What are Tensors

Tensor is container who storing a Number

Here is the **clean, easy, complete explanation** of **Tensors** — Roman Urdu + English dono languages, bilkul simple, exam-style.

⭐ What Are Tensors? (Roman Urdu Explanation)

Tensor aik mathematical data structure hota hai jo ML aur Deep Learning (specially TensorFlow, PyTorch) mein use hota hai.

Simple words:

👉 *Tensor = Multi-dimensional array.*
Jaise:

- **Scalar** → single number
- **Vector** → 1D list
- **Matrix** → 2D grid
- **Tensor** → 3D, 4D, 5D... jitni dimension chaho.

⭐ Why Tensors Are Needed in ML/DL?

Deep learning models ko **numerical data** chahiye hoti hai jisko woh fast GPU par process kar saken. Tensor is the best format because:

- GPU par fast compute hota hai
- Parallel processing possible hoti hai
- Shape-defined data hota hai
- Automatic differentiation (gradients) easy hotay hain (backpropagation)

⭐ Examples in Roman Urdu

1️⃣ Scalar (0D Tensor)

x = 5

Ye aik **0-dimensional tensor** hai — sirf aik value.

2️⃣ Vector (1D Tensor)

[2, 4, 6, 8]

Ye **1D tensor** hai — aik line type data.

3️⃣ Matrix (2D Tensor)

[

[1, 2],

[3, 4],

[5, 6]

]

Rows × Columns → 3 × 2 matrix → **2D tensor**

4️⃣ 3D Tensor Example (Images ki Batch)

Suppose tumharay pass 10 images hain, har image 28×28 grayscale:

Tensor shape:

(10, 28, 28)

👉 10 images

👉 Each image 28×28 pixels

Ye **3D tensor** hai.

5️⃣ 4D Tensor (Color Images)

Example: 32 images, size 224×224, RGB (3 channels)

Tensor shape:

(32, 224, 224, 3)

Ye deep learning mein sabse common use hota hai.

⭐ English Explanation (Clear & Simple)

A **tensor** is a generalization of scalars, vectors, and matrices into higher dimensions.

Name	Dimensions	Example	Meaning
Scalar	0D	3	Single number
Vector	1D	[1, 2, 3]	List of numbers
Matrix	2D	[[1,2],[3,4]]	Rows × Columns
Tensor	3D+	[[[...]]]	Multi-dimensional array

Tensors hold numeric data and allow ML/DL models to perform:

- Linear algebra
- Optimization
- Automatic gradients
- Fast GPU computation

⭐ Tensor Properties (Must Know)

1. Rank

Dimensions (0D, 1D, 2D...)

2. Shape

Size of each dimension.

Example: (32, 224, 224, 3)

3. Data Type

- float32
- int32
- bool

- etc.

4. Device

Where stored?

- CPU
- GPU

⭐ **Where Tensors Are Used in DL?**

✓ Neural Network Inputs

✓ Neural Network Outputs

✓ Weights & Biases of layers

✓ Images (as pixels)

✓ Audio signals

✓ Text encoded as numbers

✓ Word embeddings

✓ Batch processing

Har jagah tensor hi use hota hai.

⭐ **TensorFlow / PyTorch Example**

TensorFlow:

```
import tensorflow as tf

x = tf.constant([[1, 2], [3, 4]])
```

PyTorch:

```
import torch

x = torch.tensor([[1, 2], [3, 4]])
```

⭐ **Final Summary (Roman Urdu)**

Tensor = multi-dimensional array

Jo ML/DL models ko training aur inference ke liye data store karne aur GPU pe fast calculate karne mein help karta hai.

Agar chaho to mai **Tensor Quiz** bhi bana dun ya **Tensor Shapes** aur gradients ke sath **advanced DL-level understanding** bhi explain kar dun.

NO OF AXES=Rank or Dimensional

In ML 0-5D Tensor