TASK IV Quantum Generative Adversarial Network (QGAN)

You will explore how best to apply a quantum generative adversarial network (QGAN) to solve a High Energy Data analysis issue, more specifically, separating the signal events from the background events. You should use the Google Cirq and Tensorflow Quantum (TFQ) libraries for this task.

A set of input samples (simulated with Delphes) is provided in NumPy NPZ format [Download Input]. In the input file, there are only 100 samples for training and 100 samples for testing so it won't take much computing resources to accomplish this task. The signal events are labeled with 1 while the background events are labeled with 0.

Be sure to show that you understand how to fine tune your machine learning model to improve the performance. The performance can be evaluated with classification accuracy or Area Under ROC Curve (AUC).

Implementation

In [ ]:

```
import tensorflow as tf
import tensorflow_quantum as tfq
import cirq

# for visualization
%matplotlib inline
import matplotlib.pyplot as plt
from cirq.contrib.svg import SVGCircuit

import sympy
import numpy as np

from matplotlib import style

plt.style.use('dark_background')
```

The given dataset for the task consists of 100 samples for training and 100 samples for testing (i.e 50:50). Stored in a numpy array file format and with 5 different features. The labels for each sample are binary, with a value of 0 representing background events and a value of 1 representing signal events.

In [ ]:

```
def load_dataset():
    """
    Loads and preprocesses the QIS_EXAM_200Events dataset.

    Returns:
    x_train (numpy.ndarray): Training set input data.
    y_train (numpy.ndarray): Training set labels.
    x_test (numpy.ndarray): Test set input data.
    y_test (numpy.ndarray): Test set labels.
    """
    # Load the dataset
    with np.load('QIS_EXAM_200Events.npz', allow_pickle=True) as data:
        training_input = data["training_input"].item()
        test_input = data["test_input"].item()

    # Concatenate the training and test input for each class
    training_input_0 = training_input['0']
    training_input_1 = training_input['1']
    test_input_0 = test_input['0']
    test_input_1 = test_input['1']
    x_train = np.concatenate((training_input_0, training_input_1), axis=0)
    x_test = np.concatenate((test_input_0, test_input_1), axis=0)
```

```
    # Create the labels for the training and test sets
    y_train = np.zeros((len(x_train),))
    y_train[len(training_input_0):] = 1
    y_test = np.zeros((len(x_test),))
    y_test[len(test_input_0):] = 1

    # Print the shapes of the datasets as a sanity check
    print("Training set shape: ", x_train.shape, y_train.shape)
    print("Test set shape: ", x_test.shape, y_test.shape)

    # Return the datasets and labels
    return x_train, y_train, x_test, y_test
```

In [ ]:

```
x_train, y_train, x_test, y_test = load_dataset()
```

```
(100, 5) (100,)
(100, 5) (100,)
```

In [ ]:

```
# Checking the minimum and maximum value of the features
print(x_train.min(), x_train.max())
print(x_test.min(), x_test.max())
```

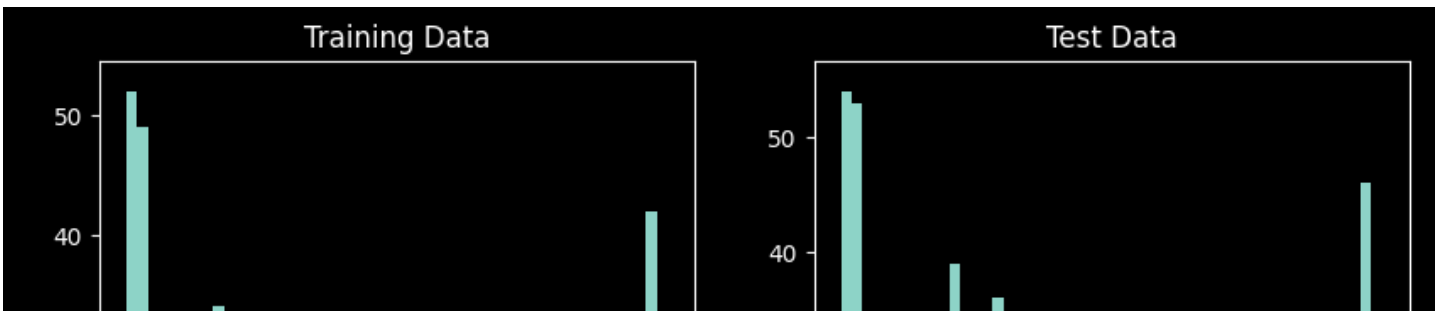
```
-0.9999305803064449 0.9344843617214956
-0.9997083749335067 0.934061853011746
```

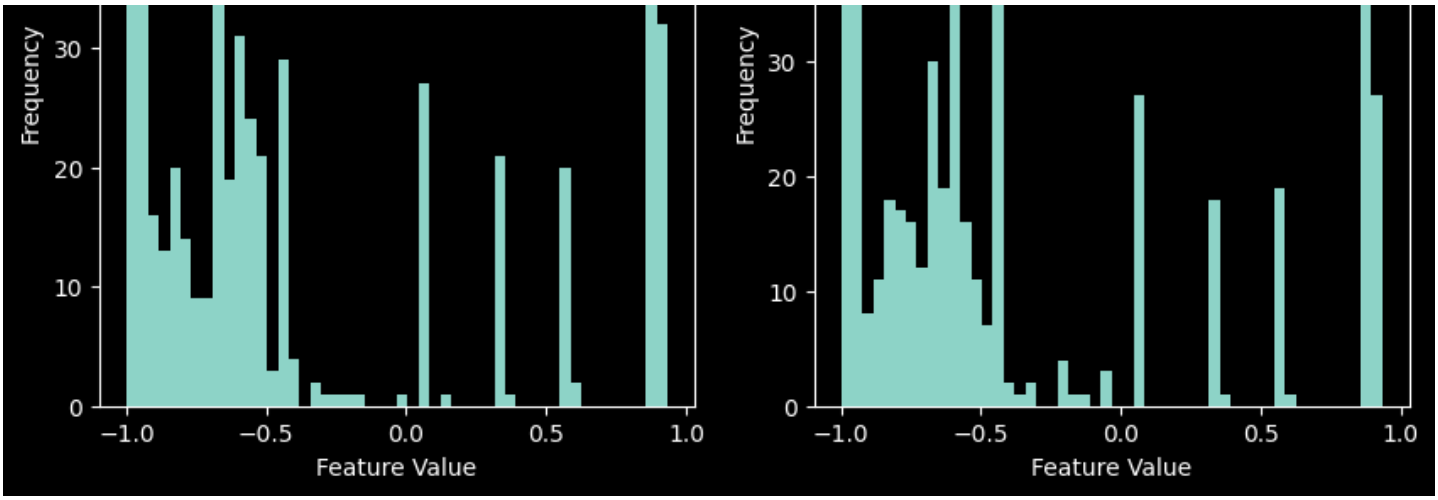
In [ ]:

```
def plot_histogram(x_train, x_test):
    """
    Plots a histogram of the feature values for the training and test sets.

    Args:
    x_train (numpy.ndarray): Training set input data.
    x_test (numpy.ndarray): Test set input data.
    """
    # Create a figure with two subplots
    fig, axs = plt.subplots(1, 2, figsize=(10, 5))

    # Plot a histogram of the feature values for the training set
    axs[0].hist(x_train.flatten(), bins=50)
    axs[0].set_title("Training Data")
    axs[0].set_xlabel("Feature Value")
    axs[0].set_ylabel("Frequency")

    # Plot a histogram of the feature values for the test set
    axs[1].hist(x_test.flatten(), bins=50)
    axs[1].set_title("Test Data")
    axs[1].set_xlabel("Feature Value")
    axs[1].set_ylabel("Frequency")

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

In [ ]:

