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Date 07/11/2019

Multiplying Matrices

Multiplying matrices A and B:

$$A = \begin{bmatrix} 4 & 0 & 1 \\ 2 & 5 & -4 \\ 3 & -3 & -2 \\ 6 & 7 & -1 \end{bmatrix} \quad B = \begin{bmatrix} 4 & 8 & 0 \\ 9 & 5 & 10 \\ 11 & 1 & 2 \end{bmatrix}.$$

Here we have (4X3) and (3X3) matrices and the number of columns in A is the same as the number of rows in B.

The first step is to write 2 matrices side by side, as follows:

$$AB = \begin{bmatrix} 4 & 0 & 1 \\ 2 & 5 & -4 \\ 3 & -3 & -2 \\ 6 & 7 & -1 \end{bmatrix} \begin{bmatrix} 4 & 8 & 0 \\ 9 & 5 & 10 \\ 11 & 1 & 2 \end{bmatrix}$$

Here we need to multiply in the first row, first column position from the matrix

$$\begin{bmatrix} \boxed{4 \quad 0 \quad 1} \\ 2 \quad 5 \quad -4 \\ 3 \quad -3 \quad -2 \\ 6 \quad 7 \quad -1 \end{bmatrix} \begin{bmatrix} \boxed{\begin{matrix} 4 \\ 9 \\ 11 \end{matrix}} & \begin{matrix} 8 & 0 \\ 5 & 10 \\ 1 & 2 \end{matrix} \end{bmatrix}$$

$$4 \times 4 + 0 + 9 + 1 \times 11 = 27$$

Next step is to multiply first row and second column as follows.

$$\begin{bmatrix} \boxed{4 \quad 0 \quad 1} \\ 2 \quad 5 \quad -4 \\ 3 \quad -3 \quad -2 \\ 6 \quad 7 \quad -1 \end{bmatrix} \begin{bmatrix} 4 & \boxed{\begin{matrix} 8 \\ 5 \\ 1 \end{matrix}} & 0 \\ 9 & & 10 \\ 11 & & 2 \end{bmatrix}$$

$$4 \times 8 + 0 \times 5 + 1 \times 1 = 33.$$

We continue on along the rows and columns as follows.

$$\begin{bmatrix} 4 & 0 & 1 \\ 2 & 5 & -4 \\ 3 & -3 & -2 \\ 6 & 7 & -1 \end{bmatrix} \begin{bmatrix} 4 & 8 & 0 \\ 9 & 5 & 10 \\ 11 & 1 & 2 \end{bmatrix}$$

$$= \begin{bmatrix} 4\times4+0\times9+1\times11 & 4\times8+0\times5+1\times1 & 4\times0+0\times10+1\times2 \\ 2\times4+5\times9+-4\times11 & 2\times8+5\times5+-4\times1 & 2\times0+5\times10+-4\times2 \\ 3\times4+-3\times9+-2\times11 & 3\times8+-3\times5+-2\times1 & 3\times0+-3\times10+-2\times2 \\ 6\times4+7\times9+-1\times11 & 6\times8+7\times5+-1\times1 & 6\times0+7\times10+-1\times2 \end{bmatrix}$$

$$AB = \begin{bmatrix} 27 & 33 & 2 \\ 9 & 37 & 42 \\ -37 & 7 & -34 \\ 76 & 82 & 68 \end{bmatrix}$$

Determinants

is a Square array of numbers which represents a Certain Sum of products.

Below is an Example of a 3x3 determinant

$$\begin{bmatrix} 10 & 0 & -3 \\ -2 & -4 & 1 \\ 3 & 0 & 2 \end{bmatrix}$$

The result of multiplying out, then Simplifying
the Elements of a determinant is a single
(a Scalar quantity).

Calculating a 2x2 Determinant

We find the Value of a 2x2 determinant with Elements a, b, c and d as follows.

$$\begin{bmatrix} a & b \\ c & d \end{bmatrix} = ad - cb.$$

We multiply diagonals, then Subtract

Ex:- $\begin{bmatrix} 4 & 1 \\ 2 & 3 \end{bmatrix}$ $\quad 4 \times 3 - 2 \times 1$

$= 12 - 2$

$\boxed{\text{Result we got Single No} = 10}$

Python code snippet

Matrix Multiplication

```
import numpy as np
A = np.array([[5,7,2], [6,2,9]])
B = np.array([[3,2], [4,7], [8,2]])
C = A.dot(B)
print(C)
```

Output:-

```
[[59 63]
 [98 44]]
```

Transpose of a matrix

```
import numpy as np
A = np.array([[3, 4], [6, 2], [4, -4]])
print(A.traspose())
```

Output:-

```
[[3, 6 4]
 [4 2 -4]]
```