PyTorch Basics

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Pytorch Basics

What is Tensor?

A tensor is a mathematical object that generalizes the concepts of scalars, vectors, and matrices to higher dimensions. It can be thought of as a multi-dimensional array of numbers that can represent data or physical quantities.

Order	Example	Shape	Interpretation
0 (Scalar)	$s = 5$	No shape	Single number
1 (Vector)	$[3, 4, 5]$	3×1	List of numbers
2 (Matrix)	$\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$	2×2	Grid of numbers
3 (Tensor)	RGB image	$32 \times 32 \times 3$	Cube of numbers
4+ (Tensor)	Batch of images	$100 \times 32 \times 32 \times 3$	Multi-dimensional array

Pytorch Basics

1. Tensor Intitalization

2. Tensor Maths

3. Tensor Indexing

4. Tensor Reshaping

Why Pytorch ?

Dynamic Computation Graphs – Build networks on the fly.

Pythonic – Easy to learn and implement.

Extensive Community Support – Strong community contributions and resources.

Research to Production – PyTorch serves both research purposes and production-level deployment.

Seamless GPU Support – Simplifies GPU-based computation.

Pytorch Basics

1. Tensor Intialization

```
device = "cuda" if torch.cuda.is_available() else "cpu"
```

```
torch_tensor = torch.tensor([[1,2,3],[4,5,6]], dtype = torch.float32, device = device, requires_grad = True)
```

Other methods for torch tensor declaration

```
X = torch.empty((2,2)),

X = torch.rand((2,2))= torch.empty((2,2)).uniform_(0,1),

X = torch.ones((2,2)),

X = torch.zeros((2,2)),

X = torch.eye((2,2)) = torch.diag(torch.ones((2,2))),

X = torch.arange(start=0,end=5, step=1),

X = torch.linspace(start=0.1, end=1, steps=10)
```

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1. Tensor Intialization

Datatype conversion in torch

```
X = torch.empty((5,5)), # dtype = int-32
X = X.bool()          # Convert into binary form
X = X.short()         # Convert into dtype int-16
X = X.long()          # Convert into dtype int-64
X = X.half()          # Convert into dtype float-16
X = X.float()         # Convert into dtype float-32
X = X.double()        # Convert into dtype float-64
```

Torch to array conversion and vise-versa

```
X = np.zeros((6,6))     # Declare numpy array
X = torch.from_numpy(X) # Convert to torch tensor
X = X.numpy()           # Convert to numpy array
```

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2. Tensor Maths

X1 = torch.tensor([1,2,3]), X2 = torch.tensor([4,5,6])

Addition: X1 + X2 = torch.add(X1, X2)

Inplace operation --> X2 += X1 or X2._add(X1)

Subraction: X1 - X2

Division: torch.true_divide(X1, X2)

Exponential: z = X1.pow(2) = X1 ** 2

Comparision: Z = X1>0, X2>X1, X2<X1

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2. Tensor Maths

X1 = torch.tensor([1,2,3]), X2 = torch.tensor([4,5,6])

Metrix Multiplication: **torch.mm(X1, X2) = X1.mm(X2)**

Element-wise Multiplication: **X1 * X2**

Dot product: **torch.dot(X1, X2)**

Batch Metrix Multiplication:

batch = 2, a = 3, b = 5, c = 4

X1 = torch.rand((batch, a, b)), X2 = torch.rand((batch, b, c))

Z = torch.bmm(X1,X2)

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2. Tensor Maths

X1 = torch.tensor([1,2,3]), X2 = torch.tensor([4,5,6])

indices, values = torch.max(X1, dim=0), indices = torch.argmax(X1, dim=0)

Absolute tensor: torch.abs(X1)

Tensor Clamping: torch.clamp(X1, min = 0)

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3. Tensor Indexing

batch_size = 2, features = 5

x = torch.rand((batch_size), features)

z = x[0].shape # Get the shape of first tensor

z = x[:,0].shape # Get the shape of all tensors at the first dimension

Conditional Formatting: Z = torch.arange(10)

Z[(Z>2) | (Z<8)] # Get the elements greater than 2 and less than 8

Z[Z.remainder(2)==0] # Get the even numbered elements

Z = torch.where(X>5, X, X*2)

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4. Tensor Reshaping

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

Z = X.view(2,2)    # When X is contiguous

Z = X.reshape(2,2) # Independent of contiguity of X
```

Concatenation: `X1 = torch.rand([2,4]), X2 = torch.rand([2,3])`

```
Z1 = torch.cat((X1, X2), dim=0), Z2 = torch.cat(X1, X2, dim=1)

T = torch.tensor([1,2,3])

T = T.permute(0,2,1)

T = T.unsqueeze(0)
```

THANK YOU

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