Python Lecture 3 – Libraries

- Numpy
- Scipy
- Matplotlib
- Exceptions
- Classes

Bibliography and learning materials

★ Bibliography:

https://docs.scipy.org/doc/

http://docs.python.it/

https://matplotlib.org/

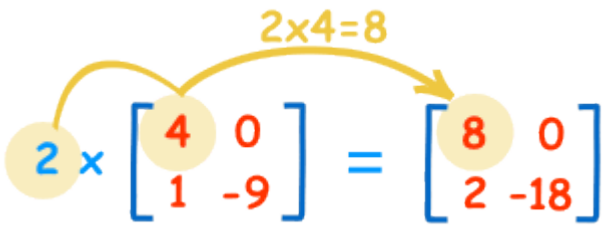
and much more available in internet

★ Learning Materials:

https://github.com/bertocco/abilita_info_units_1920

Multiply matrices: Matrix Multiply Constant

To multiply a matrix by a single number is easy:



These are the calculations:
2×4=8 2×0=0
2×1=2 2×-9=-18

We call the number ("2" in this case) a scalar, so this is called "scalar multiplication".

https://www.mathsisfun.com/algebra/matrix-multiplying.html

Exercise 1: matrix x scalar

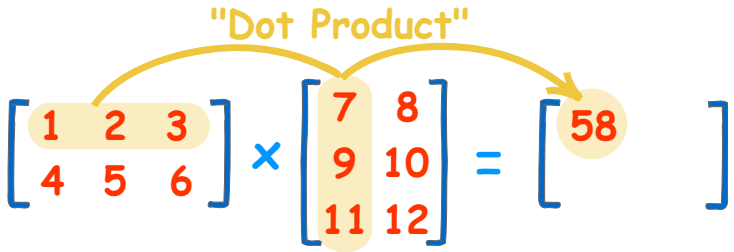
Write a python script where

- ★Write a function to multiply a matrix nxm for a scalar number.
- ★Declare the matrix of the previous example as a list of lists
- ★Declare a scalar number
- ★Multiply the matrix for the scalar
- ★Print the result

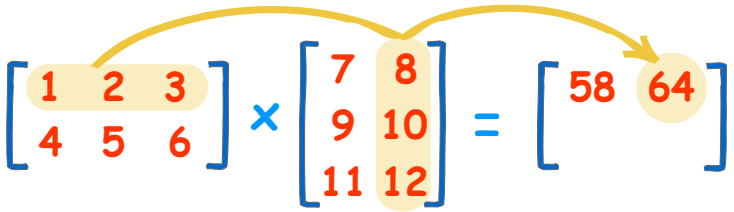
Exercise 1: matrix x scalar

```
a=3
b=[[3,6,9],
   [1,2,3],
   [2,4,8]]

def matrix_per_scalar(matrix, scalar):
    result=[]
    for i in range(len(matrix)):
        tmp=[]
        for j in range(len(matrix[i])):
            tmp.append(matrix[i][j]*scalar)
        result.append(tmp)
    return result

def print_matrix(matrix):
    for i in range(len(matrix)):
        for j in range(len(matrix[i])):
            print(str((matrix[i][j]))+"\t", end='')
        print("\n")

print("Input:")
print("Scalar=" + str(a))
print("Matrix=")
print_matrix(b)

print("Matrix x scalar multiplication result:")print_matrix(matrix_per_scalar(b,a))
```

Multiply matrices: Multiplying a Matrix by Another Matrix



1st row X 1st column:
(1, 2, 3) • (7, 9, 11) = 1×7 + 2×9 + 3×11
= 58



1st row X 2nd column:
(1, 2, 3) • (8, 10, 12) = 1×8 + 2×10 + 3×12
= 64

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \end{bmatrix} \times \begin{bmatrix} 7 & 8 \\ 9 & 10 \\ 11 & 12 \end{bmatrix} = \begin{bmatrix} 58 & 64 \\ 139 & 154 \end{bmatrix}$$ ✓

2nd row X 1st column:
(4, 5, 6) • (7, 9, 11) = 4×7 + 5×9 + 6×11
= 139

2nd row X 2nd column:
(4, 5, 6) • (8, 10, 12) = 4×8 + 5×10 + 6×12
= 154

Matrix product is possible only between matrices
nXm mXp → nXp (result dimension)

https://www.mathsisfun.com/algebra/matrix-multiplying.html

Exercise 2: matrix x matrix

Write a python script where

- ★Write a function to multiply a matrix nxm for a matrix mxn
- ★Write a function to print such kind of matrix
- ★Declare the two matrices as list of lists
- ★Multiply the two matrices
- ★Print the result

Exercise 3: matrix x scalar

```
# Program to multiply two matrices
# using nested loops
# 3x3 matrix
A = [[12,7,3],
    [4 ,5,6],
    [7 ,8,9]]
# 3x4 matrix
B = [[5,8,1,2],
    [6,7,3,0],
    [4,5,9,1]]
def print_matrix(matrix):
    for i in range(len(matrix)):
        for j in range(len(matrix[i])):
            print(str((matrix[i][j]))+"\t", end='')
        print("\n")
def matrix_x_matrix(X, Y):
    # iterate through rows of X
    # result is 3x4
    result = [[0,0,0,0], [0,0,0,0], [0,0,0,0]]
    for i in range(len(X)):
    # iterate through columns of Y
        for j in range(len(Y[0])):
            # iterate through rows of Y
            for k in range(len(Y)):
                result[i][j] += X[i][k] * Y[k][j]
    return result
```

```
# Main:
print("Input")
print("A = ")
print_matrix(A)
print("B = ")
print_matrix(B)
print("Output AxB")
print_matrix(matrix_x_matrix(A, B))
```

Output:

Input

A =

12	7	3
4	5	6
7	8	9

B =

5	8	1	2
6	7	3	0
4	5	9	1

Output AxB

114	160	60	27
74	97	73	14
119	157	112	23

numpy

Exercise: matrix x matrix

Write a python script where

- ★Write a function to multiply a matrix nxm for a matrix mxn
- ★Write a function to print such kind of matrix
- ★Declare the two matrices as list of lists
- ★Multiply the two matrices
- ★Print the result