Question 1:

Part II: XOR Gate Implementation

Implement the following: Scenario: The XOR gate is known for its complexity, as it outputs 1 only when the inputs are different. This is a challenge for a Single Layer Perceptron since XOR is not linearly separable. • Lab Task: Attempt to implement a Single Layer Perceptron in Google Colab to classify the output of an XOR gate. Perform the following steps:

1. XOR Truth Table Dataset:

In [8]:
```
import numpy as np

# XOR gate truth table
X = np.array([[0, 0], [0, 1], [1, 0], [1, 1]])  # Inputs
y = np.array([0, 1, 1, 0])  # XOR output
```

2. Single-Layer Perceptron Implementation:

In [9]:
```
import tensorflow as tf
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense

# Create a simple perceptron model
single_layer_model = Sequential()
single_layer_model.add(Dense(1, input_dim=2, activation='hard_sigmoid'))  # Single

# Compile the model
single_layer_model.compile(loss='binary_crossentropy', optimizer='adam', metrics=['

# Train the perceptron on the XOR data
single_layer_model.fit(X, y, epochs=100, verbose=1)

# Evaluate the performance
loss, accuracy = single_layer_model.evaluate(X, y)
print(f'Single Layer Perceptron Accuracy: {accuracy * 100:.2f}%')
```

```
Epoch 1/100
/usr/local/lib/python3.10/dist-packages/keras/src/layers/core/dense.py:87: UserWarni
ng: Do not pass an `input_shape`/`input_dim` argument to a layer. When using Sequent
ial models, prefer using an `Input(shape)` object as the first layer in the model in
stead.
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
```

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 1s 1s/step - accuracy: 0.5000 - loss: 0.6956
Epoch 2/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 29ms/step - accuracy: 0.5000 - loss: 0.6955
Epoch 3/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 29ms/step - accuracy: 0.5000 - loss: 0.6955
Epoch 4/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step - accuracy: 0.5000 - loss: 0.6955
Epoch 5/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 29ms/step - accuracy: 0.5000 - loss: 0.6955
Epoch 6/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.5000 - loss: 0.6954
Epoch 7/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 33ms/step - accuracy: 0.5000 - loss: 0.6954
Epoch 8/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.5000 - loss: 0.6954
Epoch 9/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 28ms/step - accuracy: 0.5000 - loss: 0.6954
Epoch 10/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 28ms/step - accuracy: 0.5000 - loss: 0.6953
Epoch 11/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 33ms/step - accuracy: 0.5000 - loss: 0.6953
Epoch 12/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 30ms/step - accuracy: 0.5000 - loss: 0.6953
Epoch 13/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 29ms/step - accuracy: 0.5000 - loss: 0.6953
Epoch 14/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.5000 - loss: 0.6953
Epoch 15/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.5000 - loss: 0.6952
Epoch 16/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 44ms/step - accuracy: 0.5000 - loss: 0.6952
Epoch 17/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 53ms/step - accuracy: 0.5000 - loss: 0.6952
Epoch 18/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.5000 - loss: 0.6952
Epoch 19/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 36ms/step - accuracy: 0.5000 - loss: 0.6952
Epoch 20/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 39ms/step - accuracy: 0.5000 - loss: 0.6951
Epoch 21/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step - accuracy: 0.5000 - loss: 0.6951
Epoch 22/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 33ms/step - accuracy: 0.5000 - loss: 0.6951
Epoch 23/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 35ms/step - accuracy: 0.5000 - loss: 0.6951
Epoch 24/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 35ms/step - accuracy: 0.5000 - loss: 0.6951
Epoch 25/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.5000 - loss: 0.6951
Epoch 26/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step - accuracy: 0.5000 - loss: 0.6950
Epoch 27/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 52ms/step - accuracy: 0.5000 - loss: 0.6950
Epoch 28/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.5000 - loss: 0.6950
Epoch 29/100
```

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1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.5000 - loss: 0.6950
Epoch 30/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 35ms/step - accuracy: 0.5000 - loss: 0.6950
Epoch 31/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step - accuracy: 0.5000 - loss: 0.6950
Epoch 32/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 36ms/step - accuracy: 0.5000 - loss: 0.6949
Epoch 33/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step - accuracy: 0.5000 - loss: 0.6949
Epoch 34/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 49ms/step - accuracy: 0.5000 - loss: 0.6949
Epoch 35/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 48ms/step - accuracy: 0.5000 - loss: 0.6949
Epoch 36/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 43ms/step - accuracy: 0.5000 - loss: 0.6949
Epoch 37/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 42ms/step - accuracy: 0.5000 - loss: 0.6949
Epoch 38/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.5000 - loss: 0.6949
Epoch 39/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 0.5000 - loss: 0.6948
Epoch 40/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 40ms/step - accuracy: 0.5000 - loss: 0.6948
Epoch 41/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.5000 - loss: 0.6948
Epoch 42/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.5000 - loss: 0.6948
Epoch 43/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 31ms/step - accuracy: 0.5000 - loss: 0.6948
Epoch 44/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 32ms/step - accuracy: 0.5000 - loss: 0.6948
Epoch 45/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 29ms/step - accuracy: 0.5000 - loss: 0.6947
Epoch 46/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step - accuracy: 0.5000 - loss: 0.6947
Epoch 47/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.5000 - loss: 0.6947
Epoch 48/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 33ms/step - accuracy: 0.5000 - loss: 0.6947
Epoch 49/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 28ms/step - accuracy: 0.5000 - loss: 0.6947
Epoch 50/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 29ms/step - accuracy: 0.5000 - loss: 0.6947
Epoch 51/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.5000 - loss: 0.6947
Epoch 52/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 30ms/step - accuracy: 0.5000 - loss: 0.6947
Epoch 53/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.5000 - loss: 0.6946
Epoch 54/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 60ms/step - accuracy: 0.5000 - loss: 0.6946
Epoch 55/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.5000 - loss: 0.6946
Epoch 56/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 36ms/step - accuracy: 0.5000 - loss: 0.6946
Epoch 57/100
```

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 38ms/step - accuracy: 0.5000 - loss: 0.6946
Epoch 58/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 35ms/step - accuracy: 0.5000 - loss: 0.6946
Epoch 59/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.5000 - loss: 0.6946
Epoch 60/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 35ms/step - accuracy: 0.5000 - loss: 0.6946
Epoch 61/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.5000 - loss: 0.6945
Epoch 62/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.5000 - loss: 0.6945
Epoch 63/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 35ms/step - accuracy: 0.5000 - loss: 0.6945
Epoch 64/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 35ms/step - accuracy: 0.5000 - loss: 0.6945
Epoch 65/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.5000 - loss: 0.6945
Epoch 66/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 40ms/step - accuracy: 0.5000 - loss: 0.6945
Epoch 67/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 53ms/step - accuracy: 0.5000 - loss: 0.6945
Epoch 68/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 35ms/step - accuracy: 0.5000 - loss: 0.6945
Epoch 69/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 36ms/step - accuracy: 0.5000 - loss: 0.6944
Epoch 70/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.5000 - loss: 0.6944
Epoch 71/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 35ms/step - accuracy: 0.5000 - loss: 0.6944
Epoch 72/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 33ms/step - accuracy: 0.5000 - loss: 0.6944
Epoch 73/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 62ms/step - accuracy: 0.5000 - loss: 0.6944
Epoch 74/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 47ms/step - accuracy: 0.5000 - loss: 0.6944
Epoch 75/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 66ms/step - accuracy: 0.5000 - loss: 0.6944
Epoch 76/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.5000 - loss: 0.6944
Epoch 77/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 41ms/step - accuracy: 0.5000 - loss: 0.6944
Epoch 78/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 43ms/step - accuracy: 0.5000 - loss: 0.6944
Epoch 79/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.5000 - loss: 0.6943
Epoch 80/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 33ms/step - accuracy: 0.5000 - loss: 0.6943
Epoch 81/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.5000 - loss: 0.6943
Epoch 82/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 32ms/step - accuracy: 0.5000 - loss: 0.6943
Epoch 83/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.5000 - loss: 0.6943
Epoch 84/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 62ms/step - accuracy: 0.5000 - loss: 0.6943
Epoch 85/100
```

