TASK 19

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Introduction to Neural Networks, Tensor Operations.

Neural Networks

Neural networks are computational models inspired by the human brain, designed to recognize patterns in data. They consist of interconnected nodes called neurons, organized in layers.

Key Concepts

1. **Neuron (Node):** The basic unit of a neural network that receives input, processes it, and passes it to the next layer.
2. **Layers:** Neural networks consist of an input, hidden, and output layer.
   - **Input Layer:** Receives the initial data.
   - **Hidden Layers:** Intermediate layers that perform complex computations and transformations.
   - **Output Layer:** Produces the final prediction or decision.
3. **Weights and Biases:** Weights are parameters that adjust the input data's significance. Biases shift the input to help the model fit better.
4. **Activation Function:** Introduces non-linearity into the network, allowing it to learn more complex patterns.

How Neural Networks Learn

- Neural networks learn through a process called backpropagation, where errors are propagated backward to adjust weights and biases.
- The goal is to minimize a loss function, which measures the difference between predicted and actual outputs.

Tensor Operations in Neural Networks

Tensors are multidimensional arrays used as the fundamental data structure in neural networks. They generalize scalars (0D), vectors (1D), and matrices (2D) to higher dimensions.

NumPy provides support for large, multi-dimensional arrays and matrices, along with a vast collection of high-level mathematical functions to operate on these arrays.

Key Tensor Operations:

1. **Tensor Creation:** Tensors can be created from lists, arrays, or directly using libraries like NumPy or TensorFlow.
2. **Element-wise Operations:** Operations applied to each element of the tensor independently, such as addition, subtraction, multiplication, and division.
3. **Matrix Multiplication:** A crucial operation in neural networks, particularly in connecting layers.
4. **Reshaping:** Changing the shape of a tensor without altering its data.
5. **Broadcasting:** Automatically expanding tensors to have compatible shapes for element-wise operations.