Smart Thermostat Adjustment

Scenario: Smart Thermostat Adjustment

A home automation company is testing a smart thermostat system that adjusts heating or cooling based on external factors like room temperature, humidity, and sunlight. The system has 3 input features and 2 output nodes. The output nodes represent "increase temperature" and "decrease temperature."

Input Features:

1. Room Temperature (in °C) = T1
2. Humidity (as a percentage) = T2
3. Sunlight (in lumens) = T3

Weights:

1. Input to Hidden Layer: w1=0.4, w2=0.3, w3=0.5
2. Bias weight: b=0.1
3. Hidden Layer to Output Layer: o1=0.7, o2=0.2

Steps:

1. Input Layer to Hidden Layer:

   Calculate H1 using the formula:

   H1 = T1 * w1 + T2 * w2 + T3 * w3 + b

   Let:

   T1 = 22, T2 = 60, T3 = 500

Substitute these values to compute H1.

2. Activation Function (Sigmoid):

Apply the sigmoid function to H1:

f(x) = 1 / (1 + e^(-x))

3. Hidden Layer to Output Layer:

Use the hidden layer output to calculate the output nodes O1 and O2:

O1 = H1 * o1 + b

O2 = H1 * o2 + b

4. Output Probabilities:

Apply the sigmoid function to O1 and O2 to find the probabilities of increasing or decreasing the temperature.

5. Error Calculation:

If the expected output is O1 = 1 (increase) and O2 = 0 (decrease), calculate the error using:

Error = 1/2 * SUM((t - z)^2)

where t is the target value and z is the predicted output.

Manual Calculation Example:

1. Hidden Node Calculation:

H1 = 22 * 0.4 + 60 * 0.3 + 500 * 0.5 + 0.1

Perform step-by-step calculations.

2. Apply Sigmoid to H1:

Substitute H1 into the sigmoid function: f(H1) = 1 / (1 + e^(-H1))

3. Output Layer Calculation:

Compute O1 and O2 using H1:

O1 = H1 * 0.7 + 0.1

O2 = H1 * 0.2 + 0.1

4. Apply Sigmoid to O1 and O2:

Convert O1 and O2 into probabilities.

5. Error Calculation:

Compute the error for the expected outputs O1 = 1 and O2 = 0 using the formula:

Error = 1/2 * ((1 - O1)^2 + (0 - O2)^2)