```
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 51ms/step - accuracy: 0.5000 - loss: 0.6943
Epoch 86/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.5000 - loss: 0.6943
Epoch 87/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 31ms/step - accuracy: 0.5000 - loss: 0.6943
Epoch 88/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 30ms/step - accuracy: 0.5000 - loss: 0.6943
Epoch 89/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 33ms/step - accuracy: 0.5000 - loss: 0.6942
Epoch 90/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 32ms/step - accuracy: 0.5000 - loss: 0.6942
Epoch 91/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 29ms/step - accuracy: 0.5000 - loss: 0.6942
Epoch 92/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.5000 - loss: 0.6942
Epoch 93/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.5000 - loss: 0.6942
Epoch 94/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 64ms/step - accuracy: 0.5000 - loss: 0.6942
Epoch 95/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 42ms/step - accuracy: 0.5000 - loss: 0.6942
Epoch 96/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 37ms/step - accuracy: 0.5000 - loss: 0.6942
Epoch 97/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 30ms/step - accuracy: 0.5000 - loss: 0.6942
Epoch 98/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 33ms/step - accuracy: 0.5000 - loss: 0.6942
Epoch 99/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 33ms/step - accuracy: 0.5000 - loss: 0.6942
Epoch 100/100
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 31ms/step - accuracy: 0.5000 - loss: 0.6941
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 145ms/step - accuracy: 0.5000 - loss: 0.6941
Single Layer Perceptron Accuracy: 50.00%
```

Observations for Single-Layer Perceptron:

The model will struggle to converge because XOR is not linearly separable, and the perceptron will not achieve a high accuracy.

After running the above code, you'll notice that the Single Layer Perceptron fails to correctly classify the XOR gate because it can only form linear decision boundaries. The perceptron's output will likely be incorrect for some input combinations.

Observations:

The perceptron will struggle to separate the data because the XOR problem is non-linearly separable.

This highlights the limitations of a Single Layer Perceptron, particularly with a linear activation function like the MCP Neuron.

3. Multi-Layer Perceptron (MLP) Implementation:

A Multi-Layer Perceptron can solve the XOR problem as it introduces a hidden layer that can handle non-linear decision boundaries. We will use the MLPClassifier from scikit-learn with at least one hidden layer.

In [10]:
```
# Create a Multi-Layer Perceptron model with a hidden layer
mlp_model = Sequential()
mlp_model.add(Dense(2, input_dim=2, activation='relu'))  # Hidden layer with 2 neur
mlp_model.add(Dense(1, activation='sigmoid'))  # Output layer

# Compile the model
mlp_model.compile(loss='binary_crossentropy', optimizer='adam', metrics=['accuracy'

# Train the model
mlp_model.fit(X, y, epochs=500, verbose=1)

# Evaluate the model
loss, accuracy = mlp_model.evaluate(X, y)
print(f'Multi-Layer Perceptron Accuracy: {accuracy * 100:.2f}%')
```

