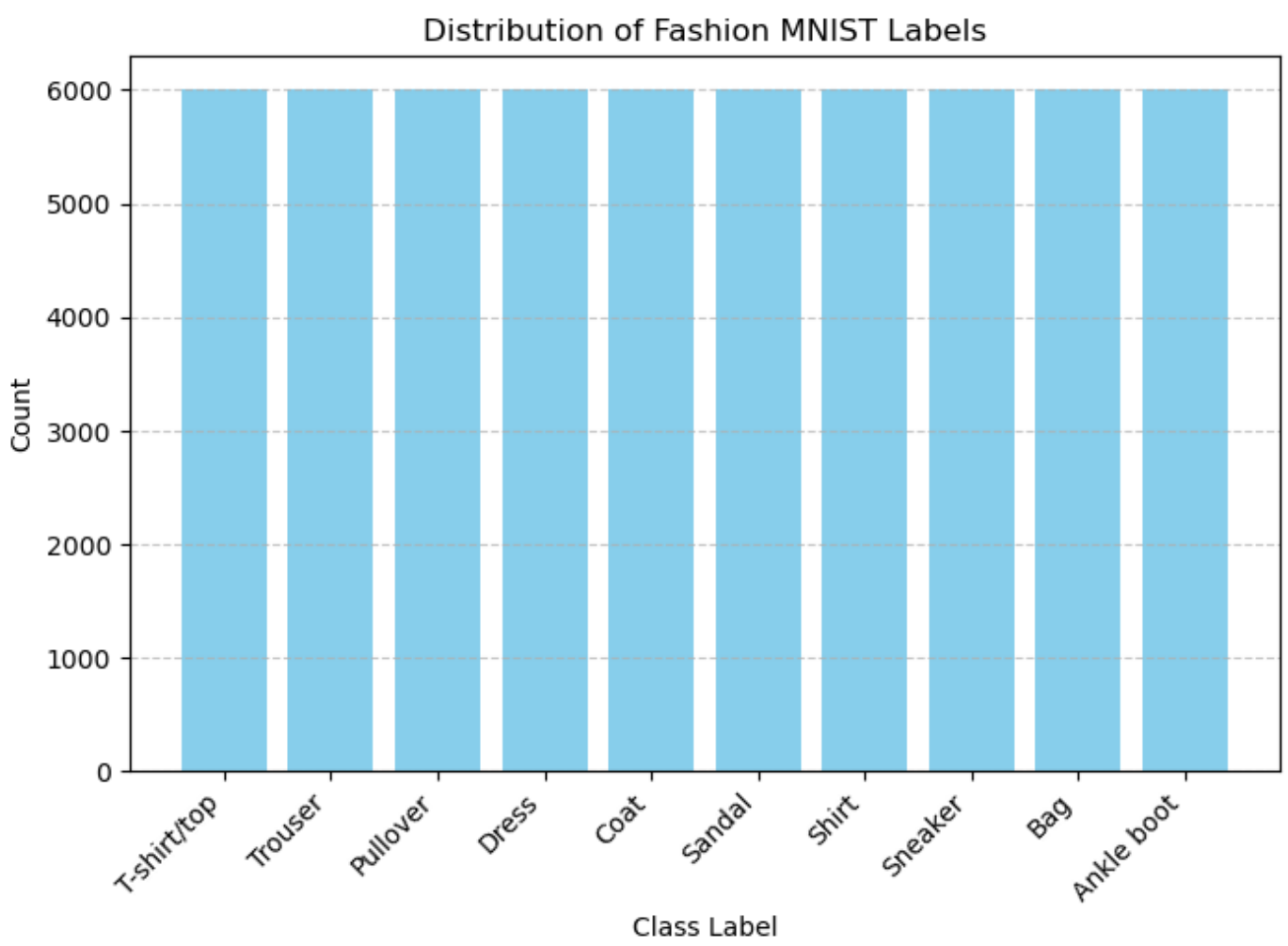
In [3]:

```
import numpy as np
import gzip
import urllib.request
import matplotlib.pyplot as plt

# Load Fashion MNIST dataset
def load_data_analysis():
    base_url = "http://fashion-mnist.s3-website.eu-central-1.amazonaws.com/"
    files = ["train-images-idx3-ubyte.gz", "train-labels-idx1-ubyte.gz",
             "t10k-images-idx3-ubyte.gz", "t10k-labels-idx1-ubyte.gz"]

    data = {}
    for file in files:
        url = base_url + file
        with urllib.request.urlopen(url) as response:
            with gzip.GzipFile(fileobj=response) as f:
                if 'images' in file:
                    data[file] = np.frombuffer(f.read(), np.uint8, offset=16).reshape(-1
                else:
                    data[file] = np.frombuffer(f.read(), np.uint8, offset=8)

    return data["train-images-idx3-ubyte.gz"], data["train-labels-idx1-ubyte.gz"]

# Load training data
X_train, y_train = load_data_analysis()

# Define class names
class_names = ['T-shirt/top', 'Trouser', 'Pullover', 'Dress', 'Coat',
               'Sandal', 'Shirt', 'Sneaker', 'Bag', 'Ankle boot']

# Visualize some sample images
plt.figure(figsize=(10, 10))
for i in range(25):
    plt.subplot(5, 5, i + 1)
    plt.imshow(X_train[i], cmap='gray')
    plt.title(class_names[y_train[i]])
    plt.axis('off')
plt.tight_layout()
plt.show()

# Plot label distribution
plt.figure(figsize=(8, 5))
plt.hist(y_train, bins=range(11), align='left', rwidth=0.8, color='skyblue')
plt.xticks(range(10), class_names, rotation=45, ha='right')
plt.xlabel('Class Label')
plt.ylabel('Count')
plt.title('Distribution of Fashion MNIST Labels')
plt.grid(axis='y', linestyle='--', alpha=0.7)
plt.show()
```


Ankle boot
T-shirt/top
T-shirt/top
Dress
T-shirt/top
Pullover
Sneaker
Pullover
Sandal
Sandal
T-shirt/top
Ankle boot
Sandal
Sandal
Sneaker
Ankle boot
Trouser
T-shirt/top
Shirt
Coat
Dress
Trouser
Coat
Bag
Coat



