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## **Back Propagation in Deep Learning**

In simple terms, backpropagation is a supervised learning algorithm that allows a neuralnetwork to learn from its mistakes by adjusting its weights and biases. It enables the network to iteratively improve its performance on a given task, such as classification or regression.

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Code:-
import numpy as np
class NeuralNetwork:
  def__init_(self, input_size, hidden_size, output_size):
    self.input_size = input_size
    self.hidden_size = hidden_size
self.output_size = output_size
# Initialize weights and biases for the hidden layer and output layer
self.W1 = np.random.randn(hidden_size, input_size)
self.b1 = np.zeros((hidden_size, 1))
self.W2 = np.random.randn(output_size, hidden_size)
self.b2 = np.zeros((output_size, 1))
def sigmoid(self, x):
return 1/(1 + np.exp(-x))
def sigmoid_derivative(self, x):
return x * (1 - x)
def forward(self, X):
# Forward pass
self.z1 = np.dot(self.W1, X) + self.b1
self.a1 = self.sigmoid(self.z1)
self.z2 = np.dot(self.W2, self.a1) + self.b2
self.a2 = self.sigmoid(self.z2)
return self.a2
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def backward(self, X, y, learning_rate):
    m = X.shape[1]
# Compute the gradients
dZ2 = self.a2 - y
dW2 = (1 / m) * np.dot(dZ2, self.a1.T)
db2 = (1 / m) * np.sum(dZ2, axis=1, keepdims=True)
dZ1 = np.dot(self.W2.T, dZ2) * self.sigmoid_derivative(self.a1)
    dW1 = (1 / m) * np.dot(dZ1, X.T)
    db1 = (1 / m) * np.sum(dZ1, axis=1, keepdims=True)
# Update weights and biases using gradients and learning rate
self.W2 -= learning_rate * dW2
self.b2 -= learning_rate * db2
self.W1 -= learning_rate * dW1
self.b1 -= learning_rate * db1
def train(self, X, y, epochs, learning_rate):
   for epoch in range(epochs):
      # Forward pass
predictions = self.forward(X)
   # Compute the mean squared error loss
loss = np.mean((predictions - y) ** 2)
   # Backward pass to update weights and biases
      self.backward(X, y, learning_rate)
if epoch \% 100 == 0:
         print(f"Epoch {epoch}, Loss: {loss:.4f}")
def predict(self, X):
    return self.forward(X)
# Example usage:
input\_size = 2
hidden_size = 4
output_size = 1
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learning_rate = 0.1
epochs = 10000

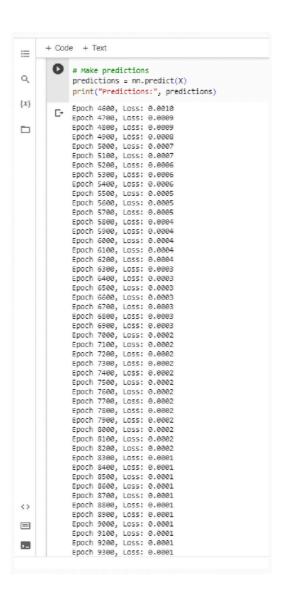
# Generate some sample data
X = np.array([[0, 0], [0, 1], [1, 0], [1, 1]]).T
y = np.array([[0, 1, 1, 0]])

# Create the neural network
nn = NeuralNetwork(input_size, hidden_size, output_size)

# Train the neural network nn.train(X,
y, epochs, learning_rate)

# Make predictions
predictions = nn.predict(X)
print("Predictions:", predictions)
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## Output:-



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                            # Make predictions
predictions = nn.predict(X)
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