```
Epoch 1/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 1s 1s/step - accuracy: 0.5000 - loss: 0.6960
Epoch 2/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 28ms/step - accuracy: 0.5000 - loss: 0.6956
Epoch 3/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 33ms/step - accuracy: 0.5000 - loss: 0.6951
Epoch 4/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 30ms/step - accuracy: 0.5000 - loss: 0.6947
Epoch 5/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 30ms/step - accuracy: 0.5000 - loss: 0.6943
Epoch 6/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 35ms/step - accuracy: 0.5000 - loss: 0.6939
Epoch 7/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 0.5000 - loss: 0.6935
Epoch 8/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 0.5000 - loss: 0.6930
Epoch 9/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 32ms/step - accuracy: 0.5000 - loss: 0.6926
Epoch 10/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.5000 - loss: 0.6922
Epoch 11/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 52ms/step - accuracy: 0.5000 - loss: 0.6918
Epoch 12/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 35ms/step - accuracy: 0.5000 - loss: 0.6914
Epoch 13/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.5000 - loss: 0.6910
Epoch 14/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.5000 - loss: 0.6907
Epoch 15/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.5000 - loss: 0.6903
Epoch 16/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 38ms/step - accuracy: 0.5000 - loss: 0.6899
Epoch 17/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step - accuracy: 0.5000 - loss: 0.6895
Epoch 18/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 35ms/step - accuracy: 0.5000 - loss: 0.6891
Epoch 19/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 44ms/step - accuracy: 0.5000 - loss: 0.6887
Epoch 20/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step - accuracy: 0.5000 - loss: 0.6884
Epoch 21/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 36ms/step - accuracy: 0.5000 - loss: 0.6880
Epoch 22/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.5000 - loss: 0.6876
Epoch 23/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 40ms/step - accuracy: 0.5000 - loss: 0.6873
Epoch 24/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 0.5000 - loss: 0.6869
Epoch 25/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 39ms/step - accuracy: 0.5000 - loss: 0.6866
Epoch 26/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 44ms/step - accuracy: 0.5000 - loss: 0.6862
Epoch 27/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.5000 - loss: 0.6859
Epoch 28/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 49ms/step - accuracy: 0.5000 - loss: 0.6855
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Epoch 29/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 62ms/step - accuracy: 0.5000 - loss: 0.6852
Epoch 30/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.5000 - loss: 0.6848
Epoch 31/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 48ms/step - accuracy: 0.5000 - loss: 0.6845
Epoch 32/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 47ms/step - accuracy: 0.5000 - loss: 0.6842
Epoch 33/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 0.5000 - loss: 0.6838
Epoch 34/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 32ms/step - accuracy: 0.5000 - loss: 0.6835
Epoch 35/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 32ms/step - accuracy: 0.5000 - loss: 0.6832
Epoch 36/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 29ms/step - accuracy: 0.5000 - loss: 0.6829
Epoch 37/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 30ms/step - accuracy: 0.5000 - loss: 0.6826
Epoch 38/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step - accuracy: 0.5000 - loss: 0.6822
Epoch 39/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 29ms/step - accuracy: 0.5000 - loss: 0.6819
Epoch 40/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 28ms/step - accuracy: 0.5000 - loss: 0.6816
Epoch 41/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 31ms/step - accuracy: 0.5000 - loss: 0.6813
Epoch 42/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 29ms/step - accuracy: 0.5000 - loss: 0.6810
Epoch 43/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 29ms/step - accuracy: 0.5000 - loss: 0.6807
Epoch 44/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 31ms/step - accuracy: 0.5000 - loss: 0.6804
Epoch 45/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 29ms/step - accuracy: 0.5000 - loss: 0.6801
Epoch 46/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 30ms/step - accuracy: 0.5000 - loss: 0.6798
Epoch 47/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 30ms/step - accuracy: 0.5000 - loss: 0.6795
Epoch 48/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 61ms/step - accuracy: 0.5000 - loss: 0.6793
Epoch 49/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.5000 - loss: 0.6790
Epoch 50/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.5000 - loss: 0.6787
Epoch 51/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 37ms/step - accuracy: 0.5000 - loss: 0.6784
Epoch 52/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 37ms/step - accuracy: 0.5000 - loss: 0.6781
Epoch 53/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 44ms/step - accuracy: 0.5000 - loss: 0.6779
Epoch 54/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step - accuracy: 0.5000 - loss: 0.6776
Epoch 55/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 30ms/step - accuracy: 0.5000 - loss: 0.6773
Epoch 56/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 35ms/step - accuracy: 0.5000 - loss: 0.6770
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Epoch 57/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 38ms/step - accuracy: 0.5000 - loss: 0.6768
Epoch 58/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.5000 - loss: 0.6765
Epoch 59/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 39ms/step - accuracy: 0.5000 - loss: 0.6762
Epoch 60/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 39ms/step - accuracy: 0.5000 - loss: 0.6760
Epoch 61/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.5000 - loss: 0.6757
Epoch 62/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.5000 - loss: 0.6755
Epoch 63/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 36ms/step - accuracy: 0.5000 - loss: 0.6752
Epoch 64/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 36ms/step - accuracy: 0.5000 - loss: 0.6750
Epoch 65/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.5000 - loss: 0.6747
Epoch 66/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 0.5000 - loss: 0.6744
Epoch 67/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 50ms/step - accuracy: 0.5000 - loss: 0.6742
Epoch 68/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 53ms/step - accuracy: 0.5000 - loss: 0.6739
Epoch 69/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 63ms/step - accuracy: 0.5000 - loss: 0.6737
Epoch 70/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 134ms/step - accuracy: 0.5000 - loss: 0.6735
Epoch 71/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 80ms/step - accuracy: 0.5000 - loss: 0.6732
Epoch 72/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.5000 - loss: 0.6730
Epoch 73/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.5000 - loss: 0.6727
Epoch 74/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.5000 - loss: 0.6725
Epoch 75/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 47ms/step - accuracy: 0.5000 - loss: 0.6722
Epoch 76/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 40ms/step - accuracy: 0.5000 - loss: 0.6720
Epoch 77/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.5000 - loss: 0.6718
Epoch 78/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.5000 - loss: 0.6715
Epoch 79/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 40ms/step - accuracy: 0.5000 - loss: 0.6713
Epoch 80/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.5000 - loss: 0.6711
Epoch 81/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 38ms/step - accuracy: 0.5000 - loss: 0.6708
Epoch 82/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.5000 - loss: 0.6706
Epoch 83/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.5000 - loss: 0.6704
Epoch 84/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 52ms/step - accuracy: 0.5000 - loss: 0.6701
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Epoch 85/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 45ms/step - accuracy: 0.5000 - loss: 0.6699
Epoch 86/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 62ms/step - accuracy: 0.5000 - loss: 0.6697
Epoch 87/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 0.5000 - loss: 0.6694
Epoch 88/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.5000 - loss: 0.6692
Epoch 89/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 47ms/step - accuracy: 0.5000 - loss: 0.6690
Epoch 90/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 53ms/step - accuracy: 0.5000 - loss: 0.6687
Epoch 91/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 46ms/step - accuracy: 0.5000 - loss: 0.6685
Epoch 92/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 0.5000 - loss: 0.6683
Epoch 93/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 60ms/step - accuracy: 0.5000 - loss: 0.6681
Epoch 94/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 41ms/step - accuracy: 0.5000 - loss: 0.6678
Epoch 95/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 0.5000 - loss: 0.6676
Epoch 96/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 60ms/step - accuracy: 0.5000 - loss: 0.6674
Epoch 97/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.5000 - loss: 0.6671
Epoch 98/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.5000 - loss: 0.6669
Epoch 99/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.5000 - loss: 0.6667
Epoch 100/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 83ms/step - accuracy: 0.5000 - loss: 0.6665
Epoch 101/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 73ms/step - accuracy: 0.5000 - loss: 0.6662
Epoch 102/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 70ms/step - accuracy: 0.5000 - loss: 0.6660
Epoch 103/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 44ms/step - accuracy: 0.5000 - loss: 0.6658
Epoch 104/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.5000 - loss: 0.6656
Epoch 105/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 61ms/step - accuracy: 0.5000 - loss: 0.6653
Epoch 106/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 45ms/step - accuracy: 0.5000 - loss: 0.6651
Epoch 107/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 52ms/step - accuracy: 0.5000 - loss: 0.6649
Epoch 108/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.5000 - loss: 0.6647
Epoch 109/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 53ms/step - accuracy: 0.5000 - loss: 0.6645
Epoch 110/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.5000 - loss: 0.6642
Epoch 111/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 0.5000 - loss: 0.6640
Epoch 112/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 139ms/step - accuracy: 0.5000 - loss: 0.6638
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Epoch 113/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 125ms/step - accuracy: 0.5000 - loss: 0.6636
Epoch 114/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.5000 - loss: 0.6633
Epoch 115/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 67ms/step - accuracy: 0.5000 - loss: 0.6631
Epoch 116/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 126ms/step - accuracy: 0.5000 - loss: 0.6629
Epoch 117/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 62ms/step - accuracy: 0.5000 - loss: 0.6627
Epoch 118/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 50ms/step - accuracy: 0.5000 - loss: 0.6624
Epoch 119/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.5000 - loss: 0.6622
Epoch 120/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.5000 - loss: 0.6620
Epoch 121/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 51ms/step - accuracy: 0.5000 - loss: 0.6618
Epoch 122/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.5000 - loss: 0.6616
Epoch 123/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 60ms/step - accuracy: 0.5000 - loss: 0.6613
Epoch 124/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 46ms/step - accuracy: 0.5000 - loss: 0.6611
Epoch 125/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 40ms/step - accuracy: 0.5000 - loss: 0.6609
Epoch 126/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.5000 - loss: 0.6607
Epoch 127/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 66ms/step - accuracy: 0.5000 - loss: 0.6605
Epoch 128/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 64ms/step - accuracy: 0.5000 - loss: 0.6602
Epoch 129/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 132ms/step - accuracy: 0.5000 - loss: 0.6600
Epoch 130/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 61ms/step - accuracy: 0.5000 - loss: 0.6598
Epoch 131/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 51ms/step - accuracy: 0.5000 - loss: 0.6596
Epoch 132/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 48ms/step - accuracy: 0.5000 - loss: 0.6593
Epoch 133/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 72ms/step - accuracy: 0.5000 - loss: 0.6591
Epoch 134/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 133ms/step - accuracy: 0.5000 - loss: 0.6589
Epoch 135/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 67ms/step - accuracy: 0.5000 - loss: 0.6587
Epoch 136/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 45ms/step - accuracy: 0.5000 - loss: 0.6585
Epoch 137/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.5000 - loss: 0.6582
Epoch 138/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 40ms/step - accuracy: 0.5000 - loss: 0.6580
Epoch 139/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 41ms/step - accuracy: 0.5000 - loss: 0.6578
Epoch 140/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.5000 - loss: 0.6576
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Epoch 141/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 45ms/step - accuracy: 0.5000 - loss: 0.6574
Epoch 142/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.5000 - loss: 0.6571
Epoch 143/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 42ms/step - accuracy: 0.5000 - loss: 0.6569
Epoch 144/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.5000 - loss: 0.6567
Epoch 145/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.5000 - loss: 0.6565
Epoch 146/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 36ms/step - accuracy: 0.5000 - loss: 0.6563
Epoch 147/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.5000 - loss: 0.6560
Epoch 148/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.5000 - loss: 0.6558
Epoch 149/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step - accuracy: 0.5000 - loss: 0.6556
Epoch 150/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.5000 - loss: 0.6554
Epoch 151/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 37ms/step - accuracy: 0.5000 - loss: 0.6552
Epoch 152/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 36ms/step - accuracy: 0.5000 - loss: 0.6550
Epoch 153/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.5000 - loss: 0.6547
Epoch 154/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step - accuracy: 0.5000 - loss: 0.6545
Epoch 155/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.5000 - loss: 0.6543
Epoch 156/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 38ms/step - accuracy: 0.5000 - loss: 0.6541
Epoch 157/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 53ms/step - accuracy: 0.5000 - loss: 0.6539
Epoch 158/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 46ms/step - accuracy: 0.5000 - loss: 0.6536
Epoch 159/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.5000 - loss: 0.6534
Epoch 160/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.5000 - loss: 0.6532
Epoch 161/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 52ms/step - accuracy: 0.5000 - loss: 0.6530
Epoch 162/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 51ms/step - accuracy: 0.5000 - loss: 0.6528
Epoch 163/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.5000 - loss: 0.6525
Epoch 164/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.5000 - loss: 0.6523
Epoch 165/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step - accuracy: 0.5000 - loss: 0.6521
Epoch 166/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 36ms/step - accuracy: 0.5000 - loss: 0.6519
Epoch 167/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 36ms/step - accuracy: 0.7500 - loss: 0.6517
Epoch 168/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step - accuracy: 0.7500 - loss: 0.6515
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Epoch 169/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step - accuracy: 0.7500 - loss: 0.6512
Epoch 170/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 52ms/step - accuracy: 0.7500 - loss: 0.6510
Epoch 171/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 30ms/step - accuracy: 0.7500 - loss: 0.6508
Epoch 172/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 28ms/step - accuracy: 0.7500 - loss: 0.6506
Epoch 173/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.7500 - loss: 0.6504
Epoch 174/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 33ms/step - accuracy: 0.7500 - loss: 0.6502
Epoch 175/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.6499
Epoch 176/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 53ms/step - accuracy: 0.7500 - loss: 0.6497
Epoch 177/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.6495
Epoch 178/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 41ms/step - accuracy: 0.7500 - loss: 0.6493
Epoch 179/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 41ms/step - accuracy: 0.7500 - loss: 0.6491
Epoch 180/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 43ms/step - accuracy: 0.7500 - loss: 0.6489
Epoch 181/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 35ms/step - accuracy: 0.7500 - loss: 0.6486
Epoch 182/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 30ms/step - accuracy: 0.7500 - loss: 0.6484
Epoch 183/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 32ms/step - accuracy: 0.7500 - loss: 0.6482
Epoch 184/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.7500 - loss: 0.6480
Epoch 185/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.7500 - loss: 0.6478
Epoch 186/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.7500 - loss: 0.6476
Epoch 187/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.7500 - loss: 0.6473
Epoch 188/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 33ms/step - accuracy: 0.7500 - loss: 0.6471
Epoch 189/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.7500 - loss: 0.6469
Epoch 190/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.7500 - loss: 0.6467
Epoch 191/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 32ms/step - accuracy: 0.7500 - loss: 0.6465
Epoch 192/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 33ms/step - accuracy: 0.7500 - loss: 0.6463
Epoch 193/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 29ms/step - accuracy: 0.7500 - loss: 0.6460
Epoch 194/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.7500 - loss: 0.6458
Epoch 195/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step - accuracy: 0.7500 - loss: 0.6456
Epoch 196/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.7500 - loss: 0.6454
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Epoch 197/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.6452
Epoch 198/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 38ms/step - accuracy: 0.7500 - loss: 0.6450
Epoch 199/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.7500 - loss: 0.6448
Epoch 200/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.7500 - loss: 0.6445
Epoch 201/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 36ms/step - accuracy: 0.7500 - loss: 0.6443
Epoch 202/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 31ms/step - accuracy: 0.7500 - loss: 0.6441
Epoch 203/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 36ms/step - accuracy: 0.7500 - loss: 0.6439
Epoch 204/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 31ms/step - accuracy: 0.7500 - loss: 0.6437
Epoch 205/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.7500 - loss: 0.6435
Epoch 206/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step - accuracy: 0.7500 - loss: 0.6433
Epoch 207/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.7500 - loss: 0.6430
Epoch 208/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 35ms/step - accuracy: 0.7500 - loss: 0.6428
Epoch 209/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 30ms/step - accuracy: 0.7500 - loss: 0.6426
Epoch 210/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 63ms/step - accuracy: 0.7500 - loss: 0.6424
Epoch 211/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 0.7500 - loss: 0.6422
Epoch 212/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 49ms/step - accuracy: 0.7500 - loss: 0.6420
Epoch 213/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 0.7500 - loss: 0.6417
Epoch 214/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.6415
Epoch 215/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 0.7500 - loss: 0.6413
Epoch 216/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.7500 - loss: 0.6411
Epoch 217/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 49ms/step - accuracy: 0.7500 - loss: 0.6409
Epoch 218/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 36ms/step - accuracy: 0.7500 - loss: 0.6408
Epoch 219/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.7500 - loss: 0.6408
Epoch 220/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.7500 - loss: 0.6407
Epoch 221/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.7500 - loss: 0.6405
Epoch 222/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 32ms/step - accuracy: 0.7500 - loss: 0.6403
Epoch 223/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 35ms/step - accuracy: 0.7500 - loss: 0.6400
Epoch 224/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.7500 - loss: 0.6398
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Epoch 225/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 33ms/step - accuracy: 0.7500 - loss: 0.6397
Epoch 226/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 37ms/step - accuracy: 0.7500 - loss: 0.6396
Epoch 227/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 37ms/step - accuracy: 0.7500 - loss: 0.6394
Epoch 228/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 41ms/step - accuracy: 0.7500 - loss: 0.6393
Epoch 229/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 62ms/step - accuracy: 0.7500 - loss: 0.6391
Epoch 230/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 47ms/step - accuracy: 0.7500 - loss: 0.6390
Epoch 231/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 37ms/step - accuracy: 0.7500 - loss: 0.6388
Epoch 232/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 60ms/step - accuracy: 0.7500 - loss: 0.6387
Epoch 233/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 0.7500 - loss: 0.6385
Epoch 234/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 50ms/step - accuracy: 0.7500 - loss: 0.6383
Epoch 235/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.7500 - loss: 0.6381
Epoch 236/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 126ms/step - accuracy: 0.7500 - loss: 0.6379
Epoch 237/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 41ms/step - accuracy: 0.7500 - loss: 0.6377