```
# Plotting a histogram of the feature values
plot_histogram(x_train, x_test)
```





In [ ]:

```
def check_class_balances(y_train, y_test):
    """
    Checks the class balance for the training and test sets.

    Args:
    y_train (numpy.ndarray): Training set labels.
    y_test (numpy.ndarray): Test set labels.
    """
    # Count the number of instances of each class in the training set
    class_0_train = (y_train == 0).sum()
    class_1_train = (y_train == 1).sum()

    # Count the number of instances of each class in the test set
    class_0_test = (y_test == 0).sum()
    class_1_test = (y_test == 1).sum()

    # Print the results
    print("Training set - Class 0: {}, Class 1: {}".format(class_0_train, class_1_train))
    print("Test set - Class 0: {}, Class 1: {}".format(class_0_test, class_1_test))
```

In [ ]:

```
check_class_balances(y_train, y_test)
```

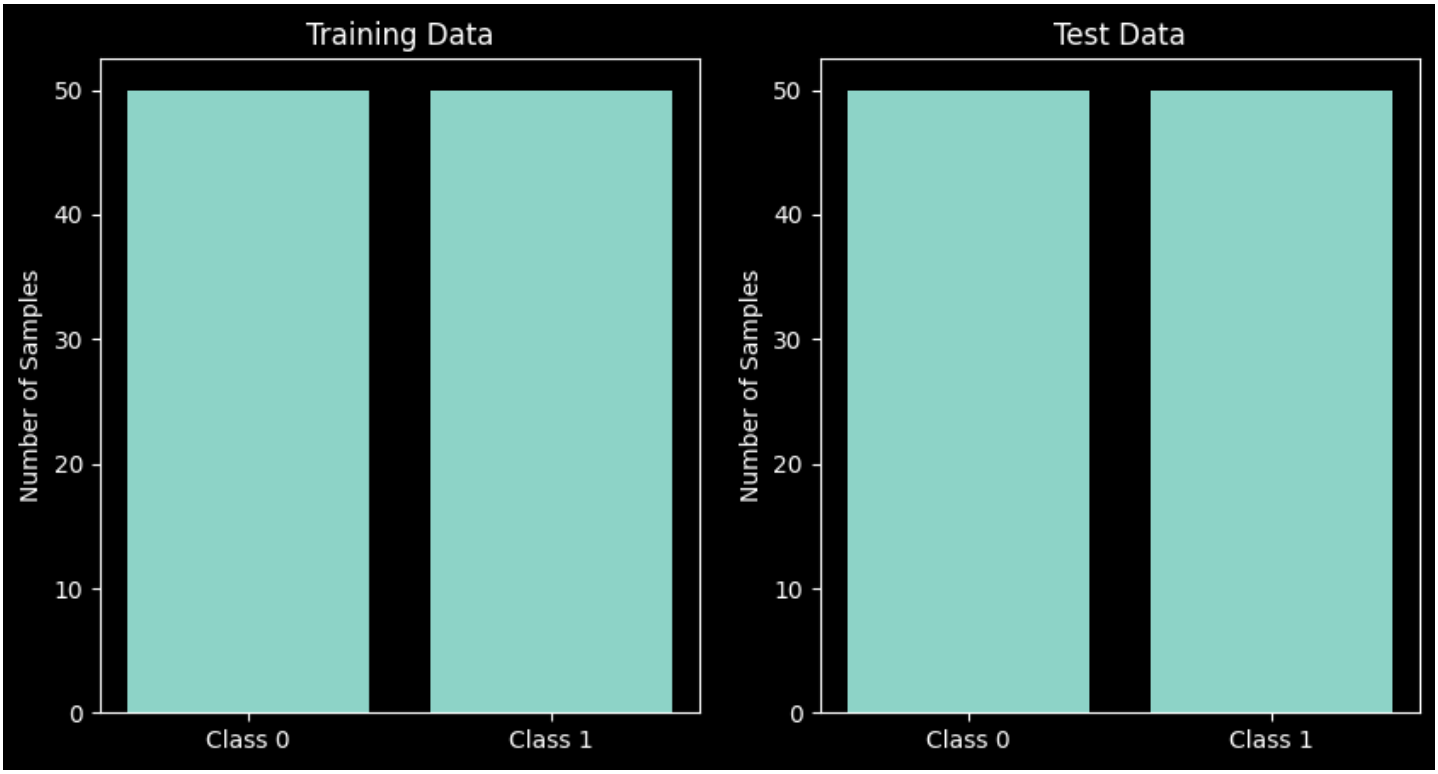
```
Class 0: 50 Class 1: 50
Class 0: 50 Class 1: 50
```

In [ ]:

```
def plot_class_balances(y_train, y_test):
    """
    Plots a bar chart of the class balances for the training and test sets.

    Args:
    y_train (numpy.ndarray): Training set labels.
    y_test (numpy.ndarray): Test set labels.
    """
    # Create a figure with two subplots
    fig, axs = plt.subplots(1, 2, figsize=(10, 5))

    # Plot a bar chart of the class balances for the training set
    axs[0].bar(['Class 0', 'Class 1'], [(y_train == 0).sum(), (y_train == 1).sum()])
    axs[0].set_title("Training Data")
    axs[0].set_ylabel("Number of Samples")

    # Plot a bar chart of the class balances for the test set
    axs[1].bar(['Class 0', 'Class 1'], [(y_test == 0).sum(), (y_test == 1).sum()])
    axs[1].set_title("Test Data")
    axs[1].set_ylabel("Number of Samples")