In [5]:

```
####### Code for MLP ##########
import numpy as np
import gzip
import urllib.request
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score

# Define activation functions and their derivatives
def sigmoid(x):
    return 1 / (1 + np.exp(-x))

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

# Define softmax function
def softmax(x):
    exps = np.exp(x - np.max(x, axis=1, keepdims=True))
    return exps / np.sum(exps, axis=1, keepdims=True)

# Define mean squared error loss function
def mean_squared_error(y_true, y_pred):
    return np.mean(np.square(y_true - y_pred))

# Load Fashion MNIST dataset
def load_data_MLP():
    base_url = "http://fashion-mnist.s3-website.eu-central-1.amazonaws.com/"
    files = ["train-images-idx3-ubyte.gz", "train-labels-idx1-ubyte.gz",
             "t10k-images-idx3-ubyte.gz", "t10k-labels-idx1-ubyte.gz"]

    data = {}
    for file in files:
        url = base_url + file
```

```
        with urllib.request.urlopen(url) as response:
            with gzip.GzipFile(fileobj=response) as f:
                if 'images' in file:
                    data[file] = np.frombuffer(f.read(), np.uint8, offset=16).reshape(-1
                else:
                    data[file] = np.frombuffer(f.read(), np.uint8, offset=8)

    return data["train-images-idx3-ubyte.gz"], data["train-labels-idx1-ubyte.gz"], \
           data["t10k-images-idx3-ubyte.gz"], data["t10k-labels-idx1-ubyte.gz"]

# MLP class
class MLP:
    def __init__(self, input_size, hidden_size, output_size):
        self.weights_input_hidden = np.random.randn(input_size, hidden_size)
        self.bias_input_hidden = np.zeros((1, hidden_size))
        self.weights_hidden_output = np.random.randn(hidden_size, output_size)
        self.bias_hidden_output = np.zeros((1, output_size))

    def forward(self, X):
        self.hidden_input = np.dot(X, self.weights_input_hidden) + self.bias_input_hidde
        self.hidden_output = sigmoid(self.hidden_input)
        self.output = np.dot(self.hidden_output, self.weights_hidden_output) + self.bias
        self.output_probs = softmax(self.output)
        return self.output_probs

    def backward(self, X, y, learning_rate):
        batch_size = X.shape[0]
        output_error = self.output_probs - y
        hidden_error = np.dot(output_error, self.weights_hidden_output.T) * sigmoid_deri

        self.weights_hidden_output -= learning_rate * np.dot(self.hidden_output.T, outpu
        self.bias_hidden_output -= learning_rate * np.sum(output_error, axis=0, keepdims
        self.weights_input_hidden -= learning_rate * np.dot(X.T, hidden_error) / batch_s
        self.bias_input_hidden -= learning_rate * np.sum(hidden_error, axis=0, keepdims=

# Load and preprocess data
X_train, y_train, X_test, y_test = load_data_MLP()
X_train, X_val, y_train, y_val = train_test_split(X_train, y_train, test_size=0.2, rando

# One-hot encode labels
num_classes = 10
y_train_onehot = np.eye(num_classes)[y_train]
y_val_onehot = np.eye(num_classes)[y_val]
y_test_onehot = np.eye(num_classes)[y_test]

# Define hyperparameters to experiment with
learning_rates = [0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1]
hidden_layer_sizes = [64, 128, 256]

# Initialize dictionary to store accuracies
accuracies = np.zeros((len(learning_rates), len(hidden_layer_sizes)))

# Experiment loop
for i, lr in enumerate(learning_rates):
    for j, hidden_size in enumerate(hidden_layer_sizes):
        # Initialize MLP model
        input_size = X_train.shape[1]
        output_size = num_classes
        mlp = MLP(input_size, hidden_size, output_size)

        # Training parameters
        epochs = 10
        batch_size = 64

        # Training loop
        for epoch in range(epochs):
```

```
            for k in range(0, X_train.shape[0], batch_size):
                batch_X = X_train[k:k+batch_size]
                batch_y = y_train_onehot[k:k+batch_size]

                # Forward pass
                output = mlp.forward(batch_X)

                # Backward pass
                mlp.backward(batch_X, batch_y, lr)

            # Validation
            val_output = mlp.forward(X_val)
            val_loss = mean_squared_error(y_val_onehot, val_output)
            val_predictions = np.argmax(val_output, axis=1)
            val_accuracy = accuracy_score(y_val, val_predictions)

            print(f"Learning Rate: {lr}, Hidden Layer Size: {hidden_size}, Epoch: {epoch

        # Test
        test_output = mlp.forward(X_test)
        test_predictions = np.argmax(test_output, axis=1)
        test_accuracy = accuracy_score(y_test, test_predictions)

        print(f"Learning Rate: {lr}, Hidden Layer Size: {hidden_size}, Test Accuracy: {t

        # Store accuracy
        accuracies[i, j] = val_accuracy

# Plotting
plt.figure(figsize=(10, 6))
plt.imshow(accuracies, cmap='viridis', origin='lower')
plt.colorbar(label='Accuracy')
plt.title('MLP Accuracy')
plt.xlabel('Hidden Layer Size')
plt.ylabel('Learning Rate')
plt.xticks(np.arange(len(hidden_layer_sizes)), hidden_layer_sizes)
plt.yticks(np.arange(len(learning_rates)), learning_rates)
plt.show()
```

```
Learning Rate: 0.1, Hidden Layer Size: 64, Epoch: 1/10, Validation Loss: 0.0412, Validat
ion Accuracy: 0.6971
Learning Rate: 0.1, Hidden Layer Size: 64, Epoch: 2/10, Validation Loss: 0.0359, Validat
ion Accuracy: 0.7401
Learning Rate: 0.1, Hidden Layer Size: 64, Epoch: 3/10, Validation Loss: 0.0335, Validat
ion Accuracy: 0.7585
Learning Rate: 0.1, Hidden Layer Size: 64, Epoch: 4/10, Validation Loss: 0.0319, Validat
ion Accuracy: 0.7708
Learning Rate: 0.1, Hidden Layer Size: 64, Epoch: 5/10, Validation Loss: 0.0308, Validat
ion Accuracy: 0.7783
Learning Rate: 0.1, Hidden Layer Size: 64, Epoch: 6/10, Validation Loss: 0.0299, Validat
ion Accuracy: 0.7867
Learning Rate: 0.1, Hidden Layer Size: 64, Epoch: 7/10, Validation Loss: 0.0291, Validat
ion Accuracy: 0.7915
Learning Rate: 0.1, Hidden Layer Size: 64, Epoch: 8/10, Validation Loss: 0.0285, Validat
ion Accuracy: 0.7956
Learning Rate: 0.1, Hidden Layer Size: 64, Epoch: 9/10, Validation Loss: 0.0280, Validat
ion Accuracy: 0.7982
Learning Rate: 0.1, Hidden Layer Size: 64, Epoch: 10/10, Validation Loss: 0.0275, Valida
tion Accuracy: 0.8017
Learning Rate: 0.1, Hidden Layer Size: 64, Test Accuracy: 0.8037
Learning Rate: 0.1, Hidden Layer Size: 128, Epoch: 1/10, Validation Loss: 0.0403, Valida
tion Accuracy: 0.7163
Learning Rate: 0.1, Hidden Layer Size: 128, Epoch: 2/10, Validation Loss: 0.0353, Valida
tion Accuracy: 0.7503
Learning Rate: 0.1, Hidden Layer Size: 128, Epoch: 3/10, Validation Loss: 0.0328, Valida
tion Accuracy: 0.7678
```

```
Learning Rate: 0.1, Hidden Layer Size: 128, Epoch: 4/10, Validation Loss: 0.0312, Valida
tion Accuracy: 0.7795
Learning Rate: 0.1, Hidden Layer Size: 128, Epoch: 5/10, Validation Loss: 0.0300, Valida
tion Accuracy: 0.7875
Learning Rate: 0.1, Hidden Layer Size: 128, Epoch: 6/10, Validation Loss: 0.0291, Valida
tion Accuracy: 0.7940
Learning Rate: 0.1, Hidden Layer Size: 128, Epoch: 7/10, Validation Loss: 0.0284, Valida
tion Accuracy: 0.7987
Learning Rate: 0.1, Hidden Layer Size: 128, Epoch: 8/10, Validation Loss: 0.0278, Valida
tion Accuracy: 0.8028
Learning Rate: 0.1, Hidden Layer Size: 128, Epoch: 9/10, Validation Loss: 0.0273, Valida
tion Accuracy: 0.8067
Learning Rate: 0.1, Hidden Layer Size: 128, Epoch: 10/10, Validation Loss: 0.0269, Valid
ation Accuracy: 0.8102
Learning Rate: 0.1, Hidden Layer Size: 128, Test Accuracy: 0.8040
Learning Rate: 0.1, Hidden Layer Size: 256, Epoch: 1/10, Validation Loss: 0.0393, Valida
tion Accuracy: 0.7418
Learning Rate: 0.1, Hidden Layer Size: 256, Epoch: 2/10, Validation Loss: 0.0340, Valida
tion Accuracy: 0.7727
Learning Rate: 0.1, Hidden Layer Size: 256, Epoch: 3/10, Validation Loss: 0.0313, Valida
tion Accuracy: 0.7866
Learning Rate: 0.1, Hidden Layer Size: 256, Epoch: 4/10, Validation Loss: 0.0296, Valida
tion Accuracy: 0.7984
Learning Rate: 0.1, Hidden Layer Size: 256, Epoch: 5/10, Validation Loss: 0.0284, Valida
tion Accuracy: 0.8063
Learning Rate: 0.1, Hidden Layer Size: 256, Epoch: 6/10, Validation Loss: 0.0274, Valida
tion Accuracy: 0.8111
Learning Rate: 0.1, Hidden Layer Size: 256, Epoch: 7/10, Validation Loss: 0.0267, Valida
tion Accuracy: 0.8167
Learning Rate: 0.1, Hidden Layer Size: 256, Epoch: 8/10, Validation Loss: 0.0261, Valida
tion Accuracy: 0.8219
Learning Rate: 0.1, Hidden Layer Size: 256, Epoch: 9/10, Validation Loss: 0.0257, Valida
tion Accuracy: 0.8247
Learning Rate: 0.1, Hidden Layer Size: 256, Epoch: 10/10, Validation Loss: 0.0253, Valid
ation Accuracy: 0.8259
Learning Rate: 0.1, Hidden Layer Size: 256, Test Accuracy: 0.8217
Learning Rate: 0.2, Hidden Layer Size: 64, Epoch: 1/10, Validation Loss: 0.0371, Validat
ion Accuracy: 0.7314
Learning Rate: 0.2, Hidden Layer Size: 64, Epoch: 2/10, Validation Loss: 0.0325, Validat
ion Accuracy: 0.7642
Learning Rate: 0.2, Hidden Layer Size: 64, Epoch: 3/10, Validation Loss: 0.0306, Validat
ion Accuracy: 0.7800
Learning Rate: 0.2, Hidden Layer Size: 64, Epoch: 4/10, Validation Loss: 0.0293, Validat
ion Accuracy: 0.7897
Learning Rate: 0.2, Hidden Layer Size: 64, Epoch: 5/10, Validation Loss: 0.0284, Validat
ion Accuracy: 0.7968
Learning Rate: 0.2, Hidden Layer Size: 64, Epoch: 6/10, Validation Loss: 0.0276, Validat
ion Accuracy: 0.8017
Learning Rate: 0.2, Hidden Layer Size: 64, Epoch: 7/10, Validation Loss: 0.0270, Validat
ion Accuracy: 0.8059
Learning Rate: 0.2, Hidden Layer Size: 64, Epoch: 8/10, Validation Loss: 0.0265, Validat
ion Accuracy: 0.8101
Learning Rate: 0.2, Hidden Layer Size: 64, Epoch: 9/10, Validation Loss: 0.0261, Validat
ion Accuracy: 0.8127
Learning Rate: 0.2, Hidden Layer Size: 64, Epoch: 10/10, Validation Loss: 0.0257, Valida
tion Accuracy: 0.8159
Learning Rate: 0.2, Hidden Layer Size: 64, Test Accuracy: 0.8090
Learning Rate: 0.2, Hidden Layer Size: 128, Epoch: 1/10, Validation Loss: 0.0358, Valida
tion Accuracy: 0.7476
Learning Rate: 0.2, Hidden Layer Size: 128, Epoch: 2/10, Validation Loss: 0.0312, Valida
tion Accuracy: 0.7797
Learning Rate: 0.2, Hidden Layer Size: 128, Epoch: 3/10, Validation Loss: 0.0290, Valida
tion Accuracy: 0.7961
Learning Rate: 0.2, Hidden Layer Size: 128, Epoch: 4/10, Validation Loss: 0.0276, Valida
tion Accuracy: 0.8053
Learning Rate: 0.2, Hidden Layer Size: 128, Epoch: 5/10, Validation Loss: 0.0267, Valida
```

```
tion Accuracy: 0.8110
Learning Rate: 0.2, Hidden Layer Size: 128, Epoch: 6/10, Validation Loss: 0.0260, Valida
tion Accuracy: 0.8171
Learning Rate: 0.2, Hidden Layer Size: 128, Epoch: 7/10, Validation Loss: 0.0254, Valida
tion Accuracy: 0.8198
Learning Rate: 0.2, Hidden Layer Size: 128, Epoch: 8/10, Validation Loss: 0.0249, Valida
tion Accuracy: 0.8239
Learning Rate: 0.2, Hidden Layer Size: 128, Epoch: 9/10, Validation Loss: 0.0245, Valida
tion Accuracy: 0.8273
Learning Rate: 0.2, Hidden Layer Size: 128, Epoch: 10/10, Validation Loss: 0.0242, Valid
ation Accuracy: 0.8299
Learning Rate: 0.2, Hidden Layer Size: 128, Test Accuracy: 0.8136
Learning Rate: 0.2, Hidden Layer Size: 256, Epoch: 1/10, Validation Loss: 0.0379, Valida
tion Accuracy: 0.7462
Learning Rate: 0.2, Hidden Layer Size: 256, Epoch: 2/10, Validation Loss: 0.0329, Valida
tion Accuracy: 0.7770
Learning Rate: 0.2, Hidden Layer Size: 256, Epoch: 3/10, Validation Loss: 0.0306, Valida
tion Accuracy: 0.7907
Learning Rate: 0.2, Hidden Layer Size: 256, Epoch: 4/10, Validation Loss: 0.0289, Valida
tion Accuracy: 0.8023
Learning Rate: 0.2, Hidden Layer Size: 256, Epoch: 5/10, Validation Loss: 0.0277, Valida
tion Accuracy: 0.8102
Learning Rate: 0.2, Hidden Layer Size: 256, Epoch: 6/10, Validation Loss: 0.0268, Valida
tion Accuracy: 0.8165
Learning Rate: 0.2, Hidden Layer Size: 256, Epoch: 7/10, Validation Loss: 0.0261, Valida
tion Accuracy: 0.8214
Learning Rate: 0.2, Hidden Layer Size: 256, Epoch: 8/10, Validation Loss: 0.0256, Valida
tion Accuracy: 0.8239
Learning Rate: 0.2, Hidden Layer Size: 256, Epoch: 9/10, Validation Loss: 0.0251, Valida
tion Accuracy: 0.8267
Learning Rate: 0.2, Hidden Layer Size: 256, Epoch: 10/10, Validation Loss: 0.0247, Valid
ation Accuracy: 0.8299
Learning Rate: 0.2, Hidden Layer Size: 256, Test Accuracy: 0.8236
Learning Rate: 0.3, Hidden Layer Size: 64, Epoch: 1/10, Validation Loss: 0.0328, Validat
ion Accuracy: 0.7668
Learning Rate: 0.3, Hidden Layer Size: 64, Epoch: 2/10, Validation Loss: 0.0293, Validat
ion Accuracy: 0.7893
Learning Rate: 0.3, Hidden Layer Size: 64, Epoch: 3/10, Validation Loss: 0.0277, Validat
ion Accuracy: 0.8023
Learning Rate: 0.3, Hidden Layer Size: 64, Epoch: 4/10, Validation Loss: 0.0267, Validat
ion Accuracy: 0.8115
Learning Rate: 0.3, Hidden Layer Size: 64, Epoch: 5/10, Validation Loss: 0.0259, Validat
ion Accuracy: 0.8172
Learning Rate: 0.3, Hidden Layer Size: 64, Epoch: 6/10, Validation Loss: 0.0253, Validat
ion Accuracy: 0.8203
Learning Rate: 0.3, Hidden Layer Size: 64, Epoch: 7/10, Validation Loss: 0.0248, Validat
ion Accuracy: 0.8243
Learning Rate: 0.3, Hidden Layer Size: 64, Epoch: 8/10, Validation Loss: 0.0244, Validat
ion Accuracy: 0.8271
Learning Rate: 0.3, Hidden Layer Size: 64, Epoch: 9/10, Validation Loss: 0.0240, Validat
ion Accuracy: 0.8295
Learning Rate: 0.3, Hidden Layer Size: 64, Epoch: 10/10, Validation Loss: 0.0237, Valida
tion Accuracy: 0.8326
Learning Rate: 0.3, Hidden Layer Size: 64, Test Accuracy: 0.8217
Learning Rate: 0.3, Hidden Layer Size: 128, Epoch: 1/10, Validation Loss: 0.0355, Valida
tion Accuracy: 0.7475
Learning Rate: 0.3, Hidden Layer Size: 128, Epoch: 2/10, Validation Loss: 0.0311, Valida
tion Accuracy: 0.7767
Learning Rate: 0.3, Hidden Layer Size: 128, Epoch: 3/10, Validation Loss: 0.0291, Valida
tion Accuracy: 0.7909
Learning Rate: 0.3, Hidden Layer Size: 128, Epoch: 4/10, Validation Loss: 0.0278, Valida
tion Accuracy: 0.8003
Learning Rate: 0.3, Hidden Layer Size: 128, Epoch: 5/10, Validation Loss: 0.0268, Valida
tion Accuracy: 0.8076
Learning Rate: 0.3, Hidden Layer Size: 128, Epoch: 6/10, Validation Loss: 0.0259, Valida
tion Accuracy: 0.8153
```

Learning Rate: 0.3, Hidden Layer Size: 128, Epoch: 7/10, Validation Loss: 0.0253, Valida
tion Accuracy: 0.8203
Learning Rate: 0.3, Hidden Layer Size: 128, Epoch: 8/10, Validation Loss: 0.0248, Valida
tion Accuracy: 0.8233
Learning Rate: 0.3, Hidden Layer Size: 128, Epoch: 9/10, Validation Loss: 0.0244, Valida
tion Accuracy: 0.8262
Learning Rate: 0.3, Hidden Layer Size: 128, Epoch: 10/10, Validation Loss: 0.0240, Valid
ation Accuracy: 0.8292
Learning Rate: 0.3, Hidden Layer Size: 128, Test Accuracy: 0.8163
Learning Rate: 0.3, Hidden Layer Size: 256, Epoch: 1/10, Validation Loss: 0.0414, Valida
tion Accuracy: 0.7242
Learning Rate: 0.3, Hidden Layer Size: 256, Epoch: 2/10, Validation Loss: 0.0359, Valida
tion Accuracy: 0.7587
Learning Rate: 0.3, Hidden Layer Size: 256, Epoch: 3/10, Validation Loss: 0.0340, Valida
tion Accuracy: 0.7691
Learning Rate: 0.3, Hidden Layer Size: 256, Epoch: 4/10, Validation Loss: 0.0324, Valida
tion Accuracy: 0.7779
Learning Rate: 0.3, Hidden Layer Size: 256, Epoch: 5/10, Validation Loss: 0.0312, Valida
tion Accuracy: 0.7865
Learning Rate: 0.3, Hidden Layer Size: 256, Epoch: 6/10, Validation Loss: 0.0305, Valida
tion Accuracy: 0.7908
Learning Rate: 0.3, Hidden Layer Size: 256, Epoch: 7/10, Validation Loss: 0.0298, Valida
tion Accuracy: 0.7940
Learning Rate: 0.3, Hidden Layer Size: 256, Epoch: 8/10, Validation Loss: 0.0292, Valida
tion Accuracy: 0.7981
Learning Rate: 0.3, Hidden Layer Size: 256, Epoch: 9/10, Validation Loss: 0.0286, Valida
tion Accuracy: 0.8025
Learning Rate: 0.3, Hidden Layer Size: 256, Epoch: 10/10, Validation Loss: 0.0280, Valid
ation Accuracy: 0.8063
Learning Rate: 0.3, Hidden Layer Size: 256, Test Accuracy: 0.7948
Learning Rate: 0.4, Hidden Layer Size: 64, Epoch: 1/10, Validation Loss: 0.0358, Validat
ion Accuracy: 0.7371
Learning Rate: 0.4, Hidden Layer Size: 64, Epoch: 2/10, Validation Loss: 0.0314, Validat
ion Accuracy: 0.7710
Learning Rate: 0.4, Hidden Layer Size: 64, Epoch: 3/10, Validation Loss: 0.0290, Validat
ion Accuracy: 0.7913
Learning Rate: 0.4, Hidden Layer Size: 64, Epoch: 4/10, Validation Loss: 0.0273, Validat
ion Accuracy: 0.8027
Learning Rate: 0.4, Hidden Layer Size: 64, Epoch: 5/10, Validation Loss: 0.0261, Validat
ion Accuracy: 0.8120
Learning Rate: 0.4, Hidden Layer Size: 64, Epoch: 6/10, Validation Loss: 0.0252, Validat
ion Accuracy: 0.8195
Learning Rate: 0.4, Hidden Layer Size: 64, Epoch: 7/10, Validation Loss: 0.0246, Validat
ion Accuracy: 0.8249
Learning Rate: 0.4, Hidden Layer Size: 64, Epoch: 8/10, Validation Loss: 0.0241, Validat
ion Accuracy: 0.8298
Learning Rate: 0.4, Hidden Layer Size: 64, Epoch: 9/10, Validation Loss: 0.0236, Validat
ion Accuracy: 0.8323
Learning Rate: 0.4, Hidden Layer Size: 64, Epoch: 10/10, Validation Loss: 0.0233, Valida
tion Accuracy: 0.8343
Learning Rate: 0.4, Hidden Layer Size: 64, Test Accuracy: 0.8268
Learning Rate: 0.4, Hidden Layer Size: 128, Epoch: 1/10, Validation Loss: 0.0349, Valida
tion Accuracy: 0.7545
Learning Rate: 0.4, Hidden Layer Size: 128, Epoch: 2/10, Validation Loss: 0.0304, Valida
tion Accuracy: 0.7846
Learning Rate: 0.4, Hidden Layer Size: 128, Epoch: 3/10, Validation Loss: 0.0277, Valida
tion Accuracy: 0.8043
Learning Rate: 0.4, Hidden Layer Size: 128, Epoch: 4/10, Validation Loss: 0.0267, Valida
tion Accuracy: 0.8107
Learning Rate: 0.4, Hidden Layer Size: 128, Epoch: 5/10, Validation Loss: 0.0260, Valida
tion Accuracy: 0.8155
Learning Rate: 0.4, Hidden Layer Size: 128, Epoch: 6/10, Validation Loss: 0.0254, Valida
tion Accuracy: 0.8203
Learning Rate: 0.4, Hidden Layer Size: 128, Epoch: 7/10, Validation Loss: 0.0249, Valida
tion Accuracy: 0.8261
Learning Rate: 0.4, Hidden Layer Size: 128, Epoch: 8/10, Validation Loss: 0.0243, Valida