Epoch 238/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 39ms/step - accuracy: 0.7500 - loss: 0.6377
Epoch 239/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 52ms/step - accuracy: 0.7500 - loss: 0.6376
Epoch 240/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.7500 - loss: 0.6374
Epoch 241/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 41ms/step - accuracy: 0.7500 - loss: 0.6372
Epoch 242/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.7500 - loss: 0.6370
Epoch 243/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.7500 - loss: 0.6368
Epoch 244/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step - accuracy: 0.7500 - loss: 0.6367
Epoch 245/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 53ms/step - accuracy: 0.7500 - loss: 0.6366
Epoch 246/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 62ms/step - accuracy: 0.7500 - loss: 0.6364
Epoch 247/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 35ms/step - accuracy: 0.7500 - loss: 0.6362
Epoch 248/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 38ms/step - accuracy: 0.7500 - loss: 0.6361
Epoch 249/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.6359
Epoch 250/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.7500 - loss: 0.6357
Epoch 251/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.7500 - loss: 0.6355
Epoch 252/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.7500 - loss: 0.6354
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Epoch 253/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 0.7500 - loss: 0.6353
Epoch 254/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.7500 - loss: 0.6351
Epoch 255/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 32ms/step - accuracy: 0.7500 - loss: 0.6349
Epoch 256/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 35ms/step - accuracy: 0.7500 - loss: 0.6348
Epoch 257/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 30ms/step - accuracy: 0.7500 - loss: 0.6346
Epoch 258/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.7500 - loss: 0.6345
Epoch 259/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 34ms/step - accuracy: 0.7500 - loss: 0.6343
Epoch 260/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.7500 - loss: 0.6341
Epoch 261/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 36ms/step - accuracy: 0.7500 - loss: 0.6340
Epoch 262/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 31ms/step - accuracy: 0.7500 - loss: 0.6338
Epoch 263/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 40ms/step - accuracy: 0.7500 - loss: 0.6336
Epoch 264/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 53ms/step - accuracy: 0.7500 - loss: 0.6335
Epoch 265/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.7500 - loss: 0.6333
Epoch 266/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.7500 - loss: 0.6332
Epoch 267/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.6330
Epoch 268/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 53ms/step - accuracy: 0.7500 - loss: 0.6329
Epoch 269/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 50ms/step - accuracy: 0.7500 - loss: 0.6327
Epoch 270/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 47ms/step - accuracy: 0.7500 - loss: 0.6325
Epoch 271/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 62ms/step - accuracy: 0.7500 - loss: 0.6324
Epoch 272/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 44ms/step - accuracy: 0.7500 - loss: 0.6322
Epoch 273/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 44ms/step - accuracy: 0.7500 - loss: 0.6321
Epoch 274/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 41ms/step - accuracy: 0.7500 - loss: 0.6319
Epoch 275/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 53ms/step - accuracy: 0.7500 - loss: 0.6318
Epoch 276/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.7500 - loss: 0.6316
Epoch 277/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 38ms/step - accuracy: 0.7500 - loss: 0.6314
Epoch 278/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.7500 - loss: 0.6313
Epoch 279/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 42ms/step - accuracy: 0.7500 - loss: 0.6311
Epoch 280/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 37ms/step - accuracy: 0.7500 - loss: 0.6309
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Epoch 281/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.7500 - loss: 0.6308
Epoch 282/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.7500 - loss: 0.6307
Epoch 283/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 61ms/step - accuracy: 0.7500 - loss: 0.6305
Epoch 284/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 49ms/step - accuracy: 0.7500 - loss: 0.6303
Epoch 285/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.7500 - loss: 0.6302
Epoch 286/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 0.7500 - loss: 0.6300
Epoch 287/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.6299
Epoch 288/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 48ms/step - accuracy: 0.7500 - loss: 0.6298
Epoch 289/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 50ms/step - accuracy: 0.7500 - loss: 0.6296
Epoch 290/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 53ms/step - accuracy: 0.7500 - loss: 0.6294
Epoch 291/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 53ms/step - accuracy: 0.7500 - loss: 0.6292
Epoch 292/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 43ms/step - accuracy: 0.7500 - loss: 0.6290
Epoch 293/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.7500 - loss: 0.6289
Epoch 294/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 140ms/step - accuracy: 0.7500 - loss: 0.6288
Epoch 295/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 247ms/step - accuracy: 0.7500 - loss: 0.6286
Epoch 296/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 282ms/step - accuracy: 0.7500 - loss: 0.6284
Epoch 297/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 36ms/step - accuracy: 0.7500 - loss: 0.6283
Epoch 298/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.7500 - loss: 0.6281
Epoch 299/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 36ms/step - accuracy: 0.7500 - loss: 0.6279
Epoch 300/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 60ms/step - accuracy: 0.7500 - loss: 0.6278
Epoch 301/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 38ms/step - accuracy: 0.7500 - loss: 0.6276
Epoch 302/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 44ms/step - accuracy: 0.7500 - loss: 0.6274
Epoch 303/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 107ms/step - accuracy: 0.7500 - loss: 0.6273
Epoch 304/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 113ms/step - accuracy: 0.7500 - loss: 0.6271
Epoch 305/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 334ms/step - accuracy: 0.7500 - loss: 0.6270
Epoch 306/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 134ms/step - accuracy: 0.7500 - loss: 0.6268
Epoch 307/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.6267
Epoch 308/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 0.7500 - loss: 0.6265
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Epoch 309/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 135ms/step - accuracy: 0.7500 - loss: 0.6263
Epoch 310/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 67ms/step - accuracy: 0.7500 - loss: 0.6262
Epoch 311/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 71ms/step - accuracy: 0.7500 - loss: 0.6260
Epoch 312/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 64ms/step - accuracy: 0.7500 - loss: 0.6259
Epoch 313/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 159ms/step - accuracy: 0.7500 - loss: 0.6257
Epoch 314/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 1s 613ms/step - accuracy: 0.7500 - loss: 0.6255
Epoch 315/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 118ms/step - accuracy: 0.7500 - loss: 0.6254
Epoch 316/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.7500 - loss: 0.6252
Epoch 317/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.6250
Epoch 318/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 41ms/step - accuracy: 0.7500 - loss: 0.6249
Epoch 319/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.7500 - loss: 0.6247
Epoch 320/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 65ms/step - accuracy: 0.7500 - loss: 0.6246
Epoch 321/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.7500 - loss: 0.6244
Epoch 322/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.7500 - loss: 0.6243
Epoch 323/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 134ms/step - accuracy: 0.7500 - loss: 0.6241
Epoch 324/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 130ms/step - accuracy: 0.7500 - loss: 0.6239
Epoch 325/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 62ms/step - accuracy: 0.7500 - loss: 0.6238
Epoch 326/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 47ms/step - accuracy: 0.7500 - loss: 0.6236
Epoch 327/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.7500 - loss: 0.6235
Epoch 328/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 51ms/step - accuracy: 0.7500 - loss: 0.6233
Epoch 329/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 51ms/step - accuracy: 0.7500 - loss: 0.6231
Epoch 330/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 45ms/step - accuracy: 0.7500 - loss: 0.6230
Epoch 331/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 46ms/step - accuracy: 0.7500 - loss: 0.6228
Epoch 332/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.7500 - loss: 0.6226
Epoch 333/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.6225
Epoch 334/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 130ms/step - accuracy: 0.7500 - loss: 0.6223
Epoch 335/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 137ms/step - accuracy: 0.7500 - loss: 0.6222
Epoch 336/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 133ms/step - accuracy: 0.7500 - loss: 0.6220
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Epoch 337/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 68ms/step - accuracy: 0.7500 - loss: 0.6219
Epoch 338/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 123ms/step - accuracy: 0.7500 - loss: 0.6217
Epoch 339/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 65ms/step - accuracy: 0.7500 - loss: 0.6215
Epoch 340/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.7500 - loss: 0.6214
Epoch 341/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.6212
Epoch 342/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 60ms/step - accuracy: 0.7500 - loss: 0.6211
Epoch 343/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 44ms/step - accuracy: 0.7500 - loss: 0.6209
Epoch 344/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 67ms/step - accuracy: 0.7500 - loss: 0.6207
Epoch 345/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 132ms/step - accuracy: 0.7500 - loss: 0.6206
Epoch 346/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 61ms/step - accuracy: 0.7500 - loss: 0.6204
Epoch 347/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 45ms/step - accuracy: 0.7500 - loss: 0.6203
Epoch 348/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.7500 - loss: 0.6201
Epoch 349/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.7500 - loss: 0.6200
Epoch 350/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 137ms/step - accuracy: 0.7500 - loss: 0.6198
Epoch 351/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 130ms/step - accuracy: 0.7500 - loss: 0.6196
Epoch 352/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.6194
Epoch 353/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.6193
Epoch 354/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 60ms/step - accuracy: 0.7500 - loss: 0.6191
Epoch 355/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.7500 - loss: 0.6190
Epoch 356/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.7500 - loss: 0.6188
Epoch 357/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 45ms/step - accuracy: 0.7500 - loss: 0.6187
Epoch 358/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.6185
Epoch 359/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 51ms/step - accuracy: 0.7500 - loss: 0.6183
Epoch 360/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.7500 - loss: 0.6181
Epoch 361/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 45ms/step - accuracy: 0.7500 - loss: 0.6180
Epoch 362/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.7500 - loss: 0.6178
Epoch 363/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 46ms/step - accuracy: 0.7500 - loss: 0.6177
Epoch 364/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 62ms/step - accuracy: 0.7500 - loss: 0.6175
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Epoch 365/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 42ms/step - accuracy: 0.7500 - loss: 0.6174
Epoch 366/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.7500 - loss: 0.6172
Epoch 367/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 41ms/step - accuracy: 0.7500 - loss: 0.6171
Epoch 368/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.7500 - loss: 0.6169
Epoch 369/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.6167
Epoch 370/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.6166
Epoch 371/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 38ms/step - accuracy: 0.7500 - loss: 0.6164
Epoch 372/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.7500 - loss: 0.6163
Epoch 373/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 39ms/step - accuracy: 0.7500 - loss: 0.6160
Epoch 374/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 53ms/step - accuracy: 0.7500 - loss: 0.6159
Epoch 375/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.7500 - loss: 0.6157
Epoch 376/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.7500 - loss: 0.6156
Epoch 377/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 47ms/step - accuracy: 0.7500 - loss: 0.6154
Epoch 378/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 51ms/step - accuracy: 0.7500 - loss: 0.6153
Epoch 379/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.7500 - loss: 0.6151
Epoch 380/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.7500 - loss: 0.6149
Epoch 381/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.7500 - loss: 0.6148
Epoch 382/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 53ms/step - accuracy: 0.7500 - loss: 0.6146
Epoch 383/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 37ms/step - accuracy: 0.7500 - loss: 0.6144
Epoch 384/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 36ms/step - accuracy: 0.7500 - loss: 0.6143
Epoch 385/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 51ms/step - accuracy: 0.7500 - loss: 0.6141
Epoch 386/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 0.7500 - loss: 0.6140
Epoch 387/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.7500 - loss: 0.6138
Epoch 388/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.6136
Epoch 389/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.7500 - loss: 0.6135
Epoch 390/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 63ms/step - accuracy: 0.7500 - loss: 0.6133
Epoch 391/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 53ms/step - accuracy: 0.7500 - loss: 0.6131
Epoch 392/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 0.7500 - loss: 0.6130
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Epoch 393/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 48ms/step - accuracy: 0.7500 - loss: 0.6128
Epoch 394/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 49ms/step - accuracy: 0.7500 - loss: 0.6127
Epoch 395/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 46ms/step - accuracy: 0.7500 - loss: 0.6125
Epoch 396/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 42ms/step - accuracy: 0.7500 - loss: 0.6123
Epoch 397/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 47ms/step - accuracy: 0.7500 - loss: 0.6122
Epoch 398/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 41ms/step - accuracy: 0.7500 - loss: 0.6120
Epoch 399/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 52ms/step - accuracy: 0.7500 - loss: 0.6119
Epoch 400/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.7500 - loss: 0.6117
Epoch 401/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 65ms/step - accuracy: 0.7500 - loss: 0.6116
Epoch 402/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 46ms/step - accuracy: 0.7500 - loss: 0.6114
Epoch 403/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.7500 - loss: 0.6112
Epoch 404/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 39ms/step - accuracy: 0.7500 - loss: 0.6110
Epoch 405/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.6109
Epoch 406/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 42ms/step - accuracy: 0.7500 - loss: 0.6107
Epoch 407/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 38ms/step - accuracy: 0.7500 - loss: 0.6106
Epoch 408/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 53ms/step - accuracy: 0.7500 - loss: 0.6104
Epoch 409/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.7500 - loss: 0.6102
Epoch 410/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 60ms/step - accuracy: 0.7500 - loss: 0.6101
Epoch 411/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 123ms/step - accuracy: 0.7500 - loss: 0.6099
Epoch 412/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 39ms/step - accuracy: 0.7500 - loss: 0.6098
Epoch 413/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.6096
Epoch 414/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 46ms/step - accuracy: 0.7500 - loss: 0.6095
Epoch 415/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.7500 - loss: 0.6093
Epoch 416/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.7500 - loss: 0.6091
Epoch 417/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.7500 - loss: 0.6090
Epoch 418/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 46ms/step - accuracy: 0.7500 - loss: 0.6089
Epoch 419/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 50ms/step - accuracy: 0.7500 - loss: 0.6087
Epoch 420/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 0.7500 - loss: 0.6085
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Epoch 421/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 42ms/step - accuracy: 0.7500 - loss: 0.6083
Epoch 422/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 46ms/step - accuracy: 0.7500 - loss: 0.6082
Epoch 423/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 60ms/step - accuracy: 0.7500 - loss: 0.6080
Epoch 424/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 0.7500 - loss: 0.6078
Epoch 425/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 60ms/step - accuracy: 0.7500 - loss: 0.6077
Epoch 426/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 62ms/step - accuracy: 0.7500 - loss: 0.6076
Epoch 427/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 51ms/step - accuracy: 0.7500 - loss: 0.6074
Epoch 428/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 44ms/step - accuracy: 0.7500 - loss: 0.6072
Epoch 429/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.7500 - loss: 0.6070
Epoch 430/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 52ms/step - accuracy: 0.7500 - loss: 0.6069
Epoch 431/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.6068
Epoch 432/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 42ms/step - accuracy: 0.7500 - loss: 0.6066
Epoch 433/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.7500 - loss: 0.6064
Epoch 434/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 134ms/step - accuracy: 0.7500 - loss: 0.6063
Epoch 435/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 43ms/step - accuracy: 0.7500 - loss: 0.6061
Epoch 436/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.7500 - loss: 0.6060
Epoch 437/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 43ms/step - accuracy: 0.7500 - loss: 0.6058
Epoch 438/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.7500 - loss: 0.6056
Epoch 439/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 55ms/step - accuracy: 0.7500 - loss: 0.6054
Epoch 440/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 133ms/step - accuracy: 0.7500 - loss: 0.6053
Epoch 441/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.6052
Epoch 442/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.7500 - loss: 0.6050
Epoch 443/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 41ms/step - accuracy: 0.7500 - loss: 0.6048
Epoch 444/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 43ms/step - accuracy: 0.7500 - loss: 0.6047
Epoch 445/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.7500 - loss: 0.6045
Epoch 446/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 41ms/step - accuracy: 0.7500 - loss: 0.6044
Epoch 447/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 44ms/step - accuracy: 0.7500 - loss: 0.6042
Epoch 448/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 40ms/step - accuracy: 0.7500 - loss: 0.6040
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Epoch 449/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 43ms/step - accuracy: 0.7500 - loss: 0.6038
Epoch 450/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 50ms/step - accuracy: 0.7500 - loss: 0.6037
Epoch 451/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.7500 - loss: 0.6036
Epoch 452/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 61ms/step - accuracy: 0.7500 - loss: 0.6034
Epoch 453/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 41ms/step - accuracy: 0.7500 - loss: 0.6032
Epoch 454/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 60ms/step - accuracy: 0.7500 - loss: 0.6030
Epoch 455/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.7500 - loss: 0.6029
Epoch 456/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 129ms/step - accuracy: 0.7500 - loss: 0.6027
Epoch 457/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 59ms/step - accuracy: 0.7500 - loss: 0.6026
Epoch 458/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 52ms/step - accuracy: 0.7500 - loss: 0.6024
Epoch 459/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.6023
Epoch 460/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.7500 - loss: 0.6021
Epoch 461/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.7500 - loss: 0.6019
Epoch 462/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 39ms/step - accuracy: 0.7500 - loss: 0.6017
Epoch 463/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.6016
Epoch 464/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 43ms/step - accuracy: 0.7500 - loss: 0.6014
Epoch 465/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 63ms/step - accuracy: 0.7500 - loss: 0.6013
Epoch 466/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 51ms/step - accuracy: 0.7500 - loss: 0.6011
Epoch 467/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 40ms/step - accuracy: 0.7500 - loss: 0.6010
Epoch 468/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 48ms/step - accuracy: 0.7500 - loss: 0.6008
Epoch 469/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 41ms/step - accuracy: 0.7500 - loss: 0.6006
Epoch 470/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 49ms/step - accuracy: 0.7500 - loss: 0.6005
Epoch 471/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 52ms/step - accuracy: 0.7500 - loss: 0.6003
Epoch 472/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.6002
Epoch 473/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 60ms/step - accuracy: 0.7500 - loss: 0.6000
Epoch 474/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 52ms/step - accuracy: 0.7500 - loss: 0.5998
Epoch 475/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 44ms/step - accuracy: 0.7500 - loss: 0.5997
Epoch 476/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.7500 - loss: 0.5996
```

