Challenge #6 Goals:

Objective:

Implement and train a single-layer perceptron.

Learn NAND and observe XOR failure.

Part 1: Implement a Simple Perceptron (2-input)

Activation: **Sigmoid**

Formula:

- $\text{sigmoid}(x)=11+e-x\text{sigmoid}(x)=1+e-x1$

Part 2: Train the Perceptron

Use **Perceptron Learning Rule** to train for:

a. **NAND**

b. **XOR** (note: XOR is **not linearly separable**; a single-layer perceptron will fail)

Theory Recap

Perceptron Output

$y=\sigma(w1\cdot x1+w2\cdot x2+b)y=\sigma(w1 \cdot x1 +w2 \cdot x2 +b)$

Perceptron Learning Rule

$wi=wi+\eta\cdot(ytrue-ypred)\cdot xiwi =wi +\eta\cdot(ytrue -ypred)\cdot xi$

$\eta\eta$: learning rate

$ypred=\text{sigmoid}(wx+b)ypred=\text{sigmoid}(wx+b)$

What I Did:

Wrote a sigmoid-based neuron.

Used perceptron learning rule.

Trained on truth tables of NAND and XOR.

Findings:

NAND learned successfully.

XOR not learned — requires multi-layer NN**.**

What I Learned:

Importance of activation functions.

Limits of single-layer perceptrons.