Matrix

June 11, 2024

Nested Lists

```
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print(NestedList)
```

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Output: [[3,2,1], [3], 3, 'string', 'python']

Accessing in Nested Lists

```
NestedList = [[3,2,1], [3], 3, "string", "python"]

print(NestedList[0])

print(NestedList[0][2])
```

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```

Matrix as a Nested List

Matrix = [[2, -5, 3],[0, 7, -2],[-1, 4, 1]]

$$A = \begin{bmatrix} 2 & -5 & 3 \\ 0 & 7 & -2 \\ -1 & 4 & 1 \end{bmatrix}$$

Inputting Matrix from user

```
R = int(input("Enter the number of rows:"))

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

matrix = [ ]

print("Enter the entries rowwise:")
```

Inputting Matrix from user

```
for i in range(R):
    a =[ ]
    for j in range(C):
        a.append(int(input()))
     matrix.append(a)
```

Printing the inputted matrix

```
for i in range(R):
    for j in range(C):
        print(matrix[i][j], end = " ")
    print()
```

MATRIX OPERATIONS

Python program to execute basic operations of two matrix.

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Python program to execute basic operations of two matrix.

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

B = [[7,8],[9,10]]

rows = len(A)

cols = len(A[0])

Continued...

```
C = [[0 for i in range(cols)] for j in range(rows)]
    for i in range(rows):
        for j in range(cols):
            C[i][j] = A[i][j] + B[i][j]
print("Addition of matrices: ", C)
```

Continued...

```
D = [[0 for i in range(cols)] for j in range(rows)]
    for i in range(rows):
        for j in range(cols):
            D[i][j] = A[i][j] - B[i][j]
print("Subtraction of matrices: ", D)
```

Continued...

```
E = [[0 for i in range(cols)] for j in range(rows)]
    for i in range(rows):
        for j in range(cols):
            E[i][j] = A[i][j] / B[i][j]
print("Division of matrices: ", E)
```

Idempotent

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Two subproblems: 1. Matrix Multiplication. 2. Checking Equality of two matrices 3. Combine both of them to check the whether the matrix is idempotent.

Checking Equality

```
def AreSame(A,B):
    for i in range(N):
        for j in range(N):
            if (A[i][j] != B[i][j]):
                return 0
    return 1
```

Continued...

```
A= [ [1, 1, 1, 1], [2, 2, 2, 2], [3, 3, 3, 3], [4, 5, 4, 5]]

B= [ [1, 1, 1, 1], [2, 2, 2, 2], [3, 3, 3, 3], [4, 5, 4, 5]]

if (AreSame(A, B)==1):

    print("Matrices are identical")

else:

    print("Matrices are not identical")
```

Python Program to compute the product of two compatible matrices.

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```
X = [[12,7,3],[4 ,5,6],[7 ,8,9]]
Y = [[5,8,1,2],[6,7,3,0],[4,5,9,1]]
result = [[0,0,0,0], [0,0,0,0],[0,0,0,0]]
for i in range(len(X)):

    for j in range(len(Y[0]))

        for k in range(len(Y)):

            result[i][j] += X[i][k] * Y[k][j]

for r in result:

    print(r)
```

Transpose of a Matrix

Python program to find transpose of a square matrix

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Python program to find transpose of a square matrix X = [[12,7],[4 ,5],[3 ,8]]

```
result = [[0,0,0],[0,0,0]]

for i in range(len(X)):
    for j in range(len(X[0])):
        result[j][i] = X[i][j]

for r in result:
   print(r)
```

Stochastic Matrix

A square matrix A is called Stochastic Matrix, if all the entries are positive real numbers (0 included) and the sum of each row is 1.

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Python Program to check if the user-entered matrix is a Stochastic Matrix. Assume that the input is promised to have positive real entries.

Stochastic Matrix

```
A = [[0, 0.5, 0.5], [0.2, 0.3, 0.5], [1, 0, 0]]

list=[ ]

var = 0

sum=0

    for i in range(3):
        for j in range(3):
            sum = sum + A[i][j]
        list.append(sum)
        sum=0
```

Continued...