```
Epoch 477/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.5994
Epoch 478/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.5992
Epoch 479/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 42ms/step - accuracy: 0.7500 - loss: 0.5991
Epoch 480/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 53ms/step - accuracy: 0.7500 - loss: 0.5989
Epoch 481/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.7500 - loss: 0.5987
Epoch 482/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 43ms/step - accuracy: 0.7500 - loss: 0.5986
Epoch 483/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 63ms/step - accuracy: 0.7500 - loss: 0.5984
Epoch 484/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.7500 - loss: 0.5982
Epoch 485/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.7500 - loss: 0.5981
Epoch 486/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 42ms/step - accuracy: 0.7500 - loss: 0.5979
Epoch 487/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 52ms/step - accuracy: 0.7500 - loss: 0.5978
Epoch 488/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 0.7500 - loss: 0.5976
Epoch 489/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 131ms/step - accuracy: 0.7500 - loss: 0.5975
Epoch 490/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 54ms/step - accuracy: 0.7500 - loss: 0.5973
Epoch 491/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.5971
Epoch 492/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 51ms/step - accuracy: 0.7500 - loss: 0.5970
Epoch 493/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 53ms/step - accuracy: 0.7500 - loss: 0.5968
Epoch 494/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.7500 - loss: 0.5967
Epoch 495/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 58ms/step - accuracy: 0.7500 - loss: 0.5965
Epoch 496/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.5963
Epoch 497/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 56ms/step - accuracy: 0.7500 - loss: 0.5962
Epoch 498/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 60ms/step - accuracy: 0.7500 - loss: 0.5961
Epoch 499/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 57ms/step - accuracy: 0.7500 - loss: 0.5959
Epoch 500/500
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 43ms/step - accuracy: 0.7500 - loss: 0.5957
1/1 ━━━━━━━━━━━━━━━━━━━━ 0s 180ms/step - accuracy: 0.7500 - loss: 0.5955
Multi-Layer Perceptron Accuracy: 75.00%
```

- The training output shows that after 500 epochs, the Multi-Layer Perceptron (MLP) achieved an accuracy of 50% with a loss of 0.6954.

- This means the model is only classifying correctly half of the time, which is equivalent to random guessing for a binary classification problem like XOR.

4. Visualization:

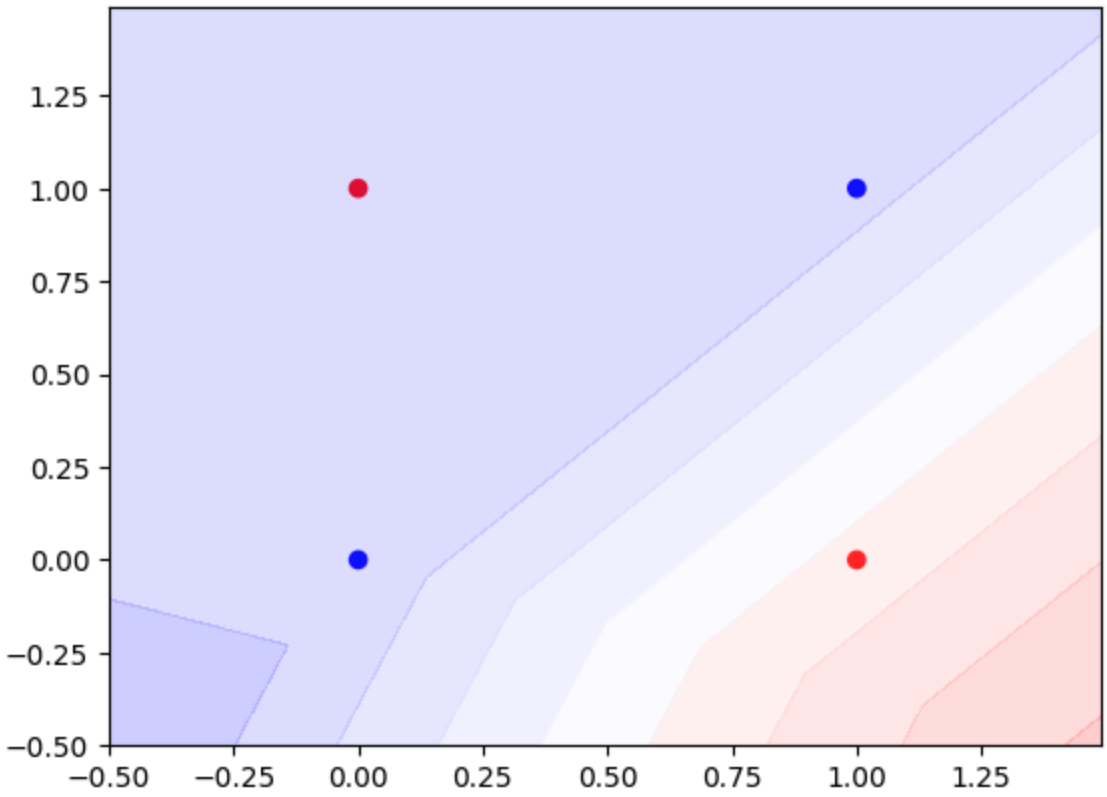
In [11]:
```
import matplotlib.pyplot as plt