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

In [ ]:

```
plot_class_balances(y_train, y_test)
```



In [ ]:

```
def preprocess_labels(y_train, y_test):
    """
    Converts the label format from 0/1 to -1/1 and adds an extra column of ones to the la
bel arrays.

    Args:
    y_train (numpy.ndarray): Training set labels.
    y_test (numpy.ndarray): Test set labels.

    Returns:
    Tuple of preprocessed label arrays (numpy.ndarray) for the training and test sets.
    """
    # Convert the label format from 0/1 to -1/1
    y_train = tf.keras.utils.to_categorical(y_train)*2-1
    y_test = tf.keras.utils.to_categorical(y_test)*2-1

    # Add an extra column of ones to the label arrays
    y_train = np.concatenate((y_train, np.ones((len(y_train), 1))), axis=1)
    y_test = np.concatenate((y_test, np.ones((len(y_test), 1))), axis=1)

    # Print the shapes of the preprocessed label arrays
    print("Preprocessed label shapes:", y_train.shape, y_test.shape)

    # Return the preprocessed label arrays
    return y_train, y_test
```

In [ ]:

```
preprocess_labels(y_train, y_test)
```

```
(100, 3) (100, 3)
```

QGAN

Generative Adversarial Networks (GANs) are a type of deep learning model that have gained popularity for their ability to generate realistic and high-quality synthetic data. The basic idea behind GANs is to train two neural networks simultaneously: a generator and a discriminator. The generator is responsible for creating samples that resemble the training set's data, while the discriminator tries to differentiate between real and generated

samples. This setup creates a feedback loop, where the generator tries to produce better samples to fool the discriminator, while the discriminator tries to become better at identifying fake samples.

While GANs have shown impressive results in many applications, they are limited by the computational power of classical computers. Quantum computing has emerged as a promising platform for machine learning, as it offers the potential for exponential speedup over classical computers for certain tasks. QGANs are a natural extension of GANs to the quantum computing domain.

QGANs implement the generator and discriminator functions using quantum circuits, which can create or categorize quantum states by leveraging quantum entanglement and superposition. In QGANs, the generator and discriminator are implemented as quantum circuits that take quantum states as input and output. The generator circuit takes a quantum state as input and applies a series of quantum gates to produce a new quantum state that represents a generated sample. The discriminator circuit takes a quantum state as input and applies a series of quantum gates to measure whether the input state is real or fake.

Classical Data to Quantum Data: Angle Encoding

Classical data can be represented as a vector of real numbers, for example, a set of features x = (x1, x2, ..., xn) representing a sample. To convert this classical data into a quantum state, angle encoding can be used.

In angle encoding, each feature xi is treated as an angle θi for an RY gate that acts on a qubit. The RY gate can be defined as:

$$RY(\theta) = \begin{pmatrix} \cos(\frac{\theta}{2}) & -\sin(\frac{\theta}{2}) \\ \sin(\frac{\theta}{2}) & \cos(\frac{\theta}{2}) \end{pmatrix}$$

Thus, for a sample with n features, we would require n qubits with an RY gate on each qubit to encode the data. We can represent the quantum state for this sample as:

$$|\psi\rangle = RY(\theta_1) \otimes RY(\theta_2) \otimes \ldots \otimes RY(\theta_n)|0\rangle^n$$

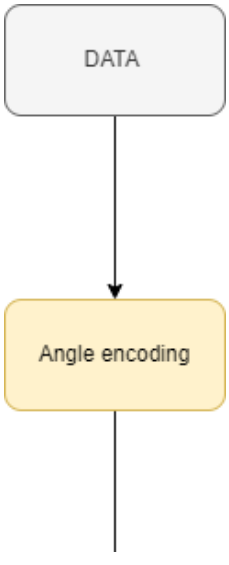
where $|0\rangle^n$ represents the n-qubit zero state.

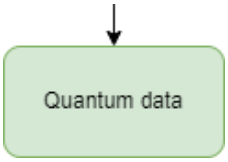
For example, if we have a sample with 5 features $(x_1, x_2, x_3, x_4, x_5)$, we would require 5 qubits and the quantum state would be:

$$|\psi\rangle = RY(\theta_1) \otimes RY(\theta_2) \otimes RY(\theta_3) \otimes RY(\theta_4) \otimes RY(\theta_5)|0\rangle^5$$

where $\theta_1, \theta_2, \theta_3, \theta_4, \theta_5$ are the angles corresponding to each feature.

Angle encoding can be used as a preprocessing step for various quantum machine learning algorithms, such as quantum support vector machines and quantum neural networks, to convert classical data into a quantum state that can be processed on a quantum computer.





In [ ]:

```
def generate_data(X, qubits):
    """
    Generate quantum data from the dataset with angle encoding.

    Args:
    X (numpy.ndarray): The dataset to be encoded.
    qubits (list): The list of qubits to be used for the encoding.

    Returns:
    list: A list of Cirq circuits representing the quantum-encoded data.
    """

    quantum_data = []
    # iterate through data samples
    for sample in X:
        circuit = cirq.Circuit()
        # iterate through sample's features
        for bit in range(len(sample)):
            circuit.append(cirq.ry(sample[bit])(qubits[bit]))

        quantum_data.append(circuit)

    return quantum_data
```

In [ ]:

```
def convert_to_quantum_data(data, qubits):
    """
    Converts classical data to quantum data using the given qubits.

    Args:
    data (numpy.ndarray): Input data to be converted.
    qubits (List[cirq.GridQubit]): List of qubits to be used for conversion.

    Returns:
    Quantum data (tf.Tensor) in the form of a tensor of circuit diagrams.
    """
    # Generate circuit diagrams for the input data using the given qubits
    circuit_diagrams = []
    for datum in data:
        circuit_diagram = generate_circuit(qubits, datum)
        circuit_diagrams.append(circuit_diagram)

    # Convert the circuit diagrams to a tensor of quantum data
    quantum_data = tfq.convert_to_tensor(circuit_diagrams)

    # Return the quantum data tensor
    return quantum_data
```

Discriminating Signal Events from Background Events using Quantum Generative Adversarial Networks (QGANs) with Parametrized Quantum Circuits (PQCs)

The problem of discriminating signal events from background events is a fundamental challenge in many areas of physics, including particle physics and quantum computing. To address this challenge, we propose using a quantum generative adversarial network (QGAN), which consists of a generator and a discriminator.

The generator in our QGAN is a parametrized quantum circuit (PQC), which is designed to create synthetic data that resembles real data. The discriminator, on the other hand, is also a PQC, which is tasked with classifying the data into the correct label and determining whether the data is real or fake, in order to assess the quality of the generated data.

The architecture of our quantum discriminator is shown in Figures 1 and 2. There are 8 qubits in the discriminator, with the first five qubits being the data qubits and the final three qubits being the output qubits. Each data qubit is given a Hadamard gate, followed by a number of one-qubit unitaries and CNOT gates that entangle nearby qubits. For multiple layers, one can repeat the one-qubit unitaries and CNOT gates. At the end of the circuit, each output qubit receives a final one-qubit unitary gate. Pauli-Z gates are used to measure each output qubit.