tion Accuracy: 0.8304
Learning Rate: 0.4, Hidden Layer Size: 128, Epoch: 9/10, Validation Loss: 0.0239, Valida
tion Accuracy: 0.8337
Learning Rate: 0.4, Hidden Layer Size: 128, Epoch: 10/10, Validation Loss: 0.0235, Valid
ation Accuracy: 0.8362
Learning Rate: 0.4, Hidden Layer Size: 128, Test Accuracy: 0.8274
Learning Rate: 0.4, Hidden Layer Size: 256, Epoch: 1/10, Validation Loss: 0.0422, Valida
tion Accuracy: 0.7308
Learning Rate: 0.4, Hidden Layer Size: 256, Epoch: 2/10, Validation Loss: 0.0397, Valida
tion Accuracy: 0.7449
Learning Rate: 0.4, Hidden Layer Size: 256, Epoch: 3/10, Validation Loss: 0.0373, Valida
tion Accuracy: 0.7564
Learning Rate: 0.4, Hidden Layer Size: 256, Epoch: 4/10, Validation Loss: 0.0344, Valida
tion Accuracy: 0.7684
Learning Rate: 0.4, Hidden Layer Size: 256, Epoch: 5/10, Validation Loss: 0.0323, Valida
tion Accuracy: 0.7793
Learning Rate: 0.4, Hidden Layer Size: 256, Epoch: 6/10, Validation Loss: 0.0305, Valida
tion Accuracy: 0.7917
Learning Rate: 0.4, Hidden Layer Size: 256, Epoch: 7/10, Validation Loss: 0.0284, Valida
tion Accuracy: 0.8070
Learning Rate: 0.4, Hidden Layer Size: 256, Epoch: 8/10, Validation Loss: 0.0268, Valida
tion Accuracy: 0.8188
Learning Rate: 0.4, Hidden Layer Size: 256, Epoch: 9/10, Validation Loss: 0.0258, Valida
tion Accuracy: 0.8252
Learning Rate: 0.4, Hidden Layer Size: 256, Epoch: 10/10, Validation Loss: 0.0252, Valid
ation Accuracy: 0.8297
Learning Rate: 0.4, Hidden Layer Size: 256, Test Accuracy: 0.8172
Learning Rate: 0.5, Hidden Layer Size: 64, Epoch: 1/10, Validation Loss: 0.0326, Validat
ion Accuracy: 0.7659
Learning Rate: 0.5, Hidden Layer Size: 64, Epoch: 2/10, Validation Loss: 0.0295, Validat
ion Accuracy: 0.7887
Learning Rate: 0.5, Hidden Layer Size: 64, Epoch: 3/10, Validation Loss: 0.0278, Validat
ion Accuracy: 0.8032
Learning Rate: 0.5, Hidden Layer Size: 64, Epoch: 4/10, Validation Loss: 0.0265, Validat
ion Accuracy: 0.8135
Learning Rate: 0.5, Hidden Layer Size: 64, Epoch: 5/10, Validation Loss: 0.0256, Validat
ion Accuracy: 0.8195
Learning Rate: 0.5, Hidden Layer Size: 64, Epoch: 6/10, Validation Loss: 0.0249, Validat
ion Accuracy: 0.8239
Learning Rate: 0.5, Hidden Layer Size: 64, Epoch: 7/10, Validation Loss: 0.0244, Validat
ion Accuracy: 0.8281
Learning Rate: 0.5, Hidden Layer Size: 64, Epoch: 8/10, Validation Loss: 0.0240, Validat
ion Accuracy: 0.8316
Learning Rate: 0.5, Hidden Layer Size: 64, Epoch: 9/10, Validation Loss: 0.0236, Validat
ion Accuracy: 0.8335
Learning Rate: 0.5, Hidden Layer Size: 64, Epoch: 10/10, Validation Loss: 0.0233, Valida
tion Accuracy: 0.8358
Learning Rate: 0.5, Hidden Layer Size: 64, Test Accuracy: 0.8269
Learning Rate: 0.5, Hidden Layer Size: 128, Epoch: 1/10, Validation Loss: 0.0351, Valida
tion Accuracy: 0.7497
Learning Rate: 0.5, Hidden Layer Size: 128, Epoch: 2/10, Validation Loss: 0.0301, Valida
tion Accuracy: 0.7847
Learning Rate: 0.5, Hidden Layer Size: 128, Epoch: 3/10, Validation Loss: 0.0285, Valida
tion Accuracy: 0.7993
Learning Rate: 0.5, Hidden Layer Size: 128, Epoch: 4/10, Validation Loss: 0.0277, Valida
tion Accuracy: 0.8055
Learning Rate: 0.5, Hidden Layer Size: 128, Epoch: 5/10, Validation Loss: 0.0273, Valida
tion Accuracy: 0.8096
Learning Rate: 0.5, Hidden Layer Size: 128, Epoch: 6/10, Validation Loss: 0.0266, Valida
tion Accuracy: 0.8133
Learning Rate: 0.5, Hidden Layer Size: 128, Epoch: 7/10, Validation Loss: 0.0257, Valida
tion Accuracy: 0.8197
Learning Rate: 0.5, Hidden Layer Size: 128, Epoch: 8/10, Validation Loss: 0.0249, Valida
tion Accuracy: 0.8265
Learning Rate: 0.5, Hidden Layer Size: 128, Epoch: 9/10, Validation Loss: 0.0243, Valida
tion Accuracy: 0.8298

Learning Rate: 0.5, Hidden Layer Size: 128, Epoch: 10/10, Validation Loss: 0.0239, Valid
ation Accuracy: 0.8347
Learning Rate: 0.5, Hidden Layer Size: 128, Test Accuracy: 0.8212
Learning Rate: 0.5, Hidden Layer Size: 256, Epoch: 1/10, Validation Loss: 0.0501, Valida
tion Accuracy: 0.6910
Learning Rate: 0.5, Hidden Layer Size: 256, Epoch: 2/10, Validation Loss: 0.0340, Valida
tion Accuracy: 0.7845
Learning Rate: 0.5, Hidden Layer Size: 256, Epoch: 3/10, Validation Loss: 0.0310, Valida
tion Accuracy: 0.8007
Learning Rate: 0.5, Hidden Layer Size: 256, Epoch: 4/10, Validation Loss: 0.0357, Valida
tion Accuracy: 0.7718
Learning Rate: 0.5, Hidden Layer Size: 256, Epoch: 5/10, Validation Loss: 0.0349, Valida
tion Accuracy: 0.7758
Learning Rate: 0.5, Hidden Layer Size: 256, Epoch: 6/10, Validation Loss: 0.0339, Valida
tion Accuracy: 0.7785
Learning Rate: 0.5, Hidden Layer Size: 256, Epoch: 7/10, Validation Loss: 0.0334, Valida
tion Accuracy: 0.7817
Learning Rate: 0.5, Hidden Layer Size: 256, Epoch: 8/10, Validation Loss: 0.0325, Valida
tion Accuracy: 0.7875
Learning Rate: 0.5, Hidden Layer Size: 256, Epoch: 9/10, Validation Loss: 0.0316, Valida
tion Accuracy: 0.7898
Learning Rate: 0.5, Hidden Layer Size: 256, Epoch: 10/10, Validation Loss: 0.0303, Valid
ation Accuracy: 0.7990
Learning Rate: 0.5, Hidden Layer Size: 256, Test Accuracy: 0.7858
Learning Rate: 0.6, Hidden Layer Size: 64, Epoch: 1/10, Validation Loss: 0.0320, Validat
ion Accuracy: 0.7634
Learning Rate: 0.6, Hidden Layer Size: 64, Epoch: 2/10, Validation Loss: 0.0282, Validat
ion Accuracy: 0.7965
Learning Rate: 0.6, Hidden Layer Size: 64, Epoch: 3/10, Validation Loss: 0.0262, Validat
ion Accuracy: 0.8143
Learning Rate: 0.6, Hidden Layer Size: 64, Epoch: 4/10, Validation Loss: 0.0249, Validat
ion Accuracy: 0.8233
Learning Rate: 0.6, Hidden Layer Size: 64, Epoch: 5/10, Validation Loss: 0.0241, Validat
ion Accuracy: 0.8301
Learning Rate: 0.6, Hidden Layer Size: 64, Epoch: 6/10, Validation Loss: 0.0236, Validat
ion Accuracy: 0.8333
Learning Rate: 0.6, Hidden Layer Size: 64, Epoch: 7/10, Validation Loss: 0.0232, Validat
ion Accuracy: 0.8369
Learning Rate: 0.6, Hidden Layer Size: 64, Epoch: 8/10, Validation Loss: 0.0228, Validat
ion Accuracy: 0.8402
Learning Rate: 0.6, Hidden Layer Size: 64, Epoch: 9/10, Validation Loss: 0.0224, Validat
ion Accuracy: 0.8401
Learning Rate: 0.6, Hidden Layer Size: 64, Epoch: 10/10, Validation Loss: 0.0221, Valida
tion Accuracy: 0.8433
Learning Rate: 0.6, Hidden Layer Size: 64, Test Accuracy: 0.8319
Learning Rate: 0.6, Hidden Layer Size: 128, Epoch: 1/10, Validation Loss: 0.0367, Valida
tion Accuracy: 0.7432
Learning Rate: 0.6, Hidden Layer Size: 128, Epoch: 2/10, Validation Loss: 0.0347, Valida
tion Accuracy: 0.7588
Learning Rate: 0.6, Hidden Layer Size: 128, Epoch: 3/10, Validation Loss: 0.0331, Valida
tion Accuracy: 0.7704
Learning Rate: 0.6, Hidden Layer Size: 128, Epoch: 4/10, Validation Loss: 0.0319, Valida
tion Accuracy: 0.7768
Learning Rate: 0.6, Hidden Layer Size: 128, Epoch: 5/10, Validation Loss: 0.0299, Valida
tion Accuracy: 0.7895
Learning Rate: 0.6, Hidden Layer Size: 128, Epoch: 6/10, Validation Loss: 0.0281, Valida
tion Accuracy: 0.8033
Learning Rate: 0.6, Hidden Layer Size: 128, Epoch: 7/10, Validation Loss: 0.0267, Valida
tion Accuracy: 0.8149
Learning Rate: 0.6, Hidden Layer Size: 128, Epoch: 8/10, Validation Loss: 0.0252, Valida
tion Accuracy: 0.8237
Learning Rate: 0.6, Hidden Layer Size: 128, Epoch: 9/10, Validation Loss: 0.0251, Valida
tion Accuracy: 0.8249
Learning Rate: 0.6, Hidden Layer Size: 128, Epoch: 10/10, Validation Loss: 0.0252, Valid
ation Accuracy: 0.8247
Learning Rate: 0.6, Hidden Layer Size: 128, Test Accuracy: 0.8099

```
Learning Rate: 0.6, Hidden Layer Size: 256, Epoch: 1/10, Validation Loss: 0.0478, Valida
tion Accuracy: 0.7071
Learning Rate: 0.6, Hidden Layer Size: 256, Epoch: 2/10, Validation Loss: 0.0364, Valida
tion Accuracy: 0.7636
Learning Rate: 0.6, Hidden Layer Size: 256, Epoch: 3/10, Validation Loss: 0.0416, Valida
tion Accuracy: 0.7378
Learning Rate: 0.6, Hidden Layer Size: 256, Epoch: 4/10, Validation Loss: 0.0333, Valida
tion Accuracy: 0.7810
Learning Rate: 0.6, Hidden Layer Size: 256, Epoch: 5/10, Validation Loss: 0.0263, Valida
tion Accuracy: 0.8263
Learning Rate: 0.6, Hidden Layer Size: 256, Epoch: 6/10, Validation Loss: 0.0260, Valida
tion Accuracy: 0.8287
Learning Rate: 0.6, Hidden Layer Size: 256, Epoch: 7/10, Validation Loss: 0.0246, Valida
tion Accuracy: 0.8382
Learning Rate: 0.6, Hidden Layer Size: 256, Epoch: 8/10, Validation Loss: 0.0240, Valida
tion Accuracy: 0.8421
Learning Rate: 0.6, Hidden Layer Size: 256, Epoch: 9/10, Validation Loss: 0.0238, Valida
tion Accuracy: 0.8423
Learning Rate: 0.6, Hidden Layer Size: 256, Epoch: 10/10, Validation Loss: 0.0231, Valid
ation Accuracy: 0.8460
Learning Rate: 0.6, Hidden Layer Size: 256, Test Accuracy: 0.8414
Learning Rate: 0.7, Hidden Layer Size: 64, Epoch: 1/10, Validation Loss: 0.0322, Validat
ion Accuracy: 0.7694
Learning Rate: 0.7, Hidden Layer Size: 64, Epoch: 2/10, Validation Loss: 0.0281, Validat
ion Accuracy: 0.8019
Learning Rate: 0.7, Hidden Layer Size: 64, Epoch: 3/10, Validation Loss: 0.0262, Validat
ion Accuracy: 0.8161
Learning Rate: 0.7, Hidden Layer Size: 64, Epoch: 4/10, Validation Loss: 0.0251, Validat
ion Accuracy: 0.8244
Learning Rate: 0.7, Hidden Layer Size: 64, Epoch: 5/10, Validation Loss: 0.0242, Validat
ion Accuracy: 0.8323
Learning Rate: 0.7, Hidden Layer Size: 64, Epoch: 6/10, Validation Loss: 0.0235, Validat
ion Accuracy: 0.8363
Learning Rate: 0.7, Hidden Layer Size: 64, Epoch: 7/10, Validation Loss: 0.0230, Validat
ion Accuracy: 0.8391
Learning Rate: 0.7, Hidden Layer Size: 64, Epoch: 8/10, Validation Loss: 0.0226, Validat
ion Accuracy: 0.8423
Learning Rate: 0.7, Hidden Layer Size: 64, Epoch: 9/10, Validation Loss: 0.0223, Validat
ion Accuracy: 0.8452
Learning Rate: 0.7, Hidden Layer Size: 64, Epoch: 10/10, Validation Loss: 0.0220, Valida
tion Accuracy: 0.8476
Learning Rate: 0.7, Hidden Layer Size: 64, Test Accuracy: 0.8387
Learning Rate: 0.7, Hidden Layer Size: 128, Epoch: 1/10, Validation Loss: 0.0351, Valida
tion Accuracy: 0.7517
Learning Rate: 0.7, Hidden Layer Size: 128, Epoch: 2/10, Validation Loss: 0.0355, Valida
tion Accuracy: 0.7513
Learning Rate: 0.7, Hidden Layer Size: 128, Epoch: 3/10, Validation Loss: 0.0320, Valida
tion Accuracy: 0.7754
Learning Rate: 0.7, Hidden Layer Size: 128, Epoch: 4/10, Validation Loss: 0.0309, Valida
tion Accuracy: 0.7857
Learning Rate: 0.7, Hidden Layer Size: 128, Epoch: 5/10, Validation Loss: 0.0305, Valida
tion Accuracy: 0.7884
Learning Rate: 0.7, Hidden Layer Size: 128, Epoch: 6/10, Validation Loss: 0.0299, Valida
tion Accuracy: 0.7929
Learning Rate: 0.7, Hidden Layer Size: 128, Epoch: 7/10, Validation Loss: 0.0294, Valida
tion Accuracy: 0.7968
Learning Rate: 0.7, Hidden Layer Size: 128, Epoch: 8/10, Validation Loss: 0.0288, Valida
tion Accuracy: 0.8011
Learning Rate: 0.7, Hidden Layer Size: 128, Epoch: 9/10, Validation Loss: 0.0281, Valida
tion Accuracy: 0.8076
Learning Rate: 0.7, Hidden Layer Size: 128, Epoch: 10/10, Validation Loss: 0.0270, Valid
ation Accuracy: 0.8137
Learning Rate: 0.7, Hidden Layer Size: 128, Test Accuracy: 0.8010
Learning Rate: 0.7, Hidden Layer Size: 256, Epoch: 1/10, Validation Loss: 0.0415, Valida
tion Accuracy: 0.7442
Learning Rate: 0.7, Hidden Layer Size: 256, Epoch: 2/10, Validation Loss: 0.0318, Valida
```