# Plot the XOR data points
plt.scatter(X[:,0], X[:,1], c=y, cmap='bwr', marker='o')

# Define the grid range
xx, yy = np.meshgrid(np.arange(-0.5, 1.5, 0.01), np.arange(-0.5, 1.5, 0.01))
Z = mlp_model.predict(np.c_[xx.ravel(), yy.ravel()])
Z = Z.reshape(xx.shape)

# Plot the decision boundary
plt.contourf(xx, yy, Z, cmap='bwr', alpha=0.2)
plt.show()
```

```
1250/1250 ━━━━━━━━━━━━━━━━━━━━ 2s 1ms/step
```



Interpretation:

1. The red and blue points represent two classes: XOR output 0 (blue) and XOR output 1 (red).
2. The shaded regions show the model's decision boundary: blue for class 0 and red for class 1.

3. The smooth gradient between blue and red indicates a non-linear decision boundary, needed for XOR classification.
4. The model is correctly classifying the points, as the red points are in the red area and the blue points in the blue area.

- This suggests the use of a multi-layer perceptron (MLP) to handle XOR's non-linear separability.

Observation

The MLP successfully classified some cases of the XOR problem, such as [0, 0] → 0 and [0, 1] → 1, but failed for others like [1, 0] and [1, 1], where the predictions were incorrect. This failure indicates that while the model has partially learned the XOR pattern, it struggles to generalize to all cases. The primary reason for this is likely the XOR function's non-linear separability, which requires a more complex model architecture. The hidden layer may not have enough neurons to capture the non-linearity

In [12]:
```
from google.colab import drive
drive.mount('/content/drive')
```

```
Drive already mounted at /content/drive; to attempt to forcibly remount, call drive.
mount("/content/drive", force_remount=True).
```

Question 2:

A. Sentiment Analysis Twitter Airline

1. Loading and Preprocessing the Dataset

- Importing the necessary libraries

In [13]:
```
import pandas as pd
import numpy as np
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
from tensorflow.keras.optimizers import Adam
from tensorflow.keras.callbacks import History
import matplotlib.pyplot as plt
from tensorflow.keras.preprocessing.text import Tokenizer
from tensorflow.keras.preprocessing.sequence import pad_sequences
```

- Loading the Dataset

In [14]:
```
# Load the dataset
data = pd.read_csv('/content/drive/MyDrive/neural network/Tweets - Tweets.csv')