The discriminator is trained on both quantum fake data and quantum real data. The quantum fake data is generated by the generator, while the quantum real data is obtained by encoding the real data through angle encoding. The discriminator is trained to output three values: the real/fake prediction [D] and the two class predictions [C0, C1]. The values of [C0, C1] correspond to the probabilities of the input data belonging to each class.

The discrimination task is formalized as follows: given an input quantum state $|\psi\rangle$, the discriminator output is a vector of three values $[D, C0, C1]$, where D is the binary real/fake decision and $C0$ and $C1$ are the class probabilities. Mathematically, the output of the discriminator can be written as:

[D, C0, C1] = Discriminator(|ψ⟩)

In [ ]:

```
# Define the qubits to be used for the conversion
qubits = cirq.GridQubit.rect(1, 5)

# Convert the classical data to quantum data using the qubits
train_quantum_data = convert_to_quantum_data(x_train, qubits)
test_quantum_data = convert_to_quantum_data(x_test, qubits)
```

In [ ]:

```
SVGCircuit(tfq.from_tensor(train_quantum_data)[y_train[:, 0]==1][0])
```

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```

Out[ ]:

In [ ]:

```
SVGCircuit(tfq.from_tensor(train_quantum_data)[y_train[:, 0]==-1][0])
```

```
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```

Out[ ]:

We will create a Quantum generator function that requires three inputs: qubits, symbols, and layer. Qubits is a list of qubits that will be acted on by the circuit, symbols is a list of parameters that will be used to construct the circuit, and layer is an optional argument that determines the number of gate layers in the circuit, with a default value of 1

value of 1.

In [ ]:

```
def one_qubit_unitary(bit, symbols):
    """Make a Cirq circuit enacting a rotation of the bloch sphere about the X,
    Y and Z axis, that depends on the values in `symbols`.

    Args:
        bit (cirq.Qid): The qubit to apply the unitary to.
        symbols (list): A list of three float values representing the angles
            of rotation about the X, Y and Z axis respectively.

    Returns:
        cirq.Circuit: A Cirq circuit implementing the desired one-qubit unitary.
    """
    return cirq.Circuit(
        cirq.X(bit)**symbols[0],
        cirq.Y(bit)**symbols[1],
        cirq.Z(bit)**symbols[2])


def two_qubit_unitary(bits, symbols):
    """Make a Cirq circuit that creates an arbitrary two qubit unitary.

    Args:
        bits (list): A list of two cirq.Qid objects representing the two qubits
            to apply the unitary to.
        symbols (list): A list of 14 float values representing the parameters
            of the two-qubit unitary operation.

    Returns:
        cirq.Circuit: A Cirq circuit implementing the desired two-qubit unitary.
    """
    circuit = cirq.Circuit()
    circuit += one_qubit_unitary(bits[0], symbols[0:3])
    circuit += one_qubit_unitary(bits[1], symbols[3:6])
    circuit += [cirq.ZZ(*bits)**symbols[6]]
    circuit += [cirq.YY(*bits)**symbols[7]]
    circuit += [cirq.XX(*bits)**symbols[8]]
    circuit += one_qubit_unitary(bits[0], symbols[9:12])
    circuit += one_qubit_unitary(bits[1], symbols[12:])
    return circuit
```

In [ ]:

```
def generator(qubits, symbols, layer=1):
    """Generates a random quantum circuit that consists of layers of one-qubit unitary
    gates and two-qubit entangling gates.

    Args:
        qubits (list): A list of cirq.Qid objects representing the qubits to apply
            the quantum circuit to.
        symbols (list): A list of float values representing the parameters for the
            one-qubit unitary gates and two-qubit entangling gates in the circuit.
        layer (int): The number of layers to add to the circuit.

    Returns:
        cirq.Circuit: A randomly generated quantum circuit that can be applied to the
            specified qubits.
    """
    # Create an empty quantum circuit using Cirq.
    circuit = cirq.Circuit()

    # Add a layer of random rotations to the first half of the qubits list, using the `ry
` gate.
    random_angle = np.random.normal(loc=0, scale=np.pi/3, size=int(len(qubits)/2))
    for i in range(int(len(qubits)/2)):
        circuit += cirq.ry(random_angle[i])(qubits[i])

    # Loop over `layer` iterations, adding two sub-layers to the circuit in each iteratio
n.
```

```
    for i in range(layer):
        # First sub-layer: apply a set of one-qubit unitary gates to each qubit, using a
set of symbols from the `symbols` list.
        for j in range(len(qubits)):
            circuit += one_qubit_unitary(qubits[j], symbols[3*j + 3*i*len(qubits) : 3*(j
+1) + 3*i*len(qubits)])

        # Second sub-layer: entangle adjacent qubits in `qubits` using the `CNOT` gate.
        for j in range(len(qubits)):
            if j != (len(qubits)-1):
                circuit += cirq.CNOT(qubits[j], qubits[j+1])
            else:
                pass

    # Final sub-layer: apply a final set of one-qubit unitary gates to the first half of
the `qubits` list using a set of symbols from the end of the `symbols` list.
    symbols_last_unitary = symbols[-(3*int(len(qubits)/2)):]
    for i in range(int(len(qubits)/2)):
        circuit += one_qubit_unitary(qubits[i], symbols_last_unitary[3*i : 3*(i+1)])

    # Return the resulting quantum circuit.
    return circuit
```

In [ ]:

```
# params total: (3*features*2)*layer params + (3*features) final params
SVGCircuit(generator(cirq.GridQubit.rect(1, 10), sympy.symbols('generator:105'), layer=2
))
```

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```

Out[ ]:

The loss function in GANs is a key component of the training process, as it is used to evaluate the performance of the discriminator and generator models. The loss function for the discriminator is typically defined as the negative average of the sum of the logarithms of its predictions for the fake and real data.

Let mfake and mreal denote the total number of fake and real data samples in the batch, respectively. Let D(x) be the discriminator's output for data point x, where D(x) is a real number between 0 and 1. Then the discriminator loss, LD, can be expressed as:

$$LD = -(1/mfake) \sum i=1^{mfake} \log(1 - D(xifake)) - (1/mreal) \sum j=1^{mreal} \log(D(xjreal))$$

where xifake represents the i-th fake data point and xjreal represents the j-th real data point. The first term in the equation represents the average negative logarithm of the discriminator's output for the fake data, while the second term represents the average logarithm of its output for the real data.

The loss function for the classifier, LC, is typically defined as the categorical cross-entropy loss function. Let ytrue be the true label set of all the samples in the batch, and let C(x) be the class prediction from the classifier. Then LC can be expressed as:

$$LC = -\sum i=1^{m}\ ytrue,i * \log(C(xi))$$

where xi is the i-th data point in the batch, and ytrue,i is its corresponding true label. The loss is computed as the sum of the negative logarithms of the predicted probabilities for the true classes.

The final loss function, L, is a weighted sum of the discriminator and classifier losses, where the weight parameter Cweight determines the relative importance of each task. The loss function can be expressed as:

$$L = (1 - Cweight)\ LD + Cweight\ LC$$

When Cweight is high, the classifier is prioritized, while a low Cweight gives priority to the generator's output.

In [ ]:

```python
def discriminator(data_qubits, output_qubits, symbols, layer=1):
    """
    Constructs a Cirq circuit for a discriminator in a quantum machine learning model.

