ML Experiment 6

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Aim : To implement Back Propogation

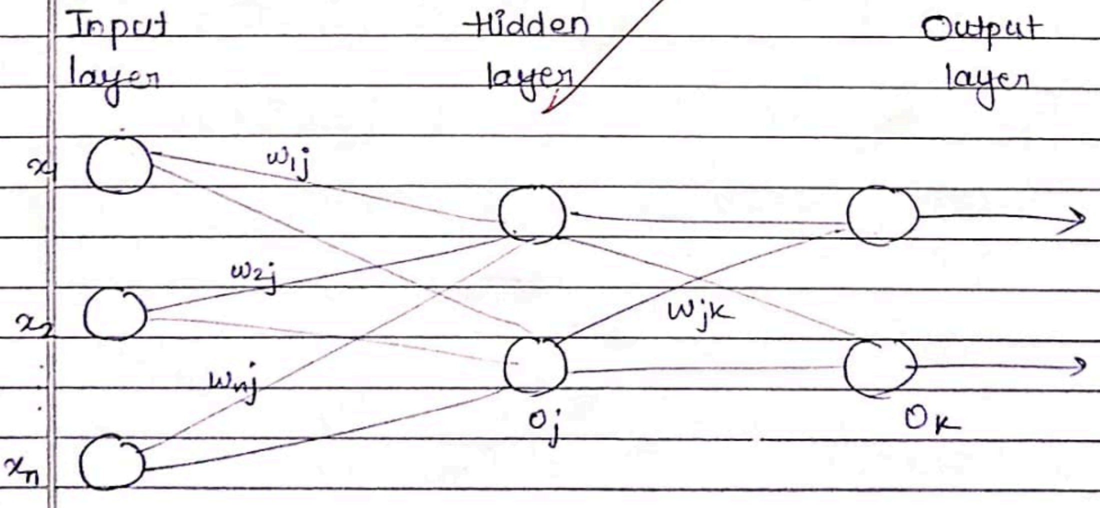
Theory :

Back propogation is an algorithm that backpropogates the errors from the output nodes to input nodes.

It is widely used algorithm for training feedforward neural networks.

It computes the gradient of loss function with respect to the network weights.

It is very efficient, rather than naively directly computing the gradient concerning each weight



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Parameters :

x = inputs training vector $(x_1 \ x_2 \ \dots \ x_n)$
t = target vector $(t_1 \ t_2 \ \dots \ t_n)$
δ_k = error at output unit
δ_j = error at hidden layer
α = learning rate
v_{0j} = bias of hiddent unit j

Conclusion : Thus, we implemented back propogation

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
self.weights_input_hidden = np.random.randn(self.input_size,
self.hidden_size)
self.bias_input_hidden = np.random.randn(1, self.hidden_size)
self.weights_hidden_output =
np.random.randn(self.hidden_size, self.output_size)
self.bias_hidden_output = np.random.randn(1,
self.output_size) def sigmoid(self, x):
return 1 / (1 + np.exp(-x))
def sigmoid_derivative(self, x):
return x * (1 - x)
def forward(self, inputs):
self.hidden_input = np.dot(inputs, self.weights_input_hidden) +
self.bias_input_hidden
self.hidden_output =
self.sigmoid(self.hidden_input) self.final_input
= np.dot(self.hidden_output,
self.weights_hidden_output) +
self.bias_hidden_output self.final_output =
self.sigmoid(self.final_input)
return self.hidden_output, self.final_output
def backward(self, inputs, targets,
learning_rate): error = targets -
self.final_output
delta_output = error * self.sigmoid_derivative(self.final_output)
delta_hidden = np.dot(delta_output,
self.weights_hidden_output.T) *
self.sigmoid_derivative(self.hidden_output)
self.weights_hidden_output +=
np.dot(self.hidden_output.T, delta_output) *
learning_rate
self.bias_hidden_output += np.sum(delta_output,
axis=0, keepdims=True) * learning_rate
self.weights_input_hidden += np.dot(inputs.T, delta_hidden) *
learning_rate
self.bias_input_hidden +=
np.sum(delta_hidden, axis=0, keepdims=True)
* learning_rate
return error
def train(self, inputs, targets, learning_rate):
hidden_output, final_output =
self.forward(inputs) error =
self.backward(inputs, targets, learning_rate)
print("Output of hidden layer:")
print(hidden_output)
print("Output of output layer:")

print(final_output)
print("Error
found:") print(error)
print("Updated weights after 1 iteration:")
```

```
print("Weights from input to hidden layer:")
print(self.weights_input_hidden)
print("Weights from hidden to output layer:")
print(self.weights_hidden_output)
dataset = pd.read_csv('reduced_digits_dataset.csv') inputs =
dataset.drop(columns=['target']).values
targets =
dataset['target'].values.reshape(-1, 1)
input_size = inputs.shape[1]
output_size =
len(np.unique(targets))
hidden_size = 3
nn = NeuralNetwork(input_size, hidden_size,
output_size) nn.train(inputs, targets, learning_rate=0.1)
```