```
# Import libraries
import numpy as np
from sklearn.datasets import load_iris
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import StandardScaler


# Load the Iris dataset
iris = load_iris()
X = iris.data  # Features
y = iris.target  # Target labels


# Split data into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)


# Standardize features (optional but recommended)
scaler = StandardScaler()
scaler.fit(X_train)
X_train = scaler.transform(X_train)
X_test = scaler.transform(X_test)
```

+ Code + Text

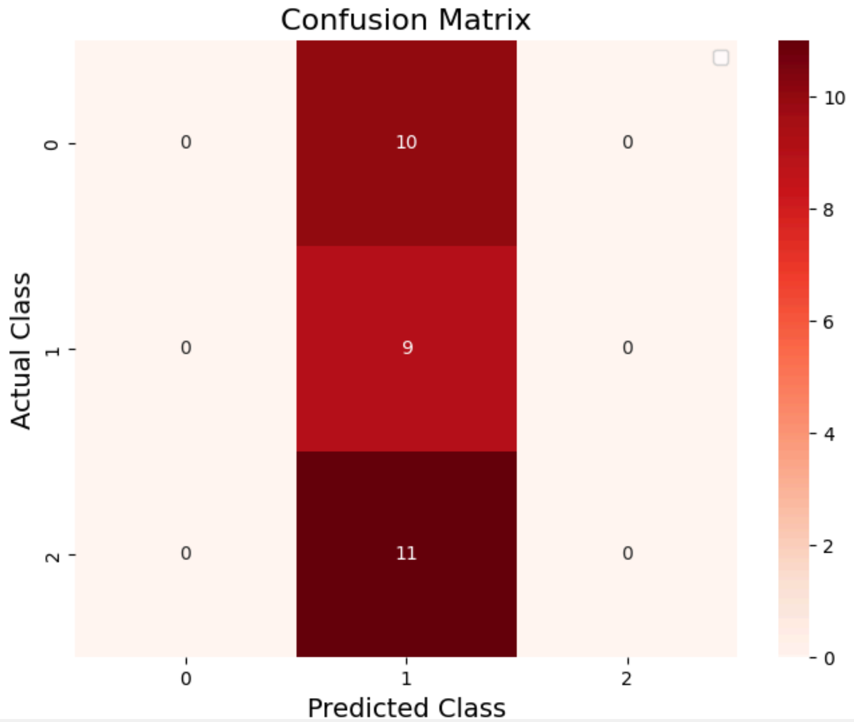
```
# Define the sigmoid activation function
def sigmoid(x):
  return 1 / (1 + np.exp(-x))


# Define the MLP class
class MLP:
  def __init__(self, input_dim, hidden_dim, output_dim):
    self.weights1 = np.random.rand(input_dim, hidden_dim)
    self.weights2 = np.random.rand(hidden_dim, output_dim)
    self.bias1 = np.zeros((1, hidden_dim))
    self.bias2 = np.zeros((1, output_dim))

  def predict(self, X):
    # Forward propagation
    z1 = X.dot(self.weights1) + self.bias1
    a1 = sigmoid(z1)
    z2 = a1.dot(self.weights2) + self.bias2
    a2 = sigmoid(z2)
    return a2

  def train(self, X, y, learning_rate, epochs):
    for epoch in range(epochs):
      # Forward propagation
      z1 = X.dot(self.weights1) + self.bias1
      a1 = sigmoid(z1)
      z2 = a1.dot(self.weights2) + self.bias2
      a2 = sigmoid(z2)

      # Backpropagation
      #delta2 = a2 - y
      #delta1 = (self.weights2.T.dot(delta2)) * a1 * (1 - a1)

      # Update weights and biases
      #self.weights2 -= learning_rate * a1.T.dot(delta2)
      #self.bias2 -= learning_rate * delta2.sum(axis=0, keepdims=True)
      #self.weights1 -= learning_rate * X.T.dot(delta1)
      #self.bias1 -= learning_rate * delta1.sum(axis=0, keepdims=True)


# Define model parameters
input_dim = X_train.shape[1]
hidden_dim = 10  # You can adjust this hyperparameter
output_dim = len(np.unique(y_train))  # Number of classes



# Create and train the MLP model
model = MLP(input_dim, hidden_dim, output_dim)
model.train(X_train, y_train, learning_rate=0.01, epochs=100)
```

```
from sklearn.metrics import accuracy_score

# Make predictions on the test set
y_pred = model.predict(X_test)

# Convert predictions to class labels if necessary
y_pred = np.argmax(y_pred, axis=1)

# Calculate and print accuracy
accuracy = accuracy_score(y_test, y_pred)
print("Accuracy:", accuracy)
```

```
Accuracy: 0.3
```