tion Accuracy: 0.7897
Learning Rate: 0.7, Hidden Layer Size: 256, Epoch: 3/10, Validation Loss: 0.0335, Valida
tion Accuracy: 0.7837
Learning Rate: 0.7, Hidden Layer Size: 256, Epoch: 4/10, Validation Loss: 0.0314, Valida
tion Accuracy: 0.7929
Learning Rate: 0.7, Hidden Layer Size: 256, Epoch: 5/10, Validation Loss: 0.0300, Valida
tion Accuracy: 0.8017
Learning Rate: 0.7, Hidden Layer Size: 256, Epoch: 6/10, Validation Loss: 0.0288, Valida
tion Accuracy: 0.8086
Learning Rate: 0.7, Hidden Layer Size: 256, Epoch: 7/10, Validation Loss: 0.0276, Valida
tion Accuracy: 0.8173
Learning Rate: 0.7, Hidden Layer Size: 256, Epoch: 8/10, Validation Loss: 0.0267, Valida
tion Accuracy: 0.8224
Learning Rate: 0.7, Hidden Layer Size: 256, Epoch: 9/10, Validation Loss: 0.0259, Valida
tion Accuracy: 0.8286
Learning Rate: 0.7, Hidden Layer Size: 256, Epoch: 10/10, Validation Loss: 0.0259, Valid
ation Accuracy: 0.8291
Learning Rate: 0.7, Hidden Layer Size: 256, Test Accuracy: 0.8142
Learning Rate: 0.8, Hidden Layer Size: 64, Epoch: 1/10, Validation Loss: 0.0365, Validat
ion Accuracy: 0.7326
Learning Rate: 0.8, Hidden Layer Size: 64, Epoch: 2/10, Validation Loss: 0.0331, Validat
ion Accuracy: 0.7629
Learning Rate: 0.8, Hidden Layer Size: 64, Epoch: 3/10, Validation Loss: 0.0314, Validat
ion Accuracy: 0.7777
Learning Rate: 0.8, Hidden Layer Size: 64, Epoch: 4/10, Validation Loss: 0.0291, Validat
ion Accuracy: 0.7915
Learning Rate: 0.8, Hidden Layer Size: 64, Epoch: 5/10, Validation Loss: 0.0272, Validat
ion Accuracy: 0.8043
Learning Rate: 0.8, Hidden Layer Size: 64, Epoch: 6/10, Validation Loss: 0.0258, Validat
ion Accuracy: 0.8137
Learning Rate: 0.8, Hidden Layer Size: 64, Epoch: 7/10, Validation Loss: 0.0243, Validat
ion Accuracy: 0.8274
Learning Rate: 0.8, Hidden Layer Size: 64, Epoch: 8/10, Validation Loss: 0.0236, Validat
ion Accuracy: 0.8331
Learning Rate: 0.8, Hidden Layer Size: 64, Epoch: 9/10, Validation Loss: 0.0232, Validat
ion Accuracy: 0.8380
Learning Rate: 0.8, Hidden Layer Size: 64, Epoch: 10/10, Validation Loss: 0.0228, Valida
tion Accuracy: 0.8401
Learning Rate: 0.8, Hidden Layer Size: 64, Test Accuracy: 0.8308
Learning Rate: 0.8, Hidden Layer Size: 128, Epoch: 1/10, Validation Loss: 0.0324, Valida
tion Accuracy: 0.7688
Learning Rate: 0.8, Hidden Layer Size: 128, Epoch: 2/10, Validation Loss: 0.0298, Valida
tion Accuracy: 0.7872
Learning Rate: 0.8, Hidden Layer Size: 128, Epoch: 3/10, Validation Loss: 0.0261, Valida
tion Accuracy: 0.8182
Learning Rate: 0.8, Hidden Layer Size: 128, Epoch: 4/10, Validation Loss: 0.0255, Valida
tion Accuracy: 0.8210
Learning Rate: 0.8, Hidden Layer Size: 128, Epoch: 5/10, Validation Loss: 0.0251, Valida
tion Accuracy: 0.8233
Learning Rate: 0.8, Hidden Layer Size: 128, Epoch: 6/10, Validation Loss: 0.0245, Valida
tion Accuracy: 0.8283
Learning Rate: 0.8, Hidden Layer Size: 128, Epoch: 7/10, Validation Loss: 0.0239, Valida
tion Accuracy: 0.8327
Learning Rate: 0.8, Hidden Layer Size: 128, Epoch: 8/10, Validation Loss: 0.0235, Valida
tion Accuracy: 0.8350
Learning Rate: 0.8, Hidden Layer Size: 128, Epoch: 9/10, Validation Loss: 0.0230, Valida
tion Accuracy: 0.8387
Learning Rate: 0.8, Hidden Layer Size: 128, Epoch: 10/10, Validation Loss: 0.0226, Valid
ation Accuracy: 0.8437
Learning Rate: 0.8, Hidden Layer Size: 128, Test Accuracy: 0.8295
Learning Rate: 0.8, Hidden Layer Size: 256, Epoch: 1/10, Validation Loss: 0.0395, Valida
tion Accuracy: 0.7460
Learning Rate: 0.8, Hidden Layer Size: 256, Epoch: 2/10, Validation Loss: 0.0302, Valida
tion Accuracy: 0.7972
Learning Rate: 0.8, Hidden Layer Size: 256, Epoch: 3/10, Validation Loss: 0.0331, Valida
tion Accuracy: 0.7830

```
Learning Rate: 0.8, Hidden Layer Size: 256, Epoch: 4/10, Validation Loss: 0.0316, Valida
tion Accuracy: 0.7913
Learning Rate: 0.8, Hidden Layer Size: 256, Epoch: 5/10, Validation Loss: 0.0316, Valida
tion Accuracy: 0.7916
Learning Rate: 0.8, Hidden Layer Size: 256, Epoch: 6/10, Validation Loss: 0.0307, Valida
tion Accuracy: 0.7984
Learning Rate: 0.8, Hidden Layer Size: 256, Epoch: 7/10, Validation Loss: 0.0292, Valida
tion Accuracy: 0.8077
Learning Rate: 0.8, Hidden Layer Size: 256, Epoch: 8/10, Validation Loss: 0.0284, Valida
tion Accuracy: 0.8117
Learning Rate: 0.8, Hidden Layer Size: 256, Epoch: 9/10, Validation Loss: 0.0273, Valida
tion Accuracy: 0.8217
Learning Rate: 0.8, Hidden Layer Size: 256, Epoch: 10/10, Validation Loss: 0.0271, Valid
ation Accuracy: 0.8226
Learning Rate: 0.8, Hidden Layer Size: 256, Test Accuracy: 0.8058
Learning Rate: 0.9, Hidden Layer Size: 64, Epoch: 1/10, Validation Loss: 0.0376, Validat
ion Accuracy: 0.7308
Learning Rate: 0.9, Hidden Layer Size: 64, Epoch: 2/10, Validation Loss: 0.0326, Validat
ion Accuracy: 0.7640
Learning Rate: 0.9, Hidden Layer Size: 64, Epoch: 3/10, Validation Loss: 0.0288, Validat
ion Accuracy: 0.7923
Learning Rate: 0.9, Hidden Layer Size: 64, Epoch: 4/10, Validation Loss: 0.0253, Validat
ion Accuracy: 0.8190
Learning Rate: 0.9, Hidden Layer Size: 64, Epoch: 5/10, Validation Loss: 0.0242, Validat
ion Accuracy: 0.8281
Learning Rate: 0.9, Hidden Layer Size: 64, Epoch: 6/10, Validation Loss: 0.0237, Validat
ion Accuracy: 0.8311
Learning Rate: 0.9, Hidden Layer Size: 64, Epoch: 7/10, Validation Loss: 0.0233, Validat
ion Accuracy: 0.8343
Learning Rate: 0.9, Hidden Layer Size: 64, Epoch: 8/10, Validation Loss: 0.0228, Validat
ion Accuracy: 0.8380
Learning Rate: 0.9, Hidden Layer Size: 64, Epoch: 9/10, Validation Loss: 0.0225, Validat
ion Accuracy: 0.8423
Learning Rate: 0.9, Hidden Layer Size: 64, Epoch: 10/10, Validation Loss: 0.0222, Valida
tion Accuracy: 0.8436
Learning Rate: 0.9, Hidden Layer Size: 64, Test Accuracy: 0.8293
Learning Rate: 0.9, Hidden Layer Size: 128, Epoch: 1/10, Validation Loss: 0.0360, Valida
tion Accuracy: 0.7462
Learning Rate: 0.9, Hidden Layer Size: 128, Epoch: 2/10, Validation Loss: 0.0318, Valida
tion Accuracy: 0.7728
Learning Rate: 0.9, Hidden Layer Size: 128, Epoch: 3/10, Validation Loss: 0.0294, Valida
tion Accuracy: 0.7907
Learning Rate: 0.9, Hidden Layer Size: 128, Epoch: 4/10, Validation Loss: 0.0275, Valida
tion Accuracy: 0.8039
Learning Rate: 0.9, Hidden Layer Size: 128, Epoch: 5/10, Validation Loss: 0.0258, Valida
tion Accuracy: 0.8171
Learning Rate: 0.9, Hidden Layer Size: 128, Epoch: 6/10, Validation Loss: 0.0248, Valida
tion Accuracy: 0.8254
Learning Rate: 0.9, Hidden Layer Size: 128, Epoch: 7/10, Validation Loss: 0.0239, Valida
tion Accuracy: 0.8309
Learning Rate: 0.9, Hidden Layer Size: 128, Epoch: 8/10, Validation Loss: 0.0232, Valida
tion Accuracy: 0.8362
Learning Rate: 0.9, Hidden Layer Size: 128, Epoch: 9/10, Validation Loss: 0.0226, Valida
tion Accuracy: 0.8407
Learning Rate: 0.9, Hidden Layer Size: 128, Epoch: 10/10, Validation Loss: 0.0221, Valid
ation Accuracy: 0.8456
Learning Rate: 0.9, Hidden Layer Size: 128, Test Accuracy: 0.8361
Learning Rate: 0.9, Hidden Layer Size: 256, Epoch: 1/10, Validation Loss: 0.0364, Valida
tion Accuracy: 0.7656
Learning Rate: 0.9, Hidden Layer Size: 256, Epoch: 2/10, Validation Loss: 0.0429, Valida
tion Accuracy: 0.7365
Learning Rate: 0.9, Hidden Layer Size: 256, Epoch: 3/10, Validation Loss: 0.0381, Valida
tion Accuracy: 0.7563
Learning Rate: 0.9, Hidden Layer Size: 256, Epoch: 4/10, Validation Loss: 0.0379, Valida
tion Accuracy: 0.7594
Learning Rate: 0.9, Hidden Layer Size: 256, Epoch: 5/10, Validation Loss: 0.0344, Valida
```