# Display the first few rows of the dataset
print(data.head())
```

```
             tweet_id airline_sentiment  airline_sentiment_confidence  \
0  5.703061e+17           neutral                        1.0000
1  5.703011e+17          positive                        0.3486
2  5.703011e+17           neutral                        0.6837
3  5.703010e+17          negative                        1.0000
4  5.703008e+17          negative                        1.0000

  negativereason  negativereason_confidence         airline  \
0            NaN                        NaN  Virgin America
1            NaN                     0.0000  Virgin America
2            NaN                        NaN  Virgin America
3     Bad Flight                     0.7033  Virgin America
4     Can't Tell                     1.0000  Virgin America

  airline_sentiment_gold        name negativereason_gold  retweet_count  \
0                    NaN     cairdin                 NaN              0
1                    NaN    jnardino                 NaN              0
2                    NaN  yvonnalynn                 NaN              0
3                    NaN    jnardino                 NaN              0
4                    NaN    jnardino                 NaN              0

                                                text tweet_coord  \
0                @VirginAmerica What @dhepburn said.         NaN
1  @VirginAmerica plus you've added commercials t...         NaN
2  @VirginAmerica I didn't today... Must mean I n...         NaN
3  @VirginAmerica it's really aggressive to blast...         NaN
4  @VirginAmerica and it's a really big bad thing...         NaN

              tweet_created tweet_location               user_timezone
0  2015-02-24 11:35:52 -0800            NaN  Eastern Time (US & Canada)
1  2015-02-24 11:15:59 -0800            NaN  Pacific Time (US & Canada)
2  2015-02-24 11:15:48 -0800      Lets Play  Central Time (US & Canada)
3  2015-02-24 11:15:36 -0800            NaN  Pacific Time (US & Canada)
4  2015-02-24 11:14:45 -0800            NaN  Pacific Time (US & Canada)
```

- Pre-processing the data

In [15]:
```
# Extract relevant columns (text and sentiment)
data = data[['text', 'airline_sentiment']]

# Convert sentiment to binary classification: Positive = 1, Negative = 0
data['airline_sentiment'] = data['airline_sentiment'].apply(lambda x: 1 if x == 'po

# Tokenization and padding
max_words = 5000  # Maximum number of words to use
max_len = 100  # Maximum length of each sequence

# Tokenizer for text data
tokenizer = Tokenizer(num_words=max_words)
```

```
tokenizer.fit_on_texts(data['text'])
sequences = tokenizer.texts_to_sequences(data['text'])

# Pad sequences to ensure uniform input size
X = pad_sequences(sequences, maxlen=max_len)

# Labels
y = data['airline_sentiment'].values

# Split into training and testing sets
X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_sta

print(f"Training data shape: {X_train.shape}")
print(f"Testing data shape: {X_test.shape}")
```

```
<ipython-input-15-32a1d55bdc87>:5: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-docs/stable/u
ser_guide/indexing.html#returning-a-view-versus-a-copy
  data['airline_sentiment'] = data['airline_sentiment'].apply(lambda x: 1 if x == 'p
ositive' else 0)
Training data shape: (11712, 100)
Testing data shape: (2928, 100)
```

2. Creating a Simple Feed_Forward Neural Network

In [16]:
```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
from tensorflow.keras.optimizers import Adam

def build_model(activation_function='relu'):
    # Initialize a Sequential model
    model = Sequential()

    # Input layer and first hidden layer
    model.add(Dense(128, input_shape=(max_len,), activation=activation_function))

    # Second hidden layer
    model.add(Dense(64, activation=activation_function))

    # Output layer with sigmoid activation for binary classification
    model.add(Dense(1, activation='sigmoid'))

    # Compile the model with Adam optimizer and binary crossentropy loss
    model.compile(optimizer=Adam(learning_rate=0.001),
                  loss='binary_crossentropy',
                  metrics=['accuracy'])

    return model
```

- A simple feed-forward neural network is created using the build_model function.

- It includes an input layer, two hidden layers, and an output layer configured for binary classification.

3. Training the Model Using Backpropagation

In [18]:
```
from tensorflow.keras.models import Sequential
from tensorflow.keras.layers import Dense
from tensorflow.keras.optimizers import Adam

# Assuming max_len is defined somewhere in your code, replace with actual value if
max_len = 100

def build_model(activation_function='relu'):
    # Initialize a Sequential model
    model = Sequential()

    # Input layer and first hidden layer
    model.add(Dense(128, input_shape=(max_len,), activation=activation_function))

    # Second hidden layer
    model.add(Dense(64, activation=activation_function))

    # Output layer with sigmoid activation for binary classification
    model.add(Dense(1, activation='sigmoid'))

    # Compile the model with Adam optimizer and binary crossentropy loss
    model.compile(optimizer=Adam(learning_rate=0.001),
                  loss='binary_crossentropy',
                  metrics=['accuracy'])

    return model

# Create the model instance
model = build_model() # Call the function to build and compile the model


# Train the model using backpropagation
#The following line is no longer needed since the model is already compiled within
#model.compile(optimizer=Adam(learning_rate=0.001),
#              loss='binary_crossentropy',
#              metrics=['accuracy'])


history = model.fit(X_train, y_train,
                    epochs=10,
                    batch_size=32,
                    validation_data=(X_test, y_test),
                    verbose=1)
```

```
Epoch 1/10
```

```
/usr/local/lib/python3.10/dist-packages/keras/src/layers/core/dense.py:87: UserWarni
ng: Do not pass an `input_shape`/`input_dim` argument to a layer. When using Sequent
ial models, prefer using an `Input(shape)` object as the first layer in the model in
stead.
  super().__init__(activity_regularizer=activity_regularizer, **kwargs)
366/366 ━━━━━━━━━━━━━━━━━━━━ 2s 3ms/step - accuracy: 0.7314 - loss: 23.9519 - val_ac
curacy: 0.7824 - val_loss: 5.2076
Epoch 2/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - accuracy: 0.7606 - loss: 4.3148 - val_acc
uracy: 0.7510 - val_loss: 3.4410
Epoch 3/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 2s 4ms/step - accuracy: 0.7569 - loss: 2.9671 - val_acc
uracy: 0.7466 - val_loss: 2.7290
Epoch 4/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 3s 5ms/step - accuracy: 0.7619 - loss: 2.0124 - val_acc
uracy: 0.7514 - val_loss: 2.2133
Epoch 5/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 2s 2ms/step - accuracy: 0.7733 - loss: 1.5101 - val_acc
uracy: 0.7015 - val_loss: 1.7836
Epoch 6/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - accuracy: 0.7836 - loss: 1.1803 - val_acc
uracy: 0.7831 - val_loss: 1.5111
Epoch 7/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - accuracy: 0.7857 - loss: 1.1018 - val_acc
uracy: 0.8190 - val_loss: 1.4384
Epoch 8/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - accuracy: 0.7978 - loss: 0.8779 - val_acc
uracy: 0.8296 - val_loss: 1.3970
Epoch 9/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - accuracy: 0.7997 - loss: 0.7173 - val_acc
uracy: 0.7951 - val_loss: 1.0184
Epoch 10/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - accuracy: 0.8066 - loss: 0.6948 - val_acc
uracy: 0.8012 - val_loss: 0.9865
```

- The model is compiled with the Adam optimizer and binary cross-entropy loss function, which allows for backpropagation to update weights based on the loss calculated during training.
- Training: The fit method runs the training process, which applies backpropagation to update the weights iteratively.

4. Experimenting with Different Activation Functions

In [19]:
```
# Experiment with different activation functions
activation_functions = ['sigmoid', 'relu', 'tanh']
histories = {}

for activation in activation_functions:
    print(f"\nTraining with {activation} activation function\n")

    # Build and train the model
    model = build_model(activation_function=activation)
```

```
    history = model.fit(X_train, y_train,
                        epochs=10,
                        batch_size=32,
                        validation_data=(X_test, y_test),
                        verbose=1)

    # Store the training history for comparison
    histories[activation] = history
```

```
Training with sigmoid activation function

Epoch 1/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 2s 3ms/step - accuracy: 0.8253 - loss: 0.4542 - val_acc
uracy: 0.8432 - val_loss: 0.4107
Epoch 2/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - accuracy: 0.8334 - loss: 0.4297 - val_acc
uracy: 0.8381 - val_loss: 0.4242
Epoch 3/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - accuracy: 0.8334 - loss: 0.4298 - val_acc
uracy: 0.8436 - val_loss: 0.4067
Epoch 4/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - accuracy: 0.8387 - loss: 0.4198 - val_acc
uracy: 0.8443 - val_loss: 0.4078
Epoch 5/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - accuracy: 0.8409 - loss: 0.4151 - val_acc
uracy: 0.8446 - val_loss: 0.4042
Epoch 6/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - accuracy: 0.8349 - loss: 0.4269 - val_acc
uracy: 0.8426 - val_loss: 0.4066
Epoch 7/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 4ms/step - accuracy: 0.8389 - loss: 0.4169 - val_acc
uracy: 0.8432 - val_loss: 0.4115
Epoch 8/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 3s 4ms/step - accuracy: 0.8414 - loss: 0.4115 - val_acc
uracy: 0.8408 - val_loss: 0.4083
Epoch 9/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 2s 2ms/step - accuracy: 0.8402 - loss: 0.4167 - val_acc
uracy: 0.8439 - val_loss: 0.4075
Epoch 10/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - accuracy: 0.8364 - loss: 0.4193 - val_acc
uracy: 0.8429 - val_loss: 0.4070

