EXPERIMENT:16 Write the python program to implement Feed forward neural Network

PROGRAM:

```python
import numpy as np

# Sigmoid and its derivative
def sigmoid(x):
    return 1 / (1 + np.exp(-x))

def sigmoid_derivative(x):
    return x * (1 - x)

# Training data (XOR problem)
X = np.array([[0,0],
        [0,1],
        [1,0],
        [1,1]])
y = np.array([[0],
        [1],
        [1],
        [0]])

# Initialize weights and biases randomly
np.random.seed(42)
weights_input_hidden = np.random.uniform(-1, 1, (2, 4))
weights_hidden_output = np.random.uniform(-1, 1, (4, 1))
```

```python
bias_hidden = np.zeros((1, 4))
bias_output = np.zeros((1, 1))


# Training loop
learning_rate = 0.1
for epoch in range(5000):
    # Forward pass
    hidden_input = np.dot(X, weights_input_hidden) + bias_hidden
    hidden_output = sigmoid(hidden_input)


    final_input = np.dot(hidden_output, weights_hidden_output) + bias_output
    final_output = sigmoid(final_input)


    # Backpropagation
    error = y - final_output
    d_output = error * sigmoid_derivative(final_output)


    error_hidden = d_output.dot(weights_hidden_output.T)
    d_hidden = error_hidden * sigmoid_derivative(hidden_output)


    # Update weights and biases
    weights_hidden_output += hidden_output.T.dot(d_output) * learning_rate
    bias_output += np.sum(d_output, axis=0, keepdims=True) * learning_rate
    weights_input_hidden += X.T.dot(d_hidden) * learning_rate
```
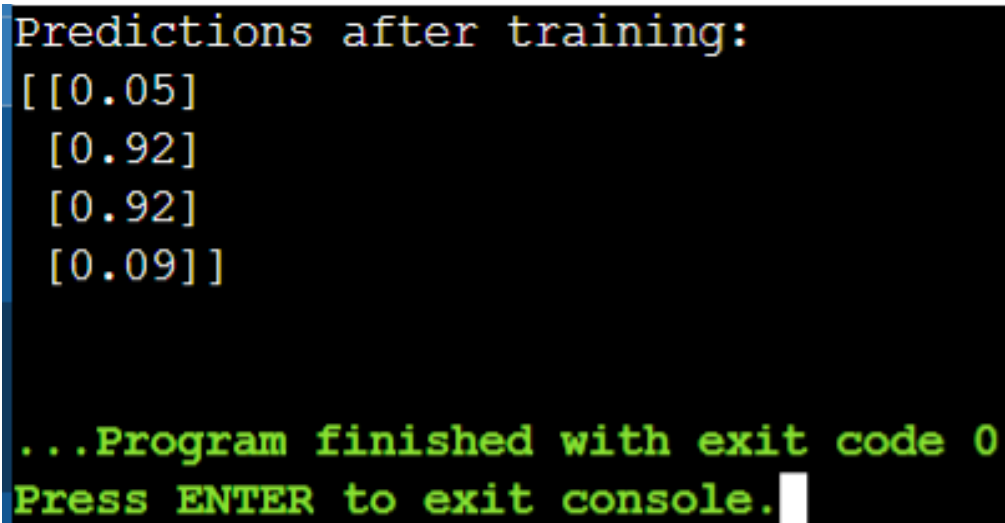
```python
    bias_hidden += np.sum(d_hidden, axis=0, keepdims=True) * learning_rate


# Testing
print("Predictions after training:")
print(np.round(final_output, 2))
```

OUTPUT:

```
Predictions after training:
[[0.05]
 [0.92]
 [0.92]
 [0.09]]


...Program finished with exit code 0
Press ENTER to exit console.
```

```
Accuracy: 1.0
|--- petal width (cm) <= 0.80
|    |--- class: 0
|--- petal width (cm) >  0.80
|    |--- petal length (cm) <= 4.75
|    |    |--- petal width (cm) <= 1.65
|    |    |    |--- class: 1
|    |    |--- petal width (cm) >  1.65
|    |    |    |--- class: 2
|    |--- petal length (cm) >  4.75
|    |    |--- petal width (cm) <= 1.75
|    |    |    |--- petal length (cm) <= 4.95
|    |    |    |    |--- class: 1
|    |    |    |--- petal length (cm) >  4.95
|    |    |    |    |--- petal width (cm) <= 1.55
|    |    |    |    |    |--- class: 2
|    |    |    |    |--- petal width (cm) >  1.55
|    |    |    |    |    |--- petal length (cm) <= 5.45
|    |    |    |    |    |    |--- class: 1
|    |    |    |    |    |--- petal length (cm) >  5.45
|    |    |    |    |    |    |--- class: 2
|    |    |--- petal width (cm) >  1.75
|    |    |    |--- petal length (cm) <= 4.85
|    |    |    |    |--- sepal width (cm) <= 3.10
|    |    |    |    |    |--- class: 2
|    |    |    |    |--- sepal width (cm) >  3.10
|    |    |    |    |    |--- class: 1
|    |    |    |--- petal length (cm) >  4.85
|    |    |    |    |--- class: 2



...Program finished with exit code 0
Press ENTER to exit console.
```