Sigmoid Perceptron From Scratch Documentation

Introduction
This document explains the implementation of a Sigmoid Perceptron from scratch using Python and NumPy. The purpose of this project is to understand how a single neuron based classifier works internally without relying on external machine learning libraries.

Libraries Used
NumPy is used for numerical computations including vector operations and weight updates.

Concept Overview
A perceptron is a fundamental neural unit that performs binary classification. The sigmoid activation function converts outputs into probability values between zero and one, making it suitable for classification tasks.

Class Design
The SigmoidPerceptron class is responsible for initializing parameters, performing predictions, and training the model using gradient descent.

Initialization
Weights are initialized randomly based on the number of input features. A bias term is added to shift the decision boundary.

Sigmoid Function
The sigmoid function maps the weighted sum of inputs to a probability value which enables smooth learning during training.

Prediction Process
Prediction is performed by computing a weighted sum of inputs, adding bias, and applying the sigmoid activation function.

Training Process
The model is trained using supervised learning. For each epoch the model predicts outputs, calculates errors, computes gradients, and updates weights and bias accordingly.

Error and Gradient
Error is calculated as the difference between target and predicted value. Gradients are derived from the sigmoid function to update parameters efficiently.

Observed Issue
An error occurs when input_size is not passed during model initialization. This value must match the number of features in the dataset.

Learning Outcomes
This project explains how neurons learn, how sigmoid activation enables probability outputs, and how gradient descent optimizes model parameters.

Limitations
This implementation supports only linearly separable data and serves as a foundational learning model for deeper neural networks.

Conclusion
Implementing a sigmoid perceptron from scratch provides a strong understanding of machine learning fundamentals and prepares learners for advanced models.

Author

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