```
for i in range(len(list)):
    if list[i]==1:
        var=var+1
if var == 3:
    print("The matrix is Stochastic Matrix")
```

Hadamard Product of two matrices

The Hadamard product is a binary operation that takes in two matrices of the same dimensions and returns a matrix of the multiplied corresponding elements.

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Python Program to compute Hadamard Product of two matrices.

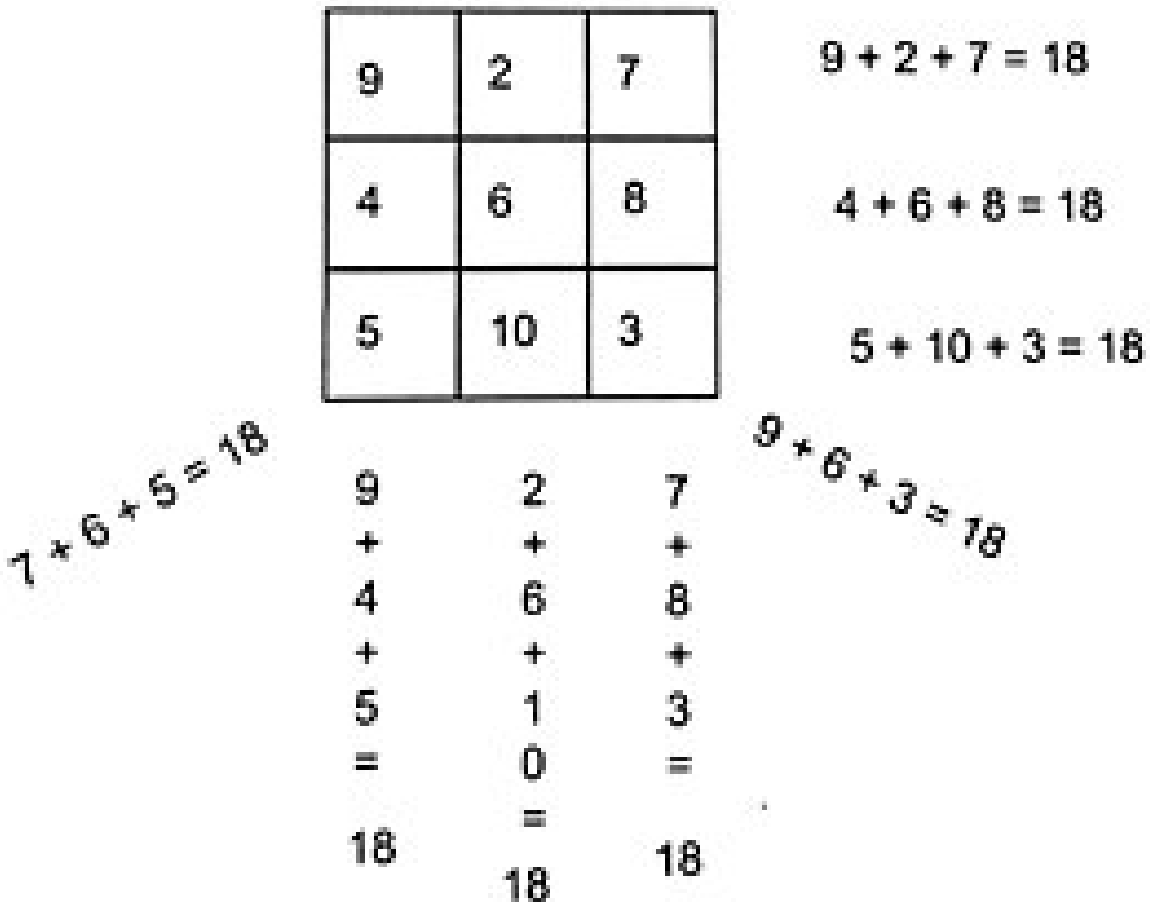
Hadamard Product of two matrices

```
D = [[0 for i in range(cols)] for j in range(rows)]
    for i in range(rows):
        for j in range(cols):
            D[i][j] = A[i][j] * B[i][j]
print("Hadamard Product of matrices: ", D)
```

Magic Squares

A magic square is a SQUARE shaped arrangement of numbers such that the sum of each row, sum of each column and sum of both the diagonals is constant.

Magic Square



Magic Square

Python program to check whether the user-entered square matrix is a magic square.

Nilpotent

In linear algebra, a nilpotent matrix is a square matrix N such that

$$N^k = 0$$

for some positive integer

$$k$$

.

Python program to calculate the constant k for a given nilpotent matrix. Note that the input is promised to be a nilpotent matrix.

Symmetric Matrix

Python Program to check whether the user-entered square matrix is symmetric matrix.

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Recall a square matrix A is symmetric iff A is equal to its transpose.

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STEPS: Compute the transpose and check the equality.

Anti-Symmetric

Python Program to check whether the user-entered square matrix is skew-symmetric matrix.

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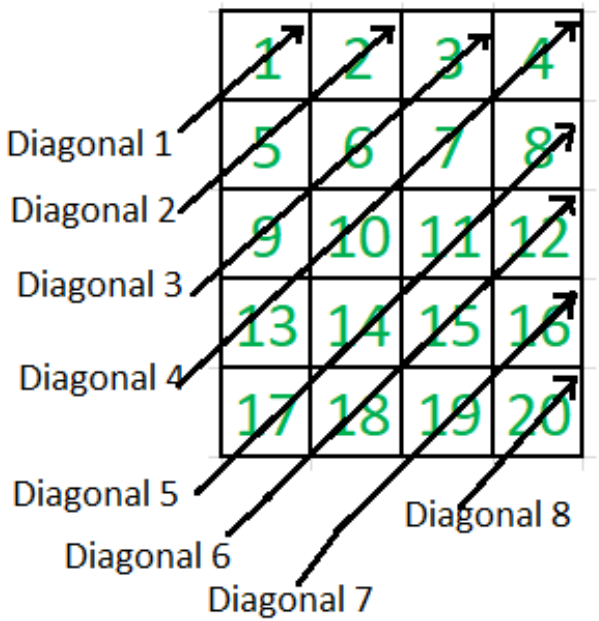
Recall a square matrix A is Anti-symmetric iff -A is equal to its transpose.

STEPS: Compute the transpose and check the equality

Traversal

Python Program to print a user-entered square matrix in the way



described in the adjoining image.

Orthogonal and Involuntary Matrices

Python program to check if the user-entered matrix is Orthogonal.
A square matrix A is orthogonal iff $A \times A^T = I$.

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A square matrix A is involuntary iff $A \times A = I$