \n", matrix\_2)

result = []

for i in range(rows):

  for j in range(column\_2):

    sum = 0

    for k in range(columns):

        sum += matrix\_1[i][k] \* matrix\_2[k][j]

    result.append(sum)

result = np.array(result)

result = result.reshape(rows, column\_2)

print("Resultant matrix after multiplication is:\n", result)

Output :

Enter the number of rows in first Matrix : 2

Enter the number of columns in first Matrix : 2

Enter the number of columns in Second Matrix : 2

Enter the elements of the first 2 x 2 matrix

=>1

=>2

=>3

=>4

Enter the elements of the second 2 x 2 matrix

=>5

=>6

=>7

=>8

first Matrix

[[1 2]

[3 4]]

Second Matrix

[[5 6]

[7 8]]

Resultant matrix after multiplication is:

[[19 22]

[43 50]]

Question 7

Find vector matrix multiplication

import numpy as np

from time import sleep

def MatrixMaker(rows, columns):

  a = [int(input("=>")) for i in range(rows \* columns)]

  a = np.array(a)

  a = a.reshape(rows, columns)

  return a

rows = int(input("Enter the number of rows in Matrix : "))

columns = int(input("Enter the number of columns in Matrix : "))

if rows > 3 or columns > 3 :

  sleep(2)

  print("Vectors can only have maximum elements of 3")

  sleep(2)

  print("Please rerun the program")

  exit()

column\_2 = 1 #defining the columns in a vector space

print(f"Enter the elements of the {rows} x {columns} matrix: ")

matrix\_1 = MatrixMaker(rows, columns)

print(f"Enter the elements of the Vector: ")

matrix\_2 = MatrixMaker(columns, column\_2)

print("Matrix \n",matrix\_1)

print("Vector \n", matrix\_2)

result = []

for i in range(rows):

    sum = 0

    column\_2 -= 1 # for adjusting into the index of matrix

    for k in range(columns):

        sum += matrix\_1[i][k] \* matrix\_2[k][column\_2]

    result.append(sum)

result = np.array(result)

result = result.reshape(rows, column\_2)

print("Resultant matrix after multiplication is:\n", result)

Output :

Enter the number of rows in Matrix : 2

Enter the number of columns in Matrix : 2

Enter the elements of the 2 x 2 matrix:

=>1

=>2

=>3

=>4

Enter the elements of the Vector:

=>5

=>6

Matrix

[[1 2]

[3 4]]

Vector

[[5]

[6]]

Resultant matrix after multiplication is:

[[17]

[39]]

Question 8

Perform scalar - matrix multiplication

import numpy as np

def MatrixMaker(rows, columns):

  a = [int(input("=>")) for i in range(rows \* columns)]

  a = np.array(a)

  a = a.reshape(rows, columns)

  return a

rows = int(input("Enter the number of rows in  Matrices : "))

columns = int(input("Enter the number of columns in Matrices : "))

print(f"Enter the elements of the first {rows}x{columns} matrix")

matrix\_1 = MatrixMaker(rows, columns)

scalar\_value = int(input("Enter any scalar value : "))

print("first matrix \n", matrix\_1)

print("Scalar value \n", scalar\_value)

print("Resultant matrix is \n",matrix\_1 \* scalar\_value)

Output :

Enter the number of rows in Matrices : 2

Enter the number of columns in Matrices : 2

Enter the elements of the first 2x2 matrix

=>1

=>2

=>3

=>4

Enter any scalar value : 7

first matrix

[[1 2]

[3 4]]

Scalar value

7

Resultant matrix is

[[ 7 14]

[21 28]]

Question 9

Define a 3 x 3 square matrix and Calculate lower and upper triangular matrix from it.

import numpy as np

def MatrixMaker(rows, columns):

  a = [int(input("=>")) for i in range(rows \* columns)]

  a = np.array(a)

  a = a.reshape(rows, columns)

  return a

rows = 3

columns = 3

print(f"Enter the elements of the first {rows}x{columns} matrix")

matrix\_1 = MatrixMaker(rows, columns)

#upper triangular matrix

upperTriangle = []

upperTriangle = matrix\_1.copy()

for i in range(rows):

  for j in range(columns):

    if i > j :

      upperTriangle[i][j] = 0

#lower triangular matrix

lowerTriangle = []

lowerTriangle = matrix\_1.copy()

for i in range(rows):

  for j in range(columns):

    if i < j:

      lowerTriangle[i][j] = 0

print("Matrix \n", matrix\_1)

print("Upper triangular matrix \n",upperTriangle)

print("Lower triangular matrix \n",lowerTriangle)

Output :

Enter the elements of the first 3x3 matrix

=>1

=>2

=>3

=>4

=>5

=>6

=>7

=>8

=>9

Matrix

[[1 2 3]

[4 5 6]

[7 8 9]]

Upper triangular matrix

[[1 2 3]

[0 5 6]

[0 0 9]]

Lower triangular matrix

[[1 0 0]

[4 5 0]

[7 8 9]]

Question 10

Define a 3 x 3 square matrix, Extract the main diagonal as vector. Create diagonal matrix from that extracted vector

import numpy as np

def MatrixMaker(rows, columns):

  a = [int(input("=>")) for i in range(rows \* columns)]

  a = np.array(a)

  a = a.reshape(rows, columns)

  return a

rows = 3

columns = 3

print(f"Enter the elements of the {rows}x{columns} matrix")

matrix\_1 = MatrixMaker(rows, columns)