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tion Accuracy: 0.7760
Learning Rate: 0.9, Hidden Layer Size: 256, Epoch: 6/10, Validation Loss: 0.0329, Valida
tion Accuracy: 0.7849
Learning Rate: 0.9, Hidden Layer Size: 256, Epoch: 7/10, Validation Loss: 0.0282, Valida
tion Accuracy: 0.8145
Learning Rate: 0.9, Hidden Layer Size: 256, Epoch: 8/10, Validation Loss: 0.0290, Valida
tion Accuracy: 0.8103
Learning Rate: 0.9, Hidden Layer Size: 256, Epoch: 9/10, Validation Loss: 0.0282, Valida
tion Accuracy: 0.8137
Learning Rate: 0.9, Hidden Layer Size: 256, Epoch: 10/10, Validation Loss: 0.0281, Valid
ation Accuracy: 0.8143
Learning Rate: 0.9, Hidden Layer Size: 256, Test Accuracy: 0.8087
Learning Rate: 1, Hidden Layer Size: 64, Epoch: 1/10, Validation Loss: 0.0336, Validatio
n Accuracy: 0.7535
Learning Rate: 1, Hidden Layer Size: 64, Epoch: 2/10, Validation Loss: 0.0292, Validatio
n Accuracy: 0.7910
Learning Rate: 1, Hidden Layer Size: 64, Epoch: 3/10, Validation Loss: 0.0279, Validatio
n Accuracy: 0.8034
Learning Rate: 1, Hidden Layer Size: 64, Epoch: 4/10, Validation Loss: 0.0264, Validatio
n Accuracy: 0.8128
Learning Rate: 1, Hidden Layer Size: 64, Epoch: 5/10, Validation Loss: 0.0254, Validatio
n Accuracy: 0.8206
Learning Rate: 1, Hidden Layer Size: 64, Epoch: 6/10, Validation Loss: 0.0244, Validatio
n Accuracy: 0.8293
Learning Rate: 1, Hidden Layer Size: 64, Epoch: 7/10, Validation Loss: 0.0236, Validatio
n Accuracy: 0.8333
Learning Rate: 1, Hidden Layer Size: 64, Epoch: 8/10, Validation Loss: 0.0232, Validatio
n Accuracy: 0.8359
Learning Rate: 1, Hidden Layer Size: 64, Epoch: 9/10, Validation Loss: 0.0229, Validatio
n Accuracy: 0.8378
Learning Rate: 1, Hidden Layer Size: 64, Epoch: 10/10, Validation Loss: 0.0227, Validati
on Accuracy: 0.8409
Learning Rate: 1, Hidden Layer Size: 64, Test Accuracy: 0.8273
Learning Rate: 1, Hidden Layer Size: 128, Epoch: 1/10, Validation Loss: 0.0376, Validati
on Accuracy: 0.7434
Learning Rate: 1, Hidden Layer Size: 128, Epoch: 2/10, Validation Loss: 0.0307, Validati
on Accuracy: 0.7849
Learning Rate: 1, Hidden Layer Size: 128, Epoch: 3/10, Validation Loss: 0.0283, Validati
on Accuracy: 0.8027
Learning Rate: 1, Hidden Layer Size: 128, Epoch: 4/10, Validation Loss: 0.0237, Validati
on Accuracy: 0.8337
Learning Rate: 1, Hidden Layer Size: 128, Epoch: 5/10, Validation Loss: 0.0220, Validati
on Accuracy: 0.8453
Learning Rate: 1, Hidden Layer Size: 128, Epoch: 6/10, Validation Loss: 0.0215, Validati
on Accuracy: 0.8480
Learning Rate: 1, Hidden Layer Size: 128, Epoch: 7/10, Validation Loss: 0.0212, Validati
on Accuracy: 0.8507
Learning Rate: 1, Hidden Layer Size: 128, Epoch: 8/10, Validation Loss: 0.0210, Validati
on Accuracy: 0.8540
Learning Rate: 1, Hidden Layer Size: 128, Epoch: 9/10, Validation Loss: 0.0208, Validati
on Accuracy: 0.8564
Learning Rate: 1, Hidden Layer Size: 128, Epoch: 10/10, Validation Loss: 0.0208, Validat
ion Accuracy: 0.8556
Learning Rate: 1, Hidden Layer Size: 128, Test Accuracy: 0.8421
Learning Rate: 1, Hidden Layer Size: 256, Epoch: 1/10, Validation Loss: 0.0380, Validati
on Accuracy: 0.7613
Learning Rate: 1, Hidden Layer Size: 256, Epoch: 2/10, Validation Loss: 0.0342, Validati
on Accuracy: 0.7732
Learning Rate: 1, Hidden Layer Size: 256, Epoch: 3/10, Validation Loss: 0.0308, Validati
on Accuracy: 0.7966
Learning Rate: 1, Hidden Layer Size: 256, Epoch: 4/10, Validation Loss: 0.0306, Validati
on Accuracy: 0.8002
Learning Rate: 1, Hidden Layer Size: 256, Epoch: 5/10, Validation Loss: 0.0298, Validati
on Accuracy: 0.8048
Learning Rate: 1, Hidden Layer Size: 256, Epoch: 6/10, Validation Loss: 0.0260, Validati
on Accuracy: 0.8268
```

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Learning Rate: 1, Hidden Layer Size: 256, Epoch: 7/10, Validation Loss: 0.0284, Validati
on Accuracy: 0.8141
Learning Rate: 1, Hidden Layer Size: 256, Epoch: 8/10, Validation Loss: 0.0281, Validati
on Accuracy: 0.8156
Learning Rate: 1, Hidden Layer Size: 256, Epoch: 9/10, Validation Loss: 0.0297, Validati
on Accuracy: 0.8058
Learning Rate: 1, Hidden Layer Size: 256, Epoch: 10/10, Validation Loss: 0.0289, Validat
ion Accuracy: 0.8103
Learning Rate: 1, Hidden Layer Size: 256, Test Accuracy: 0.7956
```

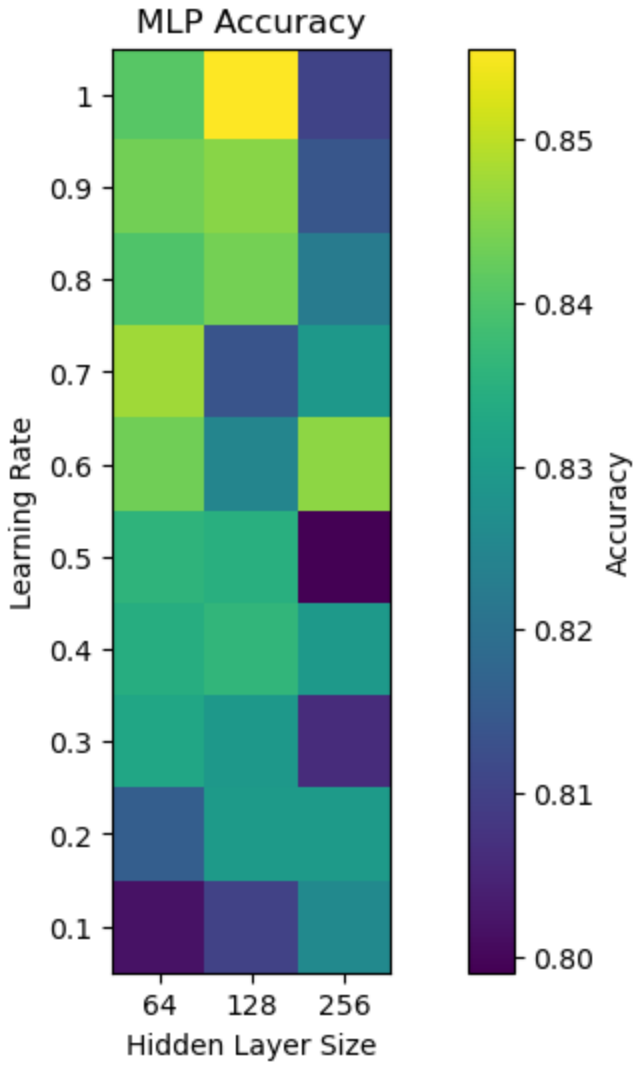

In [7]:

```python
########### RNNs Model #############
import gzip
import numpy as np
import torch
import torch.nn as nn
import torch.optim as optim
from torch.utils.data import DataLoader, TensorDataset
from sklearn.metrics import accuracy_score
import matplotlib.pyplot as plt

# Define function to load Fashion MNIST dataset
def load_data():
    def _load_data(filename, offset):
        with gzip.open(filename, 'rb') as f:
            data = np.frombuffer(f.read(), np.uint8, offset=offset)
        return data

    def _load_labels(filename):
        return _load_data(filename, offset=8)

    def _load_images(filename):
```

```
        images = _load_data(filename, offset=16)
        num_images = images.shape[0] // 784
        images = images.reshape((num_images, 28, 28))
        return images

    train_images = _load_images('train-images-idx3-ubyte.gz')
    train_labels = _load_labels('train-labels-idx1-ubyte.gz')
    test_images = _load_images('t10k-images-idx3-ubyte.gz')
    test_labels = _load_labels('t10k-labels-idx1-ubyte.gz')
    return (train_images, train_labels), (test_images, test_labels)

# Define RNN model
class RNN(nn.Module):
    def __init__(self, input_size, hidden_size, output_size):
        super(RNN, self).__init__()
        self.hidden_size = hidden_size
        self.rnn = nn.RNN(input_size, hidden_size, batch_first=True)
        self.fc = nn.Linear(hidden_size, output_size)

    def forward(self, x):
        out, _ = self.rnn(x)
        out = self.fc(out[:, -1, :])
        return out

# Load Fashion MNIST dataset
(train_images, train_labels), (test_images, test_labels) = load_data()

# Convert data to PyTorch tensors
train_images_tensor = torch.tensor(train_images, dtype=torch.float32)
train_labels_tensor = torch.tensor(train_labels, dtype=torch.long)
test_images_tensor = torch.tensor(test_images, dtype=torch.float32)
test_labels_tensor = torch.tensor(test_labels, dtype=torch.long)

# Create DataLoader
train_dataset = TensorDataset(train_images_tensor, train_labels_tensor)
train_loader = DataLoader(train_dataset, batch_size=64, shuffle=True)

# Define hyperparameters
input_size = train_images.shape[1]  # Assuming images are square
output_size = len(np.unique(train_labels))
hidden_sizes = [64, 128, 256]
learning_rates =  [0.001, 0.002, 0.003, 0.004, 0.005, 0.006, 0.007, 0.008, 0.009, 0.01]
num_epochs = 10

# Initialize dictionaries to store loss and accuracy
train_losses = {hidden_size: {lr: [] for lr in learning_rates} for hidden_size in hidden
test_losses = {hidden_size: {lr: [] for lr in learning_rates} for hidden_size in hidden_
accuracies = {hidden_size: {lr: [] for lr in learning_rates} for hidden_size in hidden_s

# Training loop for different hidden sizes, learning rates, and epochs
for hidden_size in hidden_sizes:
    for learning_rate in learning_rates:
        rnn_model = RNN(input_size, hidden_size, output_size)
        criterion = nn.CrossEntropyLoss()
        optimizer = optim.Adam(rnn_model.parameters(), lr=learning_rate)

        for epoch in range(num_epochs):
            epoch_train_losses = []
            for images, labels in train_loader:
                optimizer.zero_grad()
                output = rnn_model(images)
                loss = criterion(output, labels)
                loss.backward()
                optimizer.step()
                epoch_train_losses.append(loss.item())
```

```
            train_losses[hidden_size][learning_rate].append(np.mean(epoch_train_losses))

            # Evaluate the model
            with torch.no_grad():
                test_output = rnn_model(test_images_tensor)
                test_loss = criterion(test_output, test_labels_tensor)
                test_losses[hidden_size][learning_rate].append(test_loss.item())
                test_predictions = torch.argmax(test_output, axis=1)
                accuracy = accuracy_score(test_labels, test_predictions)
                accuracies[hidden_size][learning_rate].append(accuracy)

            print(f"Hidden Size: {hidden_size}, Learning Rate: {learning_rate}, Epoch: {

# Plotting loss and accuracy for different hidden sizes and learning rates
plt.figure(figsize=(15, 6))
plt.subplot(1, 2, 1)
for hidden_size in hidden_sizes:
    for learning_rate in learning_rates:
        plt.plot(range(1, num_epochs + 1), train_losses[hidden_size][learning_rate], lab
plt.title('Training Loss')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.legend()

plt.subplot(1, 2, 2)
for hidden_size in hidden_sizes:
    for learning_rate in learning_rates:
        plt.plot(range(1, num_epochs + 1), accuracies[hidden_size][learning_rate], label
plt.title('Test Accuracy')
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.legend()

plt.tight_layout()
plt.show()
```

```
Hidden Size: 64, Learning Rate: 0.001, Epoch: 1/10, Test Loss: 1.0144, Test Accuracy: 0.
6214
Hidden Size: 64, Learning Rate: 0.001, Epoch: 2/10, Test Loss: 0.9702, Test Accuracy: 0.
6297
Hidden Size: 64, Learning Rate: 0.001, Epoch: 3/10, Test Loss: 0.9527, Test Accuracy: 0.
6420
Hidden Size: 64, Learning Rate: 0.001, Epoch: 4/10, Test Loss: 0.9297, Test Accuracy: 0.
6447
Hidden Size: 64, Learning Rate: 0.001, Epoch: 5/10, Test Loss: 0.9288, Test Accuracy: 0.
6526
Hidden Size: 64, Learning Rate: 0.001, Epoch: 6/10, Test Loss: 0.9159, Test Accuracy: 0.
6527
Hidden Size: 64, Learning Rate: 0.001, Epoch: 7/10, Test Loss: 0.8900, Test Accuracy: 0.
6668
Hidden Size: 64, Learning Rate: 0.001, Epoch: 8/10, Test Loss: 0.8883, Test Accuracy: 0.
6683
Hidden Size: 64, Learning Rate: 0.001, Epoch: 9/10, Test Loss: 0.8670, Test Accuracy: 0.
6786
Hidden Size: 64, Learning Rate: 0.001, Epoch: 10/10, Test Loss: 0.8729, Test Accuracy:
0.6712
Hidden Size: 64, Learning Rate: 0.002, Epoch: 1/10, Test Loss: 1.0300, Test Accuracy: 0.
6090
Hidden Size: 64, Learning Rate: 0.002, Epoch: 2/10, Test Loss: 0.9790, Test Accuracy: 0.
6279
Hidden Size: 64, Learning Rate: 0.002, Epoch: 3/10, Test Loss: 0.9697, Test Accuracy: 0.
6240
Hidden Size: 64, Learning Rate: 0.002, Epoch: 4/10, Test Loss: 0.9805, Test Accuracy: 0.
6233
Hidden Size: 64, Learning Rate: 0.002, Epoch: 5/10, Test Loss: 0.9708, Test Accuracy: 0.
6278
```