    Args:
        data_qubits (List[cirq.GridQubit]): List of qubits used for encoding input data.
        output_qubits (List[cirq.GridQubit]): List of qubits used for the discriminator's output.
        symbols (np.ndarray): Array of floats used to define the parameters of the unitary operations in the circuit.
        layer (int): Number of layers in the circuit. Default is 1.

    Returns:
        circuit (cirq.Circuit): A Cirq circuit representing the discriminator.
    """
    circuit = cirq.Circuit()

    # Hadamard layer for data qubits
    for i in range(len(data_qubits)):
        circuit += cirq.H(data_qubits[i])
```

```
    qubits = data_qubits + output_qubits
    for i in range(layer):
        # unitary layer
        for j in range(len(qubits)):
            circuit += one_qubit_unitary(qubits[j], symbols[3*j + 3*i*len(qubits) : 3*(j
+1) + 3*i*len(qubits)])

        # entangling layer
        for j in range(len(qubits)):
            if j != (len(qubits)-1):
                circuit += cirq.CNOT(qubits[j], qubits[j+1])
            else:
                pass

    # final unitary for output qubits
    symbols_last_unitary = symbols[-(3*len(output_qubits)):]
    for i in range(len(output_qubits)):
        circuit += one_qubit_unitary(output_qubits[i], symbols_last_unitary[3*i : 3*(i+1
)])

    return circuit
```

In [ ]:

```
qubits = cirq.GridQubit.rect(1, 5+3)
# params total: (3 * (features + (num_class + 1)))*layer + 3*(num_class + 1) final param
s
SVGCircuit(discriminator(qubits[0:5], qubits[5:], sympy.symbols('discriminator:57'), lay
er=2))
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Out[ ]:

In [ ]:

```
def create_gen_disc_circuit(symbols_gen, symbols_disc, qubits, num_features, num_class,
gen_layer=1, disc_layer=1):
    """
    Constructs a Cirq circuit for a generator-discriminator pair in a quantum machine lea
rning model.

    Args:
```

```
        symbols_gen (np.ndarray): Array of floats used to define the parameters of the ge
nerator circuit.
        symbols_disc (np.ndarray): Array of floats used to define the parameters of the d
iscriminator circuit.
        qubits (List[cirq.GridQubit]): List of qubits used for the quantum circuit.
        num_features (int): Number of features in the input data.
        num_class (int): Number of classes in the classification task.
        gen_layer (int): Number of layers in the generator circuit. Default is 1.
        disc_layer (int): Number of layers in the discriminator circuit. Default is 1.

    Returns:
        gen_disc_circuit (cirq.Circuit): A Cirq circuit representing the generator-discri
minator pair.
    """
    gen_disc_circuit = cirq.Circuit()

    # add the generator
    gen_disc_circuit += generator(qubits[:len(qubits)-(num_class+1)], symbols_gen, layer
=gen_layer)
    # add the discriminator
    gen_disc_circuit += discriminator(qubits[:int((len(qubits)-(num_class+1))/2)], qubit
s[len(qubits)-(num_class+1):], symbols_disc, layer=disc_layer)

    return gen_disc_circuit
```

In [ ]:

```
# model fix parameters
num_class = 2
num_features = 5
gen_layer = 6
disc_layer = 6

total_gen_params = (3*num_features*2)*gen_layer + (3*num_features)
total_disc_params = (3*(num_features + num_class + 1))*disc_layer + 3*(num_class + 1)

print(total_gen_params, total_disc_params)
```

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195 153
```
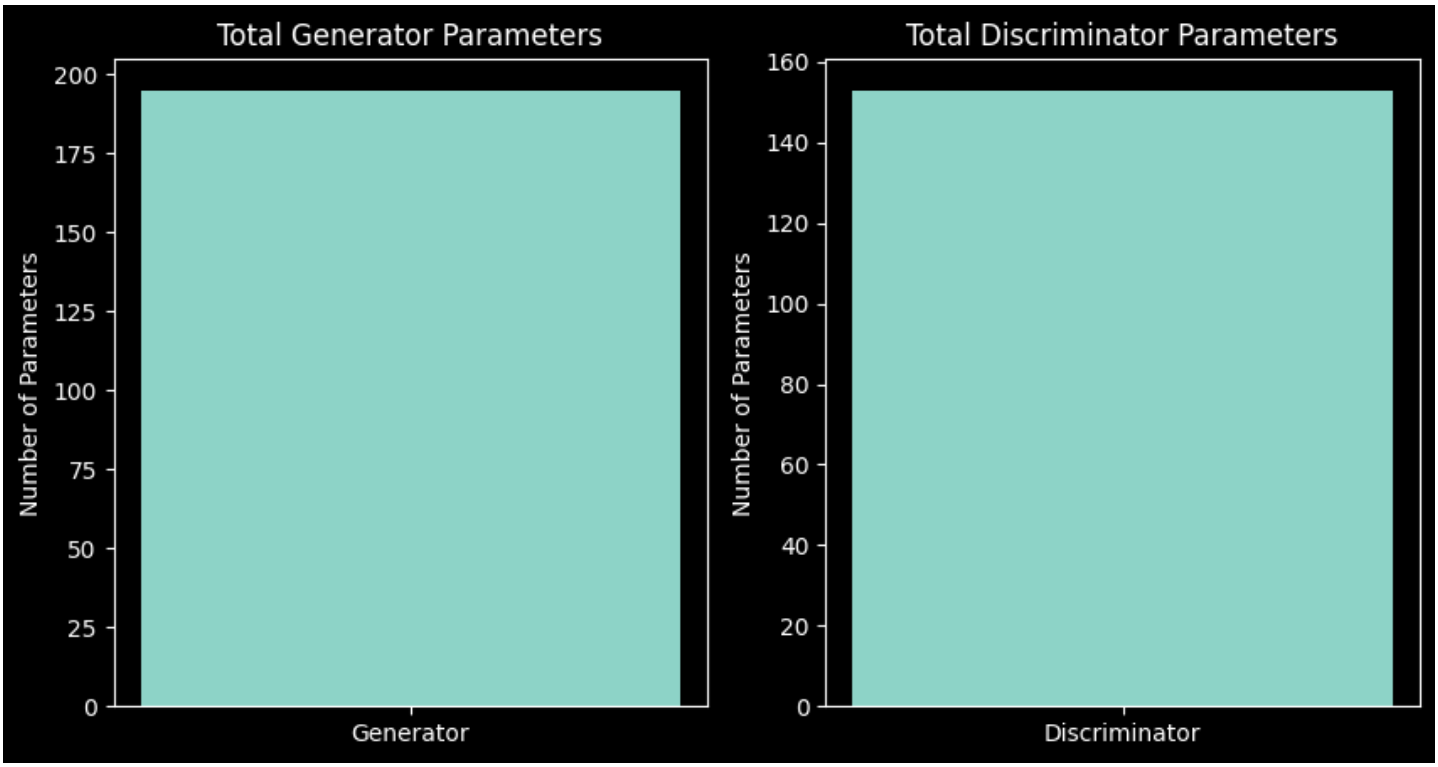

In [ ]:

