

# Matrices

A matrix is just a rectangular array of data, and the elements are scalar, real numbers.

$$A = \begin{pmatrix} a_{11} & a_{12} & \cdots & a_{1n} \\ a_{21} & a_{22} & \cdots & a_{2n} \\ \vdots & \vdots & & \vdots \\ a_{m1} & a_{m2} & \cdots & a_{mn} \end{pmatrix} \in \mathbb{R}^{m \times n}$$

## Matrix Multiplication: Example

$$A = \begin{bmatrix} \overbrace{2 \ 3} & \\ \underbrace{1 \ -1} & \end{bmatrix} \quad x = \begin{bmatrix} \underbrace{1} & \uparrow \\ \overbrace{2} & \downarrow \end{bmatrix}$$

$$Ax = \begin{bmatrix} 2 & 3 \\ 1 & -1 \end{bmatrix} \begin{bmatrix} 1 \\ 2 \end{bmatrix} =$$

$$\begin{bmatrix} 2 \times 1 + 3 \times 2 \\ 1 \times 1 + (-1) \times 2 \end{bmatrix} =$$

$$\begin{bmatrix} 8 \\ -1 \end{bmatrix}$$

# Matrix Multiplication: Example

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

```
A = np.array([2,-1],[0,4])
```

```
-----  
TypeError                                Traceback (most recent call last)  
Cell In [238], line 1  
----> 1 A = np.array([2,-1],[0,4])  
  
TypeError: Field elements must be 2- or 3-tuples, got '0'
```

```
A = np.array([[2,-1],[0,4]])  
B = np.array([[5,1,2],[-1,0,3]])  
print(A.shape, B.shape)
```

```
(2, 2) (2, 3)
```

```
print(' A=\n',A,'\n','B=\n',B)
```

```
A=  
[[ 2 -1]  
 [ 0  4]]  
B=  
[[ 5  1  2]  
 [-1  0  3]]
```

```
A@B
```

```
array([[11,  2,  1],  
       [-4,  0, 12]])
```