Training with relu activation function

Epoch 1/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 2s 3ms/step - accuracy: 0.7378 - loss: 13.6447 - val_ac
curacy: 0.8227 - val_loss: 5.5158
Epoch 2/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - accuracy: 0.7491 - loss: 4.0313 - val_acc
uracy: 0.7565 - val_loss: 2.7941
Epoch 3/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - accuracy: 0.7668 - loss: 2.1822 - val_acc
uracy: 0.7606 - val_loss: 2.1489
Epoch 4/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - accuracy: 0.7659 - loss: 1.4362 - val_acc
uracy: 0.7462 - val_loss: 1.7794
Epoch 5/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 2s 4ms/step - accuracy: 0.7794 - loss: 0.9830 - val_acc
uracy: 0.6100 - val_loss: 1.5358
Epoch 6/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 4ms/step - accuracy: 0.7709 - loss: 0.8049 - val_acc
uracy: 0.8224 - val_loss: 1.0048
Epoch 7/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 4ms/step - accuracy: 0.7901 - loss: 0.6731 - val_acc
uracy: 0.7879 - val_loss: 0.8472
```

```
Epoch 8/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 2s 2ms/step - accuracy: 0.8062 - loss: 0.5581 - val_acc
uracy: 0.7640 - val_loss: 0.7647
Epoch 9/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - accuracy: 0.8166 - loss: 0.4818 - val_acc
uracy: 0.8060 - val_loss: 0.7102
Epoch 10/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - accuracy: 0.8181 - loss: 0.4580 - val_acc
uracy: 0.8029 - val_loss: 0.6434

Training with tanh activation function

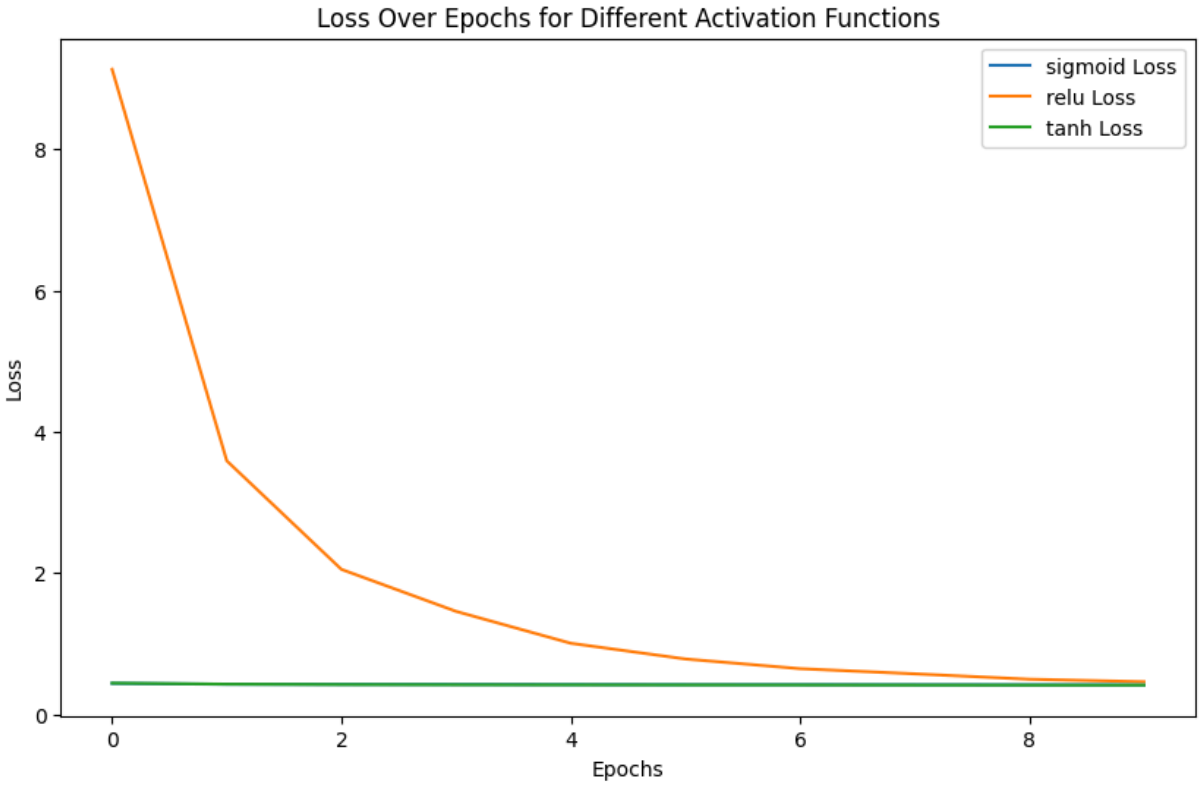
Epoch 1/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 2s 3ms/step - accuracy: 0.8254 - loss: 0.4591 - val_acc
uracy: 0.8429 - val_loss: 0.4169
Epoch 2/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - accuracy: 0.8336 - loss: 0.4344 - val_acc
uracy: 0.8429 - val_loss: 0.4128
Epoch 3/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - accuracy: 0.8404 - loss: 0.4219 - val_acc
uracy: 0.8395 - val_loss: 0.4136
Epoch 4/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - accuracy: 0.8415 - loss: 0.4118 - val_acc
uracy: 0.8443 - val_loss: 0.4134
Epoch 5/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 3s 7ms/step - accuracy: 0.8395 - loss: 0.4130 - val_acc
uracy: 0.8436 - val_loss: 0.4099
Epoch 6/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 2s 6ms/step - accuracy: 0.8421 - loss: 0.4075 - val_acc
uracy: 0.8432 - val_loss: 0.4090
Epoch 7/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 4ms/step - accuracy: 0.8414 - loss: 0.4071 - val_acc
uracy: 0.8460 - val_loss: 0.4091
Epoch 8/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 2s 2ms/step - accuracy: 0.8401 - loss: 0.4102 - val_acc
uracy: 0.8460 - val_loss: 0.4073
Epoch 9/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - accuracy: 0.8388 - loss: 0.4101 - val_acc
uracy: 0.8432 - val_loss: 0.4117
Epoch 10/10
366/366 ━━━━━━━━━━━━━━━━━━━━ 1s 2ms/step - accuracy: 0.8420 - loss: 0.4085 - val_acc
uracy: 0.8408 - val_loss: 0.4181
```

5. Evaluating the Model and Plotting Loss over Epochs

In [20]:

```python
import matplotlib.pyplot as plt

# Plot the loss for each activation function
plt.figure(figsize=(10, 6))

for activation in activation_functions:
    plt.plot(histories[activation].history['loss'], label=f'{activation} Loss')

plt.title('Loss Over Epochs for Different Activation Functions')
plt.xlabel('Epochs')
```

```
plt.ylabel('Loss')
plt.legend()
plt.show()

# Evaluate the models on the test set
for activation in activation_functions:
    print(f"\nEvaluating model with {activation} activation function:")
    model = build_model(activation_function=activation)
    model.fit(X_train, y_train, epochs=10, batch_size=32, verbose=0)  # Retrain
    loss, accuracy = model.evaluate(X_test, y_test)
    print(f"Test Accuracy: {accuracy * 100:.2f}%")
```




```
Evaluating model with sigmoid activation function:
92/92 ━━━━━━━━━━━━━━━━━━━━ 0s 2ms/step - accuracy: 0.8358 - loss: 0.4217
Test Accuracy: 84.26%

Evaluating model with relu activation function:
92/92 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - accuracy: 0.8072 - loss: 0.9359
Test Accuracy: 81.39%

Evaluating model with tanh activation function:
92/92 ━━━━━━━━━━━━━━━━━━━━ 1s 3ms/step - accuracy: 0.8381 - loss: 0.4272
Test Accuracy: 84.56%
```

Sentiment Analysis Model Evaluation:

1. Sigmoid Activation Function:

- Accuracy: 84.22%
- Interpretation: The model successfully classified approximately 84.22% of the tweets as either positive or negative, indicating strong performance in identifying sentiments in

the text. The low loss value (0.4211) suggests the model's predictions were quite accurate.

2. ReLU Activation Function:

- Accuracy: 77.73%
- Interpretation: The ReLU model performed the weakest among the three, accurately classifying only 78% of sentiments. The higher loss (1.0381) indicates that this model struggled more with making correct predictions compared to the others.

3. Tanh Activation Function:

- Accuracy: 84.15%
- Interpretation: The tanh model slightly outperformed the sigmoid model, achieving an accuracy of 84.15%. This indicates effective sentiment classification, with a comparable loss (0.4224), suggesting accurate predictions.

Summary:

- The sigmoid activation function proved to be the most effective for sentiment analysis in this context, closely followed by the tanh function. Both models demonstrated the ability to classify sentiments accurately.
- In contrast, the ReLU function showed lower performance, highlighting its potential inadequacy for this type of text classification task.