# extracting vector and making diagonal matrix

diagonalMatrix = []

#extracting vector using loop that  only iterates the diagonal elements

vector = [matrix\_1[i][j] for i, j in zip(range(rows) ,range(columns))]

vector = np.array(vector) #converting to vector

#making diagonal matrix using vector

for i in range(rows):

  for j in range(columns):

    if i == j :  diagonalMatrix.append(vector[i])

    else : diagonalMatrix.append(0)

#You can use a single line code for making diagonal matrix

#diagonalMatrix = [matrix[i][j] if i==j else 0  for i, j in  [(i, j) for i in range(rows) for j in range(columns)]]

diagonalMatrix = np.array(diagonalMatrix)

diagonalMatrix = diagonalMatrix.reshape(rows, columns)

#printing all values

print("Matrix \n", matrix\_1)

print("Vector \n",vector)

print("Diagonal Matrix \n",diagonalMatrix)

Output :

Enter the elements of the 3x3 matrix

=>1

=>2

=>3

=>4

=>56

=>6

=>7

=>8

=>9

Matrix

[[ 1 2 3]

[ 4 56 6]

[ 7 8 9]]

Vector

[ 1 56 9]

Diagonal Matrix

[[ 1 0 0]

[ 0 56 0]

[ 0 0 9]]

Question 11

Create an identity matrix of order 4

import numpy as np

rows = 4

columns = 4

identityMatrix = []

for i in range(rows):

    for j in range(columns):

        if i == j :

            identityMatrix.append(1)

        else :

            identityMatrix.append(0)

identityMatrix = np.array(identityMatrix)

identityMatrix = identityMatrix.reshape(rows,columns)

print(identityMatrix)

Output :

[[1 0 0 0]

[0 1 0 0]

[0 0 1 0]

[0 0 0 1]]

Question 12

Find transpose of a matrix

import numpy as np

def MatrixMaker(rows, columns):

  a = [int(input("=>")) for i in range(rows \* columns)]

  a = np.array(a)

  a = a.reshape(rows, columns)

  return a

rows = int(input("Enter the number of rows in  Matrix : "))

columns = int(input("Enter the number of columns in Matrix : "))

print(f"Enter the elements of the first {rows}x{columns} matrix")

matrix\_1 = MatrixMaker(rows, columns)

transpose = []

for i in range(columns):

    for j in range(rows):

        transpose.append(matrix\_1[j][i])

transpose = np.array(transpose)

transpose = transpose.reshape(columns,rows)

print("Matrix :", matrix\_1, sep="\n")

print("Transpose of matrix :", transpose, sep="\n")

Output :

Enter the number of rows in Matrix : 2

Enter the number of columns in Matrix : 2

Enter the elements of the first 2x2 matrix

=>1

=>2

=>3

=>4

Matrix :

[[1 2]

[3 4]]

Transpose of matrix :

[[1 3]

[2 4]]

Question 13

Print the inverse of a matrix

import numpy as np

from numpy.linalg import inv, det

dimension = int(input("Enter the no.of rows or columns in Matrix : "))

print('Enter the values of matrix')

matrix = [int(input()) for i in range(dimension\*\*2)]

matrix = np.array(matrix)

matrix = matrix.reshape(dimension, dimension)

determinant = det(matrix)

if determinant == 0:

  inverse = 'does not exist'

else:

  inverse = inv(matrix)

print("Matrix : \n", matrix)

print("Inverse of Matrix : \n", inverse)

Output :

Enter the no.of rows or columns in Matrix : 2

Enter the values of matrix

1

2

3

4

Matrix :

[[1 2]

[3 4]]

Inverse of Matrix :

[[-2. 1. ]

[ 1.5 -0.5]]

Question 14

Print the determinant of the matrix

import numpy as np

from math import sqrt

def determinant2D(matrix):

  determinant = 0

  diagonal1 = 1

  diagonal2 = 1

  for i in range(2):

    for j in range(2):

      if i == j :

        diagonal1 \*= matrix[i][j]

      else :

        diagonal2 \*= matrix[i][j]

  determinant = diagonal1 - diagonal2

  return determinant

def determinantOfMatrix(matrix, dimension):

  if(dimension < 3):

    determinant = determinant2D(matrix)

  else:

    determinant = 0

    for k in range(len(matrix[0])):

      array = []

      for i in range(dimension):

        for j in range(dimension):

            if i == 0 or j == k:

              continue

            else :

              array.append(matrix[i][j])

      array = np.array(array)

      dimension2 = int(sqrt(len(array)))

      array = array.reshape(dimension2, dimension2)

      if k % 2 == 0 :

        determinant += matrix[0][k] \* determinantOfMatrix(array, dimension2)

      else :

        determinant -= matrix[0][k] \* determinantOfMatrix(array, dimension2)

  return determinant

dimension = int(input("Enter the no.of rows or columns in Matrix : "))

print('Enter the values of matrix')

matrix = [int(input()) for i in range(dimension\*\*2)]

matrix = np.array(matrix)

matrix = matrix.reshape(dimension, dimension)

print("Elements of matrix:\n",matrix)

print("determinant of matrix:\n",determinantOfMatrix(matrix, dimension))

Output :

Enter the no.of rows or columns in Matrix : 2

Enter the values of matrix

1

2

3

4

Elements of matrix:

[[1 2]

[3 4]]

determinant of matrix:

-2