```
def visualize_model_params(total_gen_params, total_disc_params):
    """
    Plots a bar chart showing the number of parameters in the generator and discriminator
models.

    Args:
    total_gen_params (int): Total number of parameters in the generator model.
    total_disc_params (int): Total number of parameters in the discriminator model.

    Returns:
    None
    """
    # Create a figure with two subplots
    fig, axs = plt.subplots(1, 2, figsize=(10, 5))

    # Plot the number of parameters in the generator model
    axs[0].bar(['Generator'], [total_gen_params])
    axs[0].set_title("Total Generator Parameters")
    axs[0].set_ylabel("Number of Parameters")

    # Plot the number of parameters in the discriminator model
    axs[1].bar(['Discriminator'], [total_disc_params])
    axs[1].set_title("Total Discriminator Parameters")
    axs[1].set_ylabel("Number of Parameters")

    # Display the bar chart
    plt.show()
```

In [ ]:

```
visualize_model_params(total_gen_params, total_disc_params)
```



In [ ]:

```
# trainable parameters
symbols_gen = sympy.symbols('gen0:' + str(total_gen_params))
symbols_disc = sympy.symbols('disc0:' + str(total_disc_params))

# qubits
qgan_qubits = cirq.GridQubit.rect(1, num_features*2 + num_class + 1)
```

The discriminator loss function is used to train the discriminator network in a Generative Adversarial Network (GAN). The discriminator network tries to distinguish between real and fake data, and the loss function is used to update the network's parameters to improve its performance.

The discriminator loss function consists of two parts: the first part calculates the loss based on the discriminator's ability to correctly classify real and fake data (D_loss), while the second part calculates the loss based on the discriminator's ability to correctly classify the class label of the data (C_loss).

The code uses the sigmoid activation function to transform the discriminator's output to a value between 0 and 1, which is interpreted as the probability that the input is real. The loss is calculated using binary cross-entropy loss for D_loss and categorical cross-entropy loss for C_loss.

The C_weight variable is used to control the weight of the C_loss term in the overall loss function. The discriminator loss function is defined as a TensorFlow function to take advantage of the performance benefits of TensorFlow's computation graph.

In [ ]:

```
C_weight = 0.5

@tf.function
def disc_loss(y_true, y_pred):
    """
    This function defines the loss function for the discriminator network in a conditiona
l GAN.
    The loss function is a combination of the binary cross-entropy loss for the discrimin
ator output
    and the categorical cross-entropy loss for the classifier output.

    Args:
    y_true: A tensor of shape (batch_size, 3), representing the true labels.
    The first two columns correspond to the true class labels (one-hot encoded) and
```

```
    the third column corresponds to the discriminator's true/fake label (1 for true, -1 f
or fake).
    y_pred: A tensor of shape (batch_size, 3), representing the predicted labels.
    The first two columns correspond to the predicted class labels (one-hot encoded) and
    the third column corresponds to the discriminator's predicted true/fake label.

    Returns:
    A tensor representing the loss for the discriminator network.

    """
    # Binary cross-entropy loss for the discriminator output
    D_true = (y_true[:, 2] + 1)/2
    D_pred = (y_pred[:, 2] + 1)/2

    D_loss = -1*(tf.math.log(D_pred + 1e-10)*D_true + tf.math.log(1 - D_pred + 1e-10)*(D
_true - 1)*(-1))
    D_loss = tf.reduce_mean(D_loss, axis=0)

    # Categorical cross-entropy loss for the classifier output
    C_true = (y_true[:, :2] + 1)/2
    C_pred = (y_pred[:, :2] + 1)/2

    # Weight the loss for real samples
    D_true_size = tf.cast(tf.size(tf.where(D_true == 1), out_type=tf.int32), dtype=tf.fl
oat32) + 1e-10
    C_loss = tf.math.reduce_sum(tf.keras.losses.CategoricalCrossentropy(reduction='none'
)(C_true, C_pred) * D_true)/D_true_size

    return (1-C_weight)*D_loss + C_weight*C_loss
```

In [ ]:

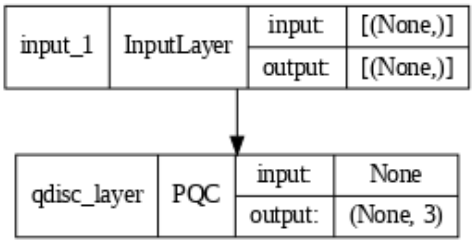
```
@tf.function
def custom_accuracy(y_true, y_pred):
    """
    Computes the custom accuracy metric for the model.

    The metric takes into account the class weights and the discriminator's predictions.

    Parameters:
    y_true (tensor): A tensor of true labels.
    y_pred (tensor): A tensor of predicted labels.

    Returns:
    Tensor: A scalar tensor representing the custom accuracy metric.

    """
    # Compute the weights for each sample based on their true label.
    D_true = (y_true[:, 2] + 1) / 2

    # Extract the real class labels from the tensors.
    C_real_true = (y_true[:, :2] + 1) / 2
    C_real_pred = (y_pred[:, :2] + 1) / 2

    # Compute the predicted class labels.
    C_real_true = tf.math.argmax(C_real_true, axis=1)
    C_real_pred = tf.math.argmax(C_real_pred, axis=1)

    # Compute the accuracy only for the samples with a true label of 1 (class 1).
    same = tf.cast(C_real_true == C_real_pred, tf.float32) * D_true

    # Compute the size of the true class 1 samples.
    D_true_size = tf.cast(tf.size(tf.where(D_true == 1), out_type=tf.int32), dtype=tf.fl
oat32) + 1e-10

    # Compute and return the custom accuracy metric.
    return tf.math.reduce_sum(same) / D_true_size
```

In [ ]:

```
# discriminator model
```

```
def discriminator_model(discriminator_weights):
    """
    Defines the discriminator model and compiles it with the Adam optimizer and the custo
m loss and accuracy functions.
    Args:
    discriminator_weights: trainable initial values of the symbols in the quantum gates o
f the discriminator model.