Hidden Size: 64, Learning Rate: 0.002, Epoch: 6/10, Test Loss: 0.9482, Test Accuracy: 0.6385
Hidden Size: 64, Learning Rate: 0.002, Epoch: 7/10, Test Loss: 0.9345, Test Accuracy: 0.6439
Hidden Size: 64, Learning Rate: 0.002, Epoch: 8/10, Test Loss: 0.9325, Test Accuracy: 0.6492
Hidden Size: 64, Learning Rate: 0.002, Epoch: 9/10, Test Loss: 0.9452, Test Accuracy: 0.6422
Hidden Size: 64, Learning Rate: 0.002, Epoch: 10/10, Test Loss: 0.9371, Test Accuracy: 0.6373
Hidden Size: 64, Learning Rate: 0.003, Epoch: 1/10, Test Loss: 1.0533, Test Accuracy: 0.6036
Hidden Size: 64, Learning Rate: 0.003, Epoch: 2/10, Test Loss: 1.0056, Test Accuracy: 0.6131
Hidden Size: 64, Learning Rate: 0.003, Epoch: 3/10, Test Loss: 1.0186, Test Accuracy: 0.6104
Hidden Size: 64, Learning Rate: 0.003, Epoch: 4/10, Test Loss: 0.9905, Test Accuracy: 0.6267
Hidden Size: 64, Learning Rate: 0.003, Epoch: 5/10, Test Loss: 1.0010, Test Accuracy: 0.6136
Hidden Size: 64, Learning Rate: 0.003, Epoch: 6/10, Test Loss: 1.0034, Test Accuracy: 0.6157
Hidden Size: 64, Learning Rate: 0.003, Epoch: 7/10, Test Loss: 0.9977, Test Accuracy: 0.6190
Hidden Size: 64, Learning Rate: 0.003, Epoch: 8/10, Test Loss: 0.9753, Test Accuracy: 0.6334
Hidden Size: 64, Learning Rate: 0.003, Epoch: 9/10, Test Loss: 0.9875, Test Accuracy: 0.6305
Hidden Size: 64, Learning Rate: 0.003, Epoch: 10/10, Test Loss: 1.0016, Test Accuracy: 0.6105
Hidden Size: 64, Learning Rate: 0.004, Epoch: 1/10, Test Loss: 1.0922, Test Accuracy: 0.5883
Hidden Size: 64, Learning Rate: 0.004, Epoch: 2/10, Test Loss: 1.0726, Test Accuracy: 0.5909
Hidden Size: 64, Learning Rate: 0.004, Epoch: 3/10, Test Loss: 1.0385, Test Accuracy: 0.6081
Hidden Size: 64, Learning Rate: 0.004, Epoch: 4/10, Test Loss: 1.0138, Test Accuracy: 0.6058
Hidden Size: 64, Learning Rate: 0.004, Epoch: 5/10, Test Loss: 1.0121, Test Accuracy: 0.6182
Hidden Size: 64, Learning Rate: 0.004, Epoch: 6/10, Test Loss: 1.0021, Test Accuracy: 0.6228
Hidden Size: 64, Learning Rate: 0.004, Epoch: 7/10, Test Loss: 1.0223, Test Accuracy: 0.6061
Hidden Size: 64, Learning Rate: 0.004, Epoch: 8/10, Test Loss: 1.0326, Test Accuracy: 0.5926
Hidden Size: 64, Learning Rate: 0.004, Epoch: 9/10, Test Loss: 1.0299, Test Accuracy: 0.6015
Hidden Size: 64, Learning Rate: 0.004, Epoch: 10/10, Test Loss: 1.0089, Test Accuracy: 0.6100
Hidden Size: 64, Learning Rate: 0.005, Epoch: 1/10, Test Loss: 1.1404, Test Accuracy: 0.5631
Hidden Size: 64, Learning Rate: 0.005, Epoch: 2/10, Test Loss: 1.0811, Test Accuracy: 0.5884
Hidden Size: 64, Learning Rate: 0.005, Epoch: 3/10, Test Loss: 1.0299, Test Accuracy: 0.5978
Hidden Size: 64, Learning Rate: 0.005, Epoch: 4/10, Test Loss: 1.0579, Test Accuracy: 0.5851
Hidden Size: 64, Learning Rate: 0.005, Epoch: 5/10, Test Loss: 1.0450, Test Accuracy: 0.6013
Hidden Size: 64, Learning Rate: 0.005, Epoch: 6/10, Test Loss: 1.0175, Test Accuracy: 0.6020
Hidden Size: 64, Learning Rate: 0.005, Epoch: 7/10, Test Loss: 1.0201, Test Accuracy: 0.6072
Hidden Size: 64, Learning Rate: 0.005, Epoch: 8/10, Test Loss: 1.0650, Test Accuracy: 0.5898

Hidden Size: 64, Learning Rate: 0.005, Epoch: 9/10, Test Loss: 1.0120, Test Accuracy: 0.6062
Hidden Size: 64, Learning Rate: 0.005, Epoch: 10/10, Test Loss: 1.0196, Test Accuracy: 0.6116
Hidden Size: 64, Learning Rate: 0.006, Epoch: 1/10, Test Loss: 1.1262, Test Accuracy: 0.5603
Hidden Size: 64, Learning Rate: 0.006, Epoch: 2/10, Test Loss: 1.1178, Test Accuracy: 0.5502
Hidden Size: 64, Learning Rate: 0.006, Epoch: 3/10, Test Loss: 1.0778, Test Accuracy: 0.5851
Hidden Size: 64, Learning Rate: 0.006, Epoch: 4/10, Test Loss: 1.0609, Test Accuracy: 0.6036
Hidden Size: 64, Learning Rate: 0.006, Epoch: 5/10, Test Loss: 1.0692, Test Accuracy: 0.5816
Hidden Size: 64, Learning Rate: 0.006, Epoch: 6/10, Test Loss: 1.0841, Test Accuracy: 0.5824
Hidden Size: 64, Learning Rate: 0.006, Epoch: 7/10, Test Loss: 1.1273, Test Accuracy: 0.5644
Hidden Size: 64, Learning Rate: 0.006, Epoch: 8/10, Test Loss: 1.0642, Test Accuracy: 0.5930
Hidden Size: 64, Learning Rate: 0.006, Epoch: 9/10, Test Loss: 1.0627, Test Accuracy: 0.5956
Hidden Size: 64, Learning Rate: 0.006, Epoch: 10/10, Test Loss: 1.0622, Test Accuracy: 0.5892
Hidden Size: 64, Learning Rate: 0.007, Epoch: 1/10, Test Loss: 1.1474, Test Accuracy: 0.5624
Hidden Size: 64, Learning Rate: 0.007, Epoch: 2/10, Test Loss: 1.1154, Test Accuracy: 0.5627
Hidden Size: 64, Learning Rate: 0.007, Epoch: 3/10, Test Loss: 1.1090, Test Accuracy: 0.5715
Hidden Size: 64, Learning Rate: 0.007, Epoch: 4/10, Test Loss: 1.0529, Test Accuracy: 0.5951
Hidden Size: 64, Learning Rate: 0.007, Epoch: 5/10, Test Loss: 1.1072, Test Accuracy: 0.5636
Hidden Size: 64, Learning Rate: 0.007, Epoch: 6/10, Test Loss: 1.0826, Test Accuracy: 0.5845
Hidden Size: 64, Learning Rate: 0.007, Epoch: 7/10, Test Loss: 1.0930, Test Accuracy: 0.5719
Hidden Size: 64, Learning Rate: 0.007, Epoch: 8/10, Test Loss: 1.0805, Test Accuracy: 0.5884
Hidden Size: 64, Learning Rate: 0.007, Epoch: 9/10, Test Loss: 1.0711, Test Accuracy: 0.5751
Hidden Size: 64, Learning Rate: 0.007, Epoch: 10/10, Test Loss: 1.0783, Test Accuracy: 0.5879
Hidden Size: 64, Learning Rate: 0.008, Epoch: 1/10, Test Loss: 1.1282, Test Accuracy: 0.5638
Hidden Size: 64, Learning Rate: 0.008, Epoch: 2/10, Test Loss: 1.1270, Test Accuracy: 0.5454
Hidden Size: 64, Learning Rate: 0.008, Epoch: 3/10, Test Loss: 1.1238, Test Accuracy: 0.5567
Hidden Size: 64, Learning Rate: 0.008, Epoch: 4/10, Test Loss: 1.1134, Test Accuracy: 0.5620
Hidden Size: 64, Learning Rate: 0.008, Epoch: 5/10, Test Loss: 1.1128, Test Accuracy: 0.5742
Hidden Size: 64, Learning Rate: 0.008, Epoch: 6/10, Test Loss: 1.1339, Test Accuracy: 0.5525
Hidden Size: 64, Learning Rate: 0.008, Epoch: 7/10, Test Loss: 1.1375, Test Accuracy: 0.5637
Hidden Size: 64, Learning Rate: 0.008, Epoch: 8/10, Test Loss: 1.0885, Test Accuracy: 0.5715
Hidden Size: 64, Learning Rate: 0.008, Epoch: 9/10, Test Loss: 1.1129, Test Accuracy: 0.5733
Hidden Size: 64, Learning Rate: 0.008, Epoch: 10/10, Test Loss: 1.1268, Test Accuracy: 0.5432
Hidden Size: 64, Learning Rate: 0.009, Epoch: 1/10, Test Loss: 1.1631, Test Accuracy: 0.5586

