



# What are Tensors



## What Are Tensors?

A **tensor** is a **generalization of arrays** used to store numerical data.

You can think of tensors as **containers of numbers**, organized in different dimensions.

👉 Scalars, vectors, matrices, and higher-dimensional arrays are **all tensors**.

1  
2  
3  
4

## Types of Tensors by Dimension

### 0D Tensor (Scalar)

- A **single number**
- No axes
- Rank = 0

Example:

```
import numpy as np

a = np.array(5)
print(a)
print(a.shape)
```

👉 Used for single values like loss, accuracy, temperature.

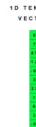
### 1D Tensor (Vector / 1D Array)

- A **list of numbers**
- One axis
- Rank = 1

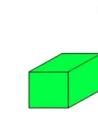
Example:

```
v = np.array([10,20,30])
print(v)
print(v.shape)
```

👉 Used for feature lists, word embeddings, coordinates.



2D TENSOR / MATRIX
9 4 2 5 7
3 0 12 8 6 1
1 2 3 6 4 5 2
2 2 3 -1 7 2 6



3D TENSOR / CUBE
9 4 2 5 7
3 0 12 8 6 1
1 2 3 6 4 5 2

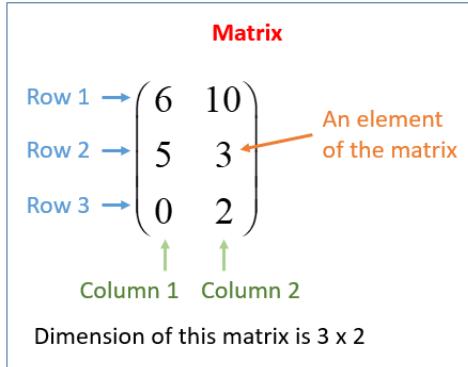
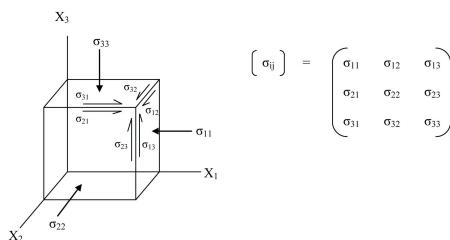
## 2D Tensor (Matrix)

- Two axes
- Rows and columns
- Rank = 2

Example:

```
m = np.array([ [1,2,3],[4,5,6] ])
print(m)
print(m.shape)
```

📌 Used for tables, grayscale images, datasets.



## 3D Tensor

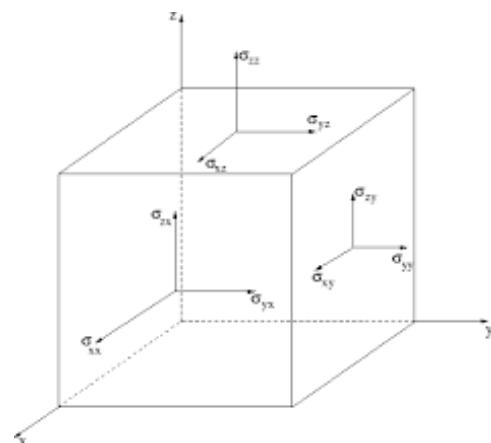
- Stack of matrices
- Three axes
- Rank = 3

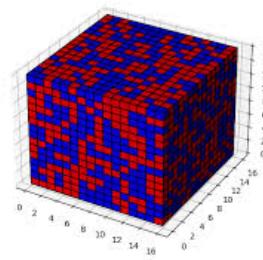
Example:

```
t3 = np.array([ [[1,2], [3,4]],[[5,6], [7,8]]])
print(t3.shape)
```

📌 Used for:

- Color images (Height × Width × Channels)
- Time series data





## 4D Tensor

- Collection of 3D tensors
- Rank = 4

Example:

```
t4 = np.random.rand(10,64,64,3)
print(t4.shape)
```

Used for:

- Image batches in deep learning  
(Batch × Height × Width × Channels)

## 5D Tensor

- Collection of 4D tensors
- Rank = 5

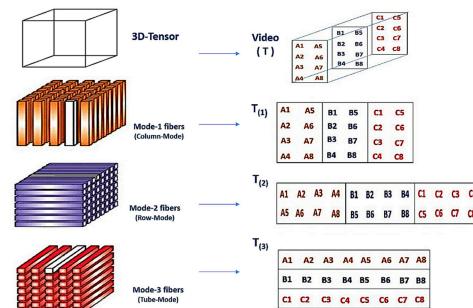
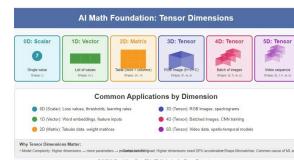
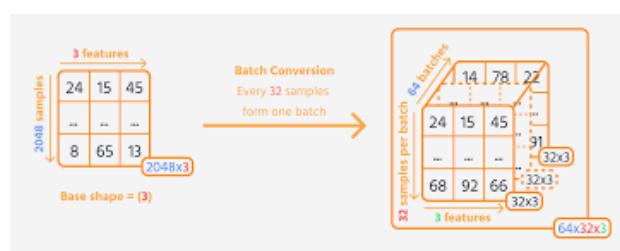
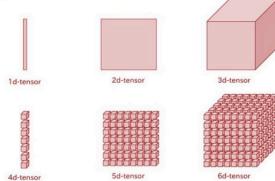
Example:

```
t5 = np.random.rand(5,10,64,6,4,3)
print(t5.shape)
```

Used for:

- Video data  
(Batch × Frames × Height × Width × Channels)

## Simple Tutorial on Tensors





## Rank, Axis, Shape (Very Important)

### ✓ Rank

- Number of dimensions
- Also called **order**

Rank = Number of Axes = Number of Dimensions

Examples:

Tensor	Rank
Scalar	0
Vector	1
Matrix	2
Image	3
Video	5

### ✓ Axis

- A **direction** along which data is stored

Example:

```
x = np.array([
    [1,2,3],
    [4,5,6]
])
```

- Axis 0 → Rows
- Axis 1 → Columns

### ✓ Shape

- Size of tensor along each axis

```
print(x.shape)
```

Output:

```
(2,3)
```

Meaning:

- 2 rows
  - 3 columns
- 

## Quick Summary (Perfect for Revision)

- ✓ Tensor = container for numbers
  - ✓ 0D → scalar
  - ✓ 1D → vector
  - ✓ 2D → matrix
  - ✓ 3D → cube
  - ✓ 4D → batch of images
  - ✓ 5D → batch of videos
-  **Rank = Number of Axes = Number of Dimensions**
-  **Shape = Size along each axis**