    Returns:
    qdisc_model: compiled discriminator model
    """
    # Define the operators for the qubits in the discriminator readout layer
    disc_readout_operators = [cirq.Z(qgan_qubits[-(num_class+1) + q]) for q in range(num
_class+1)]

    # Define data input
    data_input = tf.keras.Input(shape=(), dtype=tf.dtypes.string)

    # Define the quantum layer for the discriminator
    qdisc_layer = tfq.layers.PQC(discriminator(qgan_qubits[:int((len(qgan_qubits)-(num_c
lass+1))/2)],
                  qgan_qubits[len(qgan_qubits)-(num_class+1):], discriminator_weights, l
ayer=disc_layer),
                  disc_readout_operators, name='qdisc_layer')(data_input)

    # Define and compile the discriminator model
    qdisc_model = tf.keras.Model(inputs=[data_input], outputs=[qdisc_layer])
    qdisc_model.compile(optimizer=tf.keras.optimizers.Adam(learning_rate=0.001),
                        loss=disc_loss,
                        metrics=[custom_accuracy])

    return qdisc_model


qdisc_model = discriminator_model(symbols_disc)

# Show the keras plot of the model
tf.keras.utils.plot_model(qdisc_model,
                          show_shapes=True,
                          show_layer_names=True,
                          dpi=70)
```

Out[ ]:



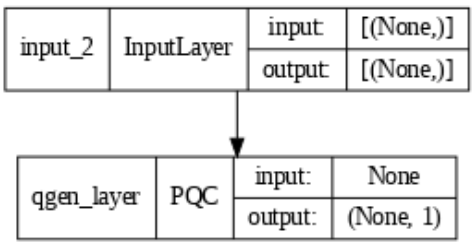
In [ ]:

```
def gen_loss(y_true, y_pred):
    """
    Calculates the generator loss.
    Arguments:
    y_true -- tensor of true labels
    y_pred -- tensor of predicted labels

    Returns:
    Generator loss as a tensor.
    """
    D_fake = (y_pred[:, 2] + 1)/2
    G_loss = tf.reduce_mean((-1)*tf.math.log(D_fake), axis=0)
    return G_loss
```

In [ ]:

```
def generator_model(generator_symbols, discriminator_weights):
    """
    Creates and compiles a quantum generator model with a given set of generator symbols
and discriminator weights.

    Args:
        generator_symbols (List[cirq.Symbol]): A list of cirq.Symbol objects representing
the the generator parameters.
        discriminator_weights (numpy.ndarray): An array of weights representing the train
ed discriminator model.

    Returns:
        A compiled quantum generator model.
    """
    # Define readout operators for the generator
    generator_readout_operators = cirq.Z(qgan_qubits[-1])

    # Define input layer for the model
    data_input = tf.keras.Input(shape=(), dtype=tf.dtypes.string)

    # Define the PQC layer for the generator
    generator_layer = tfq.layers.PQC(
        create_gen_disc_circuit(
            generator_symbols, discriminator_weights,
            qgan_qubits, num_features, num_class,
            generator_layer=generator_layer, discriminator_layer=discriminator_layer
        ),
        generator_readout_operators,
        name='generator_layer'
    )(data_input)

    # Define the generator model with the input layer and PQC layer
    generator_model = tf.keras.Model(inputs=[data_input], outputs=[generator_layer])

    # Compile the generator model with Adam optimizer and generator loss
    generator_model.compile(
        optimizer=tf.keras.optimizers.Adam(learning_rate=0.001),
        loss=generator_loss
    )

    return generator_model

# Create the generator model with the generator symbols and the weights from the discrimi
nator model
generator_model = create_generator_model(generator_symbols, discriminator_model.get_weigh
ts()[0])

# Plot the model using Keras' plot_model utility
tf.keras.utils.plot_model(
    generator_model,
    show_shapes=True,
    show_layer_names=True,
    dpi=70
)
```

Out[ ]:



In [ ]:

```
def generate_identity_data(data_samples):
    """
    Generates identity quantum data for a given number of samples.
```

```
    Args:
        data_samples (int): The number of data samples to generate.

    Returns:
        A list of cirq.Circuit objects representing the identity quantum data.
    """
    identity_data = []
    # iterate through data samples
    for sample_index in range(data_samples):
        circuit = cirq.Circuit()

        identity_data.append(circuit)

    return identity_data
```

In [ ]:

```
identity_data = tfq.convert_to_tensor(generate_identity(x_train))
identity_label = np.zeros((len(identity_data),))

# Sanity check
print(len(identity_data), identity_label.shape)
```

```
100 (100,)
```

In [ ]:

```
# Plot the distribution of the identity data
def plot_identity_data_distribution(identity_data):
    """
    Plots the distribution of identity quantum data.

    Args:
        identity_data (list): A list of cirq.Circuit objects representing the identity qu
antum data.
    """
    # Set the font to Arial
    plt.rcParams['font.family'] = 'Arial'

    # Create a histogram of the identity data values
    flattened_identity_data = np.array([identity_data_sample for identity_data_sample in
identity_data]).flatten()
    fig, axs = plt.subplots(figsize=(7, 5))
    axs.hist(flattened_identity_data, bins=50)

    # Set the plot title, x-axis label, and y-axis label
    axs.set_title("Identity Data Distribution")
    axs.set_xlabel("Value")
    axs.set_ylabel("Count")

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

In [ ]:

```
# Plotting the distribution of the identity data
plot_identity_data_distribution(identity_data)
```