Hidden Size: 64, Learning Rate: 0.009, Epoch: 2/10, Test Loss: 1.1515, Test Accuracy: 0.5576
Hidden Size: 64, Learning Rate: 0.009, Epoch: 3/10, Test Loss: 1.1899, Test Accuracy: 0.5362
Hidden Size: 64, Learning Rate: 0.009, Epoch: 4/10, Test Loss: 1.1546, Test Accuracy: 0.5567
Hidden Size: 64, Learning Rate: 0.009, Epoch: 5/10, Test Loss: 1.1633, Test Accuracy: 0.5508
Hidden Size: 64, Learning Rate: 0.009, Epoch: 6/10, Test Loss: 1.1137, Test Accuracy: 0.5477
Hidden Size: 64, Learning Rate: 0.009, Epoch: 7/10, Test Loss: 1.1194, Test Accuracy: 0.5702
Hidden Size: 64, Learning Rate: 0.009, Epoch: 8/10, Test Loss: 1.1373, Test Accuracy: 0.5658
Hidden Size: 64, Learning Rate: 0.009, Epoch: 9/10, Test Loss: 1.1183, Test Accuracy: 0.5570
Hidden Size: 64, Learning Rate: 0.009, Epoch: 10/10, Test Loss: 1.0867, Test Accuracy: 0.5748
Hidden Size: 64, Learning Rate: 0.01, Epoch: 1/10, Test Loss: 1.2697, Test Accuracy: 0.5194
Hidden Size: 64, Learning Rate: 0.01, Epoch: 2/10, Test Loss: 1.1886, Test Accuracy: 0.5283
Hidden Size: 64, Learning Rate: 0.01, Epoch: 3/10, Test Loss: 1.1305, Test Accuracy: 0.5524
Hidden Size: 64, Learning Rate: 0.01, Epoch: 4/10, Test Loss: 1.1490, Test Accuracy: 0.5545
Hidden Size: 64, Learning Rate: 0.01, Epoch: 5/10, Test Loss: 1.1639, Test Accuracy: 0.5379
Hidden Size: 64, Learning Rate: 0.01, Epoch: 6/10, Test Loss: 1.1642, Test Accuracy: 0.5649
Hidden Size: 64, Learning Rate: 0.01, Epoch: 7/10, Test Loss: 1.1539, Test Accuracy: 0.5401
Hidden Size: 64, Learning Rate: 0.01, Epoch: 8/10, Test Loss: 1.1131, Test Accuracy: 0.5732
Hidden Size: 64, Learning Rate: 0.01, Epoch: 9/10, Test Loss: 1.1526, Test Accuracy: 0.5532
Hidden Size: 64, Learning Rate: 0.01, Epoch: 10/10, Test Loss: 1.1402, Test Accuracy: 0.5532
Hidden Size: 128, Learning Rate: 0.001, Epoch: 1/10, Test Loss: 0.9563, Test Accuracy: 0.6415
Hidden Size: 128, Learning Rate: 0.001, Epoch: 2/10, Test Loss: 0.9211, Test Accuracy: 0.6514
Hidden Size: 128, Learning Rate: 0.001, Epoch: 3/10, Test Loss: 0.8836, Test Accuracy: 0.6686
Hidden Size: 128, Learning Rate: 0.001, Epoch: 4/10, Test Loss: 0.8935, Test Accuracy: 0.6635
Hidden Size: 128, Learning Rate: 0.001, Epoch: 5/10, Test Loss: 0.8823, Test Accuracy: 0.6686
Hidden Size: 128, Learning Rate: 0.001, Epoch: 6/10, Test Loss: 0.8666, Test Accuracy: 0.6749
Hidden Size: 128, Learning Rate: 0.001, Epoch: 7/10, Test Loss: 0.8664, Test Accuracy: 0.6767
Hidden Size: 128, Learning Rate: 0.001, Epoch: 8/10, Test Loss: 0.8664, Test Accuracy: 0.6706
Hidden Size: 128, Learning Rate: 0.001, Epoch: 9/10, Test Loss: 0.8549, Test Accuracy: 0.6827
Hidden Size: 128, Learning Rate: 0.001, Epoch: 10/10, Test Loss: 0.8486, Test Accuracy: 0.6840
Hidden Size: 128, Learning Rate: 0.002, Epoch: 1/10, Test Loss: 1.0025, Test Accuracy: 0.6204
Hidden Size: 128, Learning Rate: 0.002, Epoch: 2/10, Test Loss: 1.0100, Test Accuracy: 0.6164
Hidden Size: 128, Learning Rate: 0.002, Epoch: 3/10, Test Loss: 0.9532, Test Accuracy: 0.6390
Hidden Size: 128, Learning Rate: 0.002, Epoch: 4/10, Test Loss: 0.9437, Test Accuracy: 0.6366

```
Hidden Size: 128, Learning Rate: 0.002, Epoch: 5/10, Test Loss: 0.9569, Test Accuracy:
0.6409
Hidden Size: 128, Learning Rate: 0.002, Epoch: 6/10, Test Loss: 0.9609, Test Accuracy:
0.6328
Hidden Size: 128, Learning Rate: 0.002, Epoch: 7/10, Test Loss: 0.9226, Test Accuracy:
0.6459
Hidden Size: 128, Learning Rate: 0.002, Epoch: 8/10, Test Loss: 0.9247, Test Accuracy:
0.6499
Hidden Size: 128, Learning Rate: 0.002, Epoch: 9/10, Test Loss: 0.9231, Test Accuracy:
0.6532
Hidden Size: 128, Learning Rate: 0.002, Epoch: 10/10, Test Loss: 0.9382, Test Accuracy:
0.6453
Hidden Size: 128, Learning Rate: 0.003, Epoch: 1/10, Test Loss: 1.0204, Test Accuracy:
0.6116
Hidden Size: 128, Learning Rate: 0.003, Epoch: 2/10, Test Loss: 0.9877, Test Accuracy:
0.6158
Hidden Size: 128, Learning Rate: 0.003, Epoch: 3/10, Test Loss: 0.9919, Test Accuracy:
0.6245
Hidden Size: 128, Learning Rate: 0.003, Epoch: 4/10, Test Loss: 0.9684, Test Accuracy:
0.6272
Hidden Size: 128, Learning Rate: 0.003, Epoch: 5/10, Test Loss: 0.9758, Test Accuracy:
0.6310
Hidden Size: 128, Learning Rate: 0.003, Epoch: 6/10, Test Loss: 0.9795, Test Accuracy:
0.6275
Hidden Size: 128, Learning Rate: 0.003, Epoch: 7/10, Test Loss: 0.9849, Test Accuracy:
0.6279
Hidden Size: 128, Learning Rate: 0.003, Epoch: 8/10, Test Loss: 0.9891, Test Accuracy:
0.6163
Hidden Size: 128, Learning Rate: 0.003, Epoch: 9/10, Test Loss: 0.9820, Test Accuracy:
0.6297
Hidden Size: 128, Learning Rate: 0.003, Epoch: 10/10, Test Loss: 0.9531, Test Accuracy:
0.6434
Hidden Size: 128, Learning Rate: 0.004, Epoch: 1/10, Test Loss: 1.0479, Test Accuracy:
0.5870
Hidden Size: 128, Learning Rate: 0.004, Epoch: 2/10, Test Loss: 1.0302, Test Accuracy:
0.6095
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0.5582
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0.6136
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0.6191
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0.6045
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0.6003
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0.5975
Hidden Size: 128, Learning Rate: 0.004, Epoch: 9/10, Test Loss: 1.0156, Test Accuracy:
0.6119
Hidden Size: 128, Learning Rate: 0.004, Epoch: 10/10, Test Loss: 1.0561, Test Accuracy:
0.5840
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0.5868
Hidden Size: 128, Learning Rate: 0.005, Epoch: 2/10, Test Loss: 1.0656, Test Accuracy:
0.5945
Hidden Size: 128, Learning Rate: 0.005, Epoch: 3/10, Test Loss: 1.0657, Test Accuracy:
0.5920
Hidden Size: 128, Learning Rate: 0.005, Epoch: 4/10, Test Loss: 1.0910, Test Accuracy:
0.5818
Hidden Size: 128, Learning Rate: 0.005, Epoch: 5/10, Test Loss: 1.0408, Test Accuracy:
0.6040
Hidden Size: 128, Learning Rate: 0.005, Epoch: 6/10, Test Loss: 1.0777, Test Accuracy:
0.5942
Hidden Size: 128, Learning Rate: 0.005, Epoch: 7/10, Test Loss: 1.0676, Test Accuracy:
0.5970
```

Hidden Size: 128, Learning Rate: 0.005, Epoch: 8/10, Test Loss: 1.0485, Test Accuracy: 0.6024
Hidden Size: 128, Learning Rate: 0.005, Epoch: 9/10, Test Loss: 1.0478, Test Accuracy: 0.6031
Hidden Size: 128, Learning Rate: 0.005, Epoch: 10/10, Test Loss: 1.0429, Test Accuracy: 0.6001
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Hidden Size: 128, Learning Rate: 0.006, Epoch: 2/10, Test Loss: 1.1164, Test Accuracy: 0.5697
Hidden Size: 128, Learning Rate: 0.006, Epoch: 3/10, Test Loss: 1.0761, Test Accuracy: 0.5813
Hidden Size: 128, Learning Rate: 0.006, Epoch: 4/10, Test Loss: 1.1300, Test Accuracy: 0.5701
Hidden Size: 128, Learning Rate: 0.006, Epoch: 5/10, Test Loss: 1.0874, Test Accuracy: 0.5757
Hidden Size: 128, Learning Rate: 0.006, Epoch: 6/10, Test Loss: 1.1086, Test Accuracy: 0.5822
Hidden Size: 128, Learning Rate: 0.006, Epoch: 7/10, Test Loss: 1.0645, Test Accuracy: 0.5980
Hidden Size: 128, Learning Rate: 0.006, Epoch: 8/10, Test Loss: 1.0822, Test Accuracy: 0.5786
Hidden Size: 128, Learning Rate: 0.006, Epoch: 9/10, Test Loss: 1.1036, Test Accuracy: 0.5824
Hidden Size: 128, Learning Rate: 0.006, Epoch: 10/10, Test Loss: 1.0935, Test Accuracy: 0.5755
Hidden Size: 128, Learning Rate: 0.007, Epoch: 1/10, Test Loss: 1.1191, Test Accuracy: 0.5762
Hidden Size: 128, Learning Rate: 0.007, Epoch: 2/10, Test Loss: 1.1220, Test Accuracy: 0.5609
Hidden Size: 128, Learning Rate: 0.007, Epoch: 3/10, Test Loss: 1.1140, Test Accuracy: 0.5772
Hidden Size: 128, Learning Rate: 0.007, Epoch: 4/10, Test Loss: 1.2013, Test Accuracy: 0.5476
Hidden Size: 128, Learning Rate: 0.007, Epoch: 5/10, Test Loss: 1.0999, Test Accuracy: 0.5710
Hidden Size: 128, Learning Rate: 0.007, Epoch: 6/10, Test Loss: 1.1391, Test Accuracy: 0.5624
Hidden Size: 128, Learning Rate: 0.007, Epoch: 7/10, Test Loss: 1.1832, Test Accuracy: 0.5276
Hidden Size: 128, Learning Rate: 0.007, Epoch: 8/10, Test Loss: 1.1428, Test Accuracy: 0.5757
Hidden Size: 128, Learning Rate: 0.007, Epoch: 9/10, Test Loss: 1.0928, Test Accuracy: 0.5572
Hidden Size: 128, Learning Rate: 0.007, Epoch: 10/10, Test Loss: 1.0916, Test Accuracy: 0.5867
Hidden Size: 128, Learning Rate: 0.008, Epoch: 1/10, Test Loss: 1.1279, Test Accuracy: 0.5666
Hidden Size: 128, Learning Rate: 0.008, Epoch: 2/10, Test Loss: 1.1301, Test Accuracy: 0.5714
Hidden Size: 128, Learning Rate: 0.008, Epoch: 3/10, Test Loss: 1.1836, Test Accuracy: 0.5235
Hidden Size: 128, Learning Rate: 0.008, Epoch: 4/10, Test Loss: 1.1789, Test Accuracy: 0.5359
Hidden Size: 128, Learning Rate: 0.008, Epoch: 5/10, Test Loss: 1.1674, Test Accuracy: 0.5359
Hidden Size: 128, Learning Rate: 0.008, Epoch: 6/10, Test Loss: 1.1551, Test Accuracy: 0.5499
Hidden Size: 128, Learning Rate: 0.008, Epoch: 7/10, Test Loss: 1.1776, Test Accuracy: 0.5332
Hidden Size: 128, Learning Rate: 0.008, Epoch: 8/10, Test Loss: 1.1741, Test Accuracy: 0.5283
Hidden Size: 128, Learning Rate: 0.008, Epoch: 9/10, Test Loss: 1.1158, Test Accuracy: 0.5505
Hidden Size: 128, Learning Rate: 0.008, Epoch: 10/10, Test Loss: 1.1837, Test Accuracy: 0.5200

```
Hidden Size: 128, Learning Rate: 0.009, Epoch: 1/10, Test Loss: 1.1591, Test Accuracy:
0.5676
Hidden Size: 128, Learning Rate: 0.009, Epoch: 2/10, Test Loss: 1.1629, Test Accuracy:
0.5548
Hidden Size: 128, Learning Rate: 0.009, Epoch: 3/10, Test Loss: 1.1658, Test Accuracy:
0.5573
Hidden Size: 128, Learning Rate: 0.009, Epoch: 4/10, Test Loss: 1.1653, Test Accuracy:
0.5324
Hidden Size: 128, Learning Rate: 0.009, Epoch: 5/10, Test Loss: 1.1336, Test Accuracy:
0.5536
Hidden Size: 128, Learning Rate: 0.009, Epoch: 6/10, Test Loss: 1.1918, Test Accuracy:
0.5334
Hidden Size: 128, Learning Rate: 0.009, Epoch: 7/10, Test Loss: 1.1605, Test Accuracy:
0.5518
Hidden Size: 128, Learning Rate: 0.009, Epoch: 8/10, Test Loss: 1.1533, Test Accuracy:
0.5391
Hidden Size: 128, Learning Rate: 0.009, Epoch: 9/10, Test Loss: 1.1583, Test Accuracy:
0.5685
Hidden Size: 128, Learning Rate: 0.009, Epoch: 10/10, Test Loss: 1.1215, Test Accuracy:
0.5730
Hidden Size: 128, Learning Rate: 0.01, Epoch: 1/10, Test Loss: 1.2597, Test Accuracy: 0.
5243
Hidden Size: 128, Learning Rate: 0.01, Epoch: 2/10, Test Loss: 1.2765, Test Accuracy: 0.
4714
Hidden Size: 128, Learning Rate: 0.01, Epoch: 3/10, Test Loss: 1.2083, Test Accuracy: 0.
5266
Hidden Size: 128, Learning Rate: 0.01, Epoch: 4/10, Test Loss: 1.3513, Test Accuracy: 0.
4366
Hidden Size: 128, Learning Rate: 0.01, Epoch: 5/10, Test Loss: 1.2216, Test Accuracy: 0.
4711
Hidden Size: 128, Learning Rate: 0.01, Epoch: 6/10, Test Loss: 1.2824, Test Accuracy: 0.
4635
Hidden Size: 128, Learning Rate: 0.01, Epoch: 7/10, Test Loss: 1.4225, Test Accuracy: 0.
4520
Hidden Size: 128, Learning Rate: 0.01, Epoch: 8/10, Test Loss: 1.4066, Test Accuracy: 0.
4542
Hidden Size: 128, Learning Rate: 0.01, Epoch: 9/10, Test Loss: 1.2335, Test Accuracy: 0.
4709
Hidden Size: 128, Learning Rate: 0.01, Epoch: 10/10, Test Loss: 1.2360, Test Accuracy:
0.5083
Hidden Size: 256, Learning Rate: 0.001, Epoch: 1/10, Test Loss: 0.9108, Test Accuracy:
0.6502
Hidden Size: 256, Learning Rate: 0.001, Epoch: 2/10, Test Loss: 0.8908, Test Accuracy:
0.6665
Hidden Size: 256, Learning Rate: 0.001, Epoch: 3/10, Test Loss: 0.8637, Test Accuracy:
0.6738
Hidden Size: 256, Learning Rate: 0.001, Epoch: 4/10, Test Loss: 0.8491, Test Accuracy:
0.6805
Hidden Size: 256, Learning Rate: 0.001, Epoch: 5/10, Test Loss: 0.8525, Test Accuracy:
0.6807
Hidden Size: 256, Learning Rate: 0.001, Epoch: 6/10, Test Loss: 0.8458, Test Accuracy:
0.6825
Hidden Size: 256, Learning Rate: 0.001, Epoch: 7/10, Test Loss: 0.8282, Test Accuracy:
0.6876
Hidden Size: 256, Learning Rate: 0.001, Epoch: 8/10, Test Loss: 0.8443, Test Accuracy:
0.6809
Hidden Size: 256, Learning Rate: 0.001, Epoch: 9/10, Test Loss: 0.8297, Test Accuracy:
0.6778
Hidden Size: 256, Learning Rate: 0.001, Epoch: 10/10, Test Loss: 0.8346, Test Accuracy:
0.6811
Hidden Size: 256, Learning Rate: 0.002, Epoch: 1/10, Test Loss: 1.0504, Test Accuracy:
0.6119
Hidden Size: 256, Learning Rate: 0.002, Epoch: 2/10, Test Loss: 0.9616, Test Accuracy:
0.6324
Hidden Size: 256, Learning Rate: 0.002, Epoch: 3/10, Test Loss: 0.9614, Test Accuracy:
0.6335
```