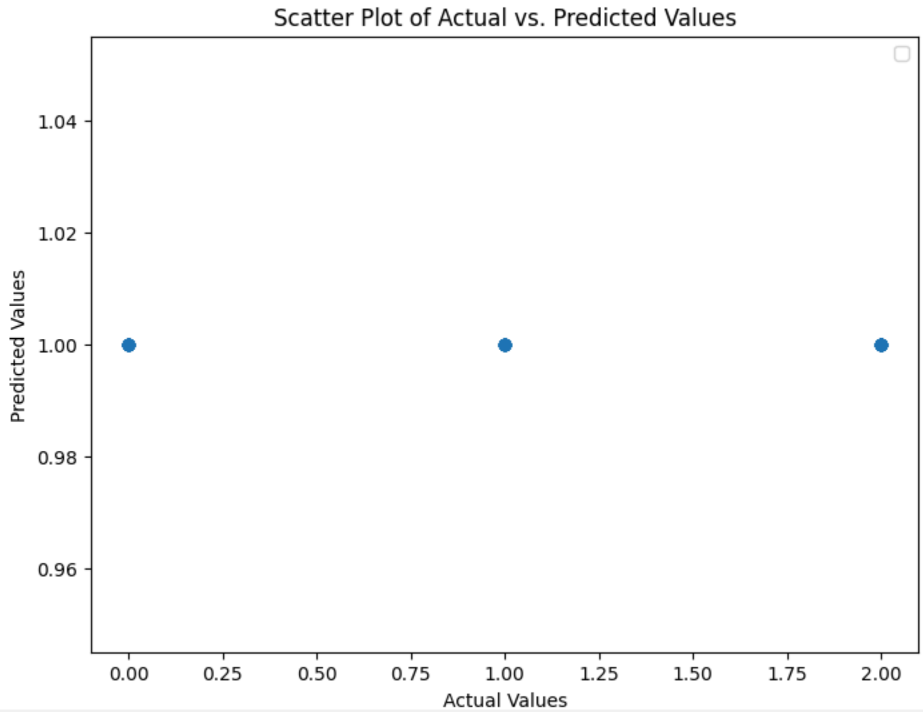
```
import matplotlib.pyplot as plt
import seaborn as sns
from sklearn.metrics import confusion_matrix

# Create a heatmap of the confusion matrix
cm_matrix = confusion_matrix(y_test, y_pred)

# Configure plot size
plt.figure(figsize=(8, 6))

# Create heatmap using seaborn
sns.heatmap(cm_matrix, annot=True, fmt="d", cmap="Reds")

# Add labels and title
plt.title("Confusion Matrix", fontsize=16)
plt.xlabel("Predicted Class", fontsize=14)
plt.ylabel("Actual Class", fontsize=14)
plt.legend()

# Display the plot
plt.show()
```

```
WARNING:matplotlib.legend:No artists with labels found to put in legend.  Note that artists whose label start with an underscore are
```




```
import matplotlib.pyplot as plt
import seaborn as sns

# Scatter plot
plt.figure(figsize=(8, 6))
plt.scatter(y_test, y_pred)
plt.xlabel("Actual Values")
plt.ylabel("Predicted Values")
plt.title("Scatter Plot of Actual vs. Predicted Values")
plt.legend()
plt.show()
```

```
WARNING:matplotlib.legend:No artists with labels found to put in legend.  Note that artists whose label start with an underscore are
```




```python
import numpy as np
import matplotlib.pyplot as plt

# Set the width of the bars
width = 0.35

# Example data (replace this with your actual data)
y_test = np.random.randint(0, 5, size=20)
y_pred = np.random.randint(0, 5, size=20)

actual_class_distribution = np.unique(y_test, return_counts=True)[1]
predicted_class_distribution = np.unique(y_pred, return_counts=True)[1]

plt.figure(figsize=(8, 6))
x = np.arange(len(actual_class_distribution))
plt.bar(x - width/2, actual_class_distribution, width, label="Actual", color="red")
plt.bar(x + width/2, predicted_class_distribution, width, label="Predicted", color="green")
plt.legend()  # <-- Added the missing parenthesis here
plt.show()
```