Segment 2: Common Tensor Operations

Tensor Transposition

```
[68] X
```

```
array([[25,  2],
       [ 5, 26],
       [ 3,  7]])
```

```
[69] X.T
```

```
array([[25,  5,  3],
       [ 2, 26,  7]])
```

```
tf.transpose(X_tf)
```

```
<tf.Tensor: shape=(2, 3), dtype=int32, numpy=
array([[25,  5,  3],
       [ 2, 26,  7]], dtype=int32)>
```

```
[70] X_pt.T # more pythonic!
```

```
tensor([[25,  5,  3],
        [ 2, 26,  7]])
```

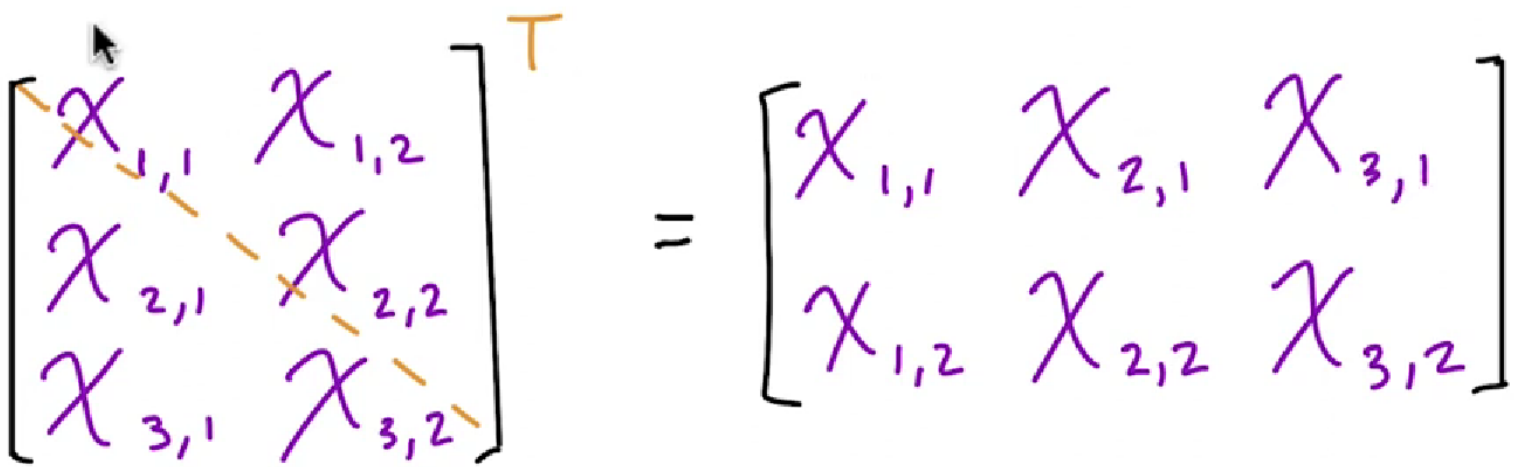
Basic Tensor Arithmetic

Tensor Transposition

- Transpose of scalar is itself, e.g.: $x^T = x$
- Transpose of vector, seen earlier, converts column to row (and vice versa)
- Scalar and vector transposition are special cases of **matrix transposition**:
  - Flip of axes over **main diagonal** such that:

$$(\boldsymbol{X}^T)_{i,j} = \boldsymbol{X}_{j,i}$$

Hands-on code demo



ML Foundations Series

Intro to Linear Algebra **is foundational for:**

1. **Intro to Linear Algebra**
2. **Linear Algebra II: Matrix Operations**
3. Calculus I: Limits & Derivatives
4. Calculus II: Partial Derivatives & Integrals
5. Probability & Information Theory
6. Intro to Statistics
7. Algorithms & Data Structures
8. **Optimization**

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Exercises

1. What is the transpose of this vector?

$$\begin{bmatrix} 25 \\ 2 \\ -3 \\ -23 \end{bmatrix}$$

2. Using algebraic notation, what are the dimensions of this matrix $\boldsymbol{Y}$?

$$Y = \begin{bmatrix} 42 & 4 & 7 & 99 \\ -99 & -3 & 17 & 22 \end{bmatrix}$$

3. Using algebraic notation, what is the position of the element in this matrix $\boldsymbol{Y}$ with the value of 17?

Segment 1: Data Structures for Algebra

- What Linear Algebra Is
- A Brief History of Algebra
- Tensors
- Scalars
- Vectors and Vector Transposition
- Norms and Unit Vectors
- Basis, Orthogonal, and Orthonormal Vectors
- Arrays in NumPy
- Matrices
- Tensors in TensorFlow and PyTorch