Hidden Size: 256, Learning Rate: 0.002, Epoch: 4/10, Test Loss: 0.9277, Test Accuracy: 0.6377
Hidden Size: 256, Learning Rate: 0.002, Epoch: 5/10, Test Loss: 0.9511, Test Accuracy: 0.6435
Hidden Size: 256, Learning Rate: 0.002, Epoch: 6/10, Test Loss: 0.9331, Test Accuracy: 0.6483
Hidden Size: 256, Learning Rate: 0.002, Epoch: 7/10, Test Loss: 0.9403, Test Accuracy: 0.6345
Hidden Size: 256, Learning Rate: 0.002, Epoch: 8/10, Test Loss: 0.9368, Test Accuracy: 0.6504
Hidden Size: 256, Learning Rate: 0.002, Epoch: 9/10, Test Loss: 0.9231, Test Accuracy: 0.6517
Hidden Size: 256, Learning Rate: 0.002, Epoch: 10/10, Test Loss: 0.9459, Test Accuracy: 0.6461
Hidden Size: 256, Learning Rate: 0.003, Epoch: 1/10, Test Loss: 1.0010, Test Accuracy: 0.6227
Hidden Size: 256, Learning Rate: 0.003, Epoch: 2/10, Test Loss: 1.0319, Test Accuracy: 0.6040
Hidden Size: 256, Learning Rate: 0.003, Epoch: 3/10, Test Loss: 1.0696, Test Accuracy: 0.5891
Hidden Size: 256, Learning Rate: 0.003, Epoch: 4/10, Test Loss: 1.0318, Test Accuracy: 0.6190
Hidden Size: 256, Learning Rate: 0.003, Epoch: 5/10, Test Loss: 1.0203, Test Accuracy: 0.6037
Hidden Size: 256, Learning Rate: 0.003, Epoch: 6/10, Test Loss: 0.9860, Test Accuracy: 0.6234
Hidden Size: 256, Learning Rate: 0.003, Epoch: 7/10, Test Loss: 1.0030, Test Accuracy: 0.6226
Hidden Size: 256, Learning Rate: 0.003, Epoch: 8/10, Test Loss: 0.9936, Test Accuracy: 0.6262
Hidden Size: 256, Learning Rate: 0.003, Epoch: 9/10, Test Loss: 0.9750, Test Accuracy: 0.6323
Hidden Size: 256, Learning Rate: 0.003, Epoch: 10/10, Test Loss: 0.9844, Test Accuracy: 0.6181
Hidden Size: 256, Learning Rate: 0.004, Epoch: 1/10, Test Loss: 1.1739, Test Accuracy: 0.5276
Hidden Size: 256, Learning Rate: 0.004, Epoch: 2/10, Test Loss: 1.0803, Test Accuracy: 0.5871
Hidden Size: 256, Learning Rate: 0.004, Epoch: 3/10, Test Loss: 1.0395, Test Accuracy: 0.5920
Hidden Size: 256, Learning Rate: 0.004, Epoch: 4/10, Test Loss: 1.0546, Test Accuracy: 0.5982
Hidden Size: 256, Learning Rate: 0.004, Epoch: 5/10, Test Loss: 1.0345, Test Accuracy: 0.6057
Hidden Size: 256, Learning Rate: 0.004, Epoch: 6/10, Test Loss: 1.0263, Test Accuracy: 0.6074
Hidden Size: 256, Learning Rate: 0.004, Epoch: 7/10, Test Loss: 1.1539, Test Accuracy: 0.5577
Hidden Size: 256, Learning Rate: 0.004, Epoch: 8/10, Test Loss: 1.0452, Test Accuracy: 0.6080
Hidden Size: 256, Learning Rate: 0.004, Epoch: 9/10, Test Loss: 1.0548, Test Accuracy: 0.5992
Hidden Size: 256, Learning Rate: 0.004, Epoch: 10/10, Test Loss: 1.0701, Test Accuracy: 0.5788
Hidden Size: 256, Learning Rate: 0.005, Epoch: 1/10, Test Loss: 1.1449, Test Accuracy: 0.5648
Hidden Size: 256, Learning Rate: 0.005, Epoch: 2/10, Test Loss: 1.0856, Test Accuracy: 0.5936
Hidden Size: 256, Learning Rate: 0.005, Epoch: 3/10, Test Loss: 1.0819, Test Accuracy: 0.5637
Hidden Size: 256, Learning Rate: 0.005, Epoch: 4/10, Test Loss: 1.0953, Test Accuracy: 0.5660
Hidden Size: 256, Learning Rate: 0.005, Epoch: 5/10, Test Loss: 1.0861, Test Accuracy: 0.5911
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Hidden Size: 256, Learning Rate: 0.005, Epoch: 7/10, Test Loss: 1.1153, Test Accuracy: 0.5625
Hidden Size: 256, Learning Rate: 0.005, Epoch: 8/10, Test Loss: 1.1069, Test Accuracy: 0.5833
Hidden Size: 256, Learning Rate: 0.005, Epoch: 9/10, Test Loss: 1.1072, Test Accuracy: 0.5659
Hidden Size: 256, Learning Rate: 0.005, Epoch: 10/10, Test Loss: 1.1181, Test Accuracy: 0.5624
Hidden Size: 256, Learning Rate: 0.006, Epoch: 1/10, Test Loss: 1.1757, Test Accuracy: 0.5630
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Hidden Size: 256, Learning Rate: 0.006, Epoch: 6/10, Test Loss: 1.2216, Test Accuracy: 0.4896
Hidden Size: 256, Learning Rate: 0.006, Epoch: 7/10, Test Loss: 1.3180, Test Accuracy: 0.4633
Hidden Size: 256, Learning Rate: 0.006, Epoch: 8/10, Test Loss: 1.2414, Test Accuracy: 0.4915
Hidden Size: 256, Learning Rate: 0.006, Epoch: 9/10, Test Loss: 1.3222, Test Accuracy: 0.4613
Hidden Size: 256, Learning Rate: 0.006, Epoch: 10/10, Test Loss: 1.2403, Test Accuracy: 0.4973
Hidden Size: 256, Learning Rate: 0.007, Epoch: 1/10, Test Loss: 1.1966, Test Accuracy: 0.5136
Hidden Size: 256, Learning Rate: 0.007, Epoch: 2/10, Test Loss: 1.1892, Test Accuracy: 0.5482
Hidden Size: 256, Learning Rate: 0.007, Epoch: 3/10, Test Loss: 1.3062, Test Accuracy: 0.4594
Hidden Size: 256, Learning Rate: 0.007, Epoch: 4/10, Test Loss: 1.2977, Test Accuracy: 0.5064
Hidden Size: 256, Learning Rate: 0.007, Epoch: 5/10, Test Loss: 1.2760, Test Accuracy: 0.4818
Hidden Size: 256, Learning Rate: 0.007, Epoch: 6/10, Test Loss: 1.3489, Test Accuracy: 0.4479
Hidden Size: 256, Learning Rate: 0.007, Epoch: 7/10, Test Loss: 1.4006, Test Accuracy: 0.3959
Hidden Size: 256, Learning Rate: 0.007, Epoch: 8/10, Test Loss: 1.2955, Test Accuracy: 0.4927
Hidden Size: 256, Learning Rate: 0.007, Epoch: 9/10, Test Loss: 1.3269, Test Accuracy: 0.4651
Hidden Size: 256, Learning Rate: 0.007, Epoch: 10/10, Test Loss: 1.3032, Test Accuracy: 0.5002
Hidden Size: 256, Learning Rate: 0.008, Epoch: 1/10, Test Loss: 1.3150, Test Accuracy: 0.4457
Hidden Size: 256, Learning Rate: 0.008, Epoch: 2/10, Test Loss: 1.3155, Test Accuracy: 0.4427
Hidden Size: 256, Learning Rate: 0.008, Epoch: 3/10, Test Loss: 1.3510, Test Accuracy: 0.4718
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Hidden Size: 256, Learning Rate: 0.008, Epoch: 6/10, Test Loss: 1.4111, Test Accuracy: 0.4054
Hidden Size: 256, Learning Rate: 0.008, Epoch: 7/10, Test Loss: 1.3964, Test Accuracy: 0.4518
Hidden Size: 256, Learning Rate: 0.008, Epoch: 8/10, Test Loss: 1.3120, Test Accuracy: 0.4748
Hidden Size: 256, Learning Rate: 0.008, Epoch: 9/10, Test Loss: 1.4242, Test Accuracy: 0.4053

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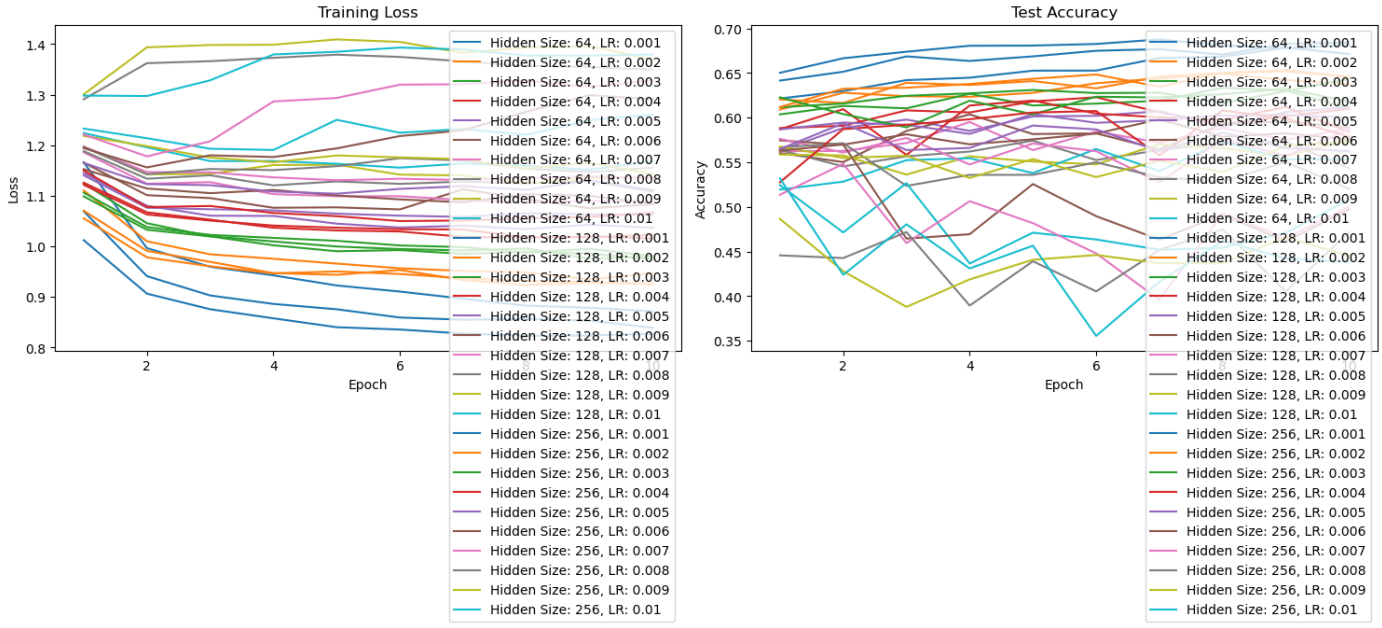
Hidden Size: 256, Learning Rate: 0.008, Epoch: 10/10, Test Loss: 1.3486, Test Accuracy:
0.4717
Hidden Size: 256, Learning Rate: 0.009, Epoch: 1/10, Test Loss: 1.3740, Test Accuracy:
0.4866
Hidden Size: 256, Learning Rate: 0.009, Epoch: 2/10, Test Loss: 1.4482, Test Accuracy:
0.4280
Hidden Size: 256, Learning Rate: 0.009, Epoch: 3/10, Test Loss: 1.4147, Test Accuracy:
0.3880
Hidden Size: 256, Learning Rate: 0.009, Epoch: 4/10, Test Loss: 1.5152, Test Accuracy:
0.4188
Hidden Size: 256, Learning Rate: 0.009, Epoch: 5/10, Test Loss: 1.3619, Test Accuracy:
0.4408
Hidden Size: 256, Learning Rate: 0.009, Epoch: 6/10, Test Loss: 1.4241, Test Accuracy:
0.4461
Hidden Size: 256, Learning Rate: 0.009, Epoch: 7/10, Test Loss: 1.3137, Test Accuracy:
0.4370
Hidden Size: 256, Learning Rate: 0.009, Epoch: 8/10, Test Loss: 1.4504, Test Accuracy:
0.4369
Hidden Size: 256, Learning Rate: 0.009, Epoch: 9/10, Test Loss: 1.3534, Test Accuracy:
0.4662
Hidden Size: 256, Learning Rate: 0.009, Epoch: 10/10, Test Loss: 1.4269, Test Accuracy:
0.4449
Hidden Size: 256, Learning Rate: 0.01, Epoch: 1/10, Test Loss: 1.1946, Test Accuracy: 0.
5319
Hidden Size: 256, Learning Rate: 0.01, Epoch: 2/10, Test Loss: 1.3660, Test Accuracy: 0.
4239
Hidden Size: 256, Learning Rate: 0.01, Epoch: 3/10, Test Loss: 1.3217, Test Accuracy: 0.
4805
Hidden Size: 256, Learning Rate: 0.01, Epoch: 4/10, Test Loss: 1.4011, Test Accuracy: 0.
4311
Hidden Size: 256, Learning Rate: 0.01, Epoch: 5/10, Test Loss: 1.4101, Test Accuracy: 0.
4565
Hidden Size: 256, Learning Rate: 0.01, Epoch: 6/10, Test Loss: 1.3725, Test Accuracy: 0.
3555
Hidden Size: 256, Learning Rate: 0.01, Epoch: 7/10, Test Loss: 1.3491, Test Accuracy: 0.
4161
Hidden Size: 256, Learning Rate: 0.01, Epoch: 8/10, Test Loss: 1.3926, Test Accuracy: 0.
4618
Hidden Size: 256, Learning Rate: 0.01, Epoch: 9/10, Test Loss: 1.4111, Test Accuracy: 0.
4422
Hidden Size: 256, Learning Rate: 0.01, Epoch: 10/10, Test Loss: 1.3710, Test Accuracy:
0.4383
```



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