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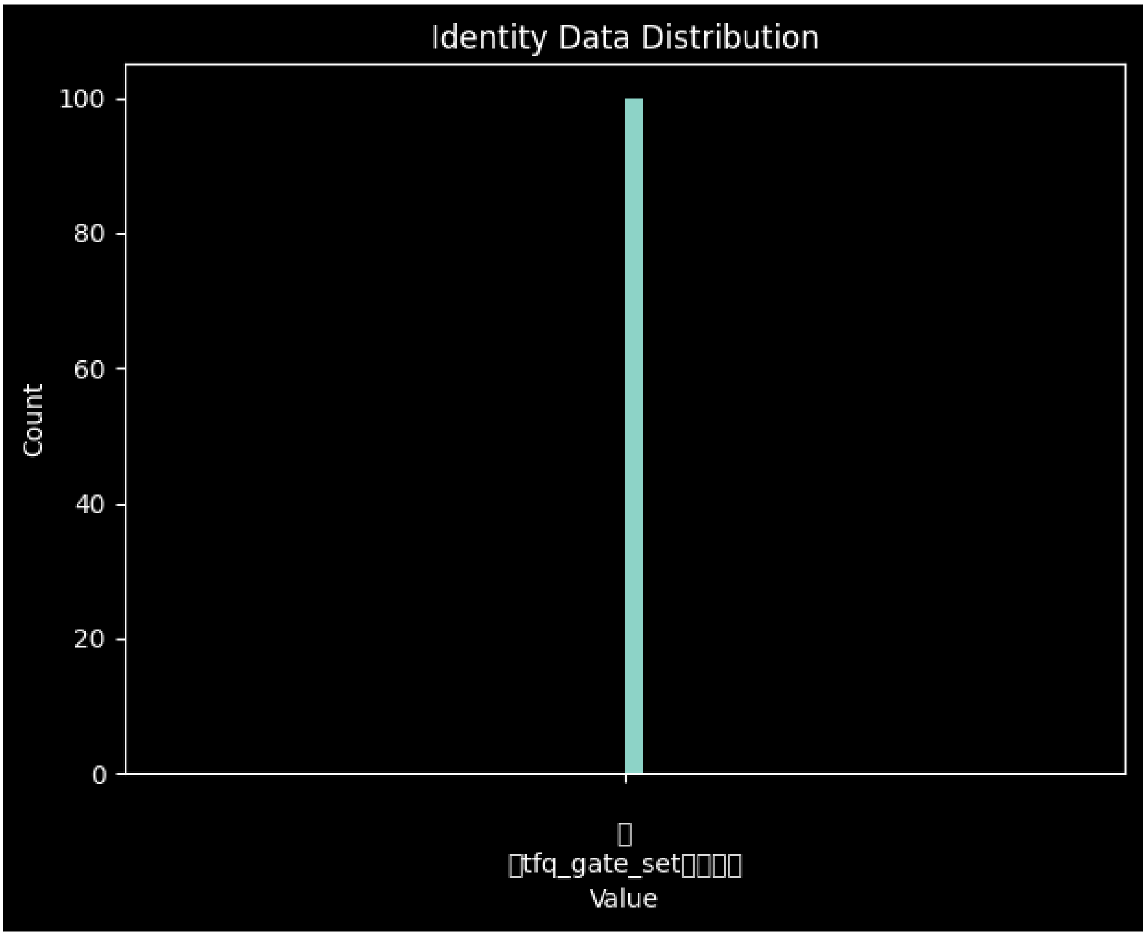
```



In [ ]:

```
def generate_fake_data(real_data_samples, qubits, generator_symbols, generator_layer=1):
    """
    Generates fake quantum data using a quantum generator circuit.

    Args:
        real_data_samples (int): The number of real data samples used to determine how ma
ny fake samples to generate.
        qubits (list): A list of cirq.GridQubit objects representing the qubits to use in
the generator circuit.
        generator_symbols (list): A list of cirq.Symbol objects representing the symbols
to use in the generator circuit.
        generator_layer (int): The number of layers to use in the generator circuit.
```

```
    Returns:
        A list of cirq.Circuit objects representing the fake quantum data.
    """
    fake_data = []
    # iterate through the number of fake samples to generate
    for _ in range(real_data_samples):
        generator_circuit = generator(qubits[:2 * len(generator_symbols)], generator_symbols, layer=generator_layer)

        fake_data.append(generator_circuit)

    return fake_data
```

In [ ]:

```
fake_data = tfq.convert_to_tensor(generate_fake_data(x_train, qgan_qubits, qgen_model.get_weights()[0], layer=gen_layer))
y_true_fake = np.zeros((len(fake_data), num_class+1))
y_true_fake[:, 2] += (-1)

y_true_fake.shape
```

Out[ ]:

```
(100, 3)
```

In [ ]:

```
SVGCircuit(tfq.from_tensor(fake_data)[0])
```

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Out[ ]:

In [ ]:

```
SVGCircuit(tfq.from_tensor(fake_data)[1])
```

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```

Out[ ]:

In [ ]:

```
# Model initialization
qdisc_model = discriminator_model(symbols_disc)
qgen_model = generator_model(symbols_gen, qdisc_model.get_weights()[0])
```

In [ ]:

```
def checkpoints(cycle):
    gen_model_cp = tf.keras.callbacks.ModelCheckpoint(
        filepath='cp_generator_' + str(cycle) + '.h5',
        save_weights_only=True,
        monitor='loss',
        mode='min',
        save_best_only=True)

    disc_model_cp = tf.keras.callbacks.ModelCheckpoint(
        filepath='cp_disc_' + str(cycle) + '.h5',
        save_weights_only=True,
        monitor='custom_accuracy',
        mode='max',
        save_best_only=True)

    return gen_model_cp, disc_model_cp
```

In [ ]:

```
def train_qgen(epochs, batch, verbose):
    # Fit the Generator Model
    history = qgen_model.fit(x=identity_data,
                             y=identity_label,
                             batch_size=batch,
                             epochs=epochs,
                             verbose=verbose,
                             callbacks=[gen_model_cp])

    return history
```

In [ ]:

```
def train_qdisc(epochs, batch, verbose):
    # Fit the Discriminator Model
    history = qdisc_model.fit(x=gen_data_train,
                              y=y_gen_train,
                              batch_size=batch,
                              epochs=epochs,
                              verbose=verbose,
                              callbacks=[disc_model_cp],
                              validation_data=(gen_data_test, y_gen_test)
                              )
    return history
```

In [ ]:

```
best_qdisc_weights = qdisc_model.get_weights()[0]
best_qgen_weights = qgen_model.get_weights()[0]

# re-declare the generator model using the discriminator's weights
qgen_model = generator_model(symbols_gen, qdisc_model.get_weights()[0])
```

In [ ]:

```
gen_model_cp, disc_model_cp = checkpoints(cycle=1)
```

In [ ]:

```
# Fit the Generator Model
H = train_qgen(2000, 100, 1)
```

```
Epoch 1/2000
1/1 [==============================] - 4s 4s/step - loss: 0.6485
Epoch 2/2000
1/1 [==============================] - 3s 3s/step - loss: 0.6432
Epoch 3/2000
1/1 [==============================] - 3s 3s/step - loss: 0.6380
Epoch 4/2000
1/1 [==============================] - 5s 5s/step - loss: 0.6328
Epoch 5/2000
1/1 [==============================] - 5s 5s/step - loss: 0.6276
Epoch 6/2000
1/1 [==============================] - 3s 3s/step - loss: 0.6225
Epoch 7/2000
1/1 [==============================] - 7s 7s/step - loss: 0.6174
Epoch 8/2000
1/1 [==============================] - 9s 9s/step - loss: 0.6124
Epoch 9/2000
1/1 [==============================] - 6s 6s/step - loss: 0.6074
Epoch 10/2000
1/1 [==============================] - 7s 7s/step - loss: 0.6025
Epoch 11/2000
1/1 [==============================] - 8s 8s/step - loss: 0.5977
Epoch 12/2000
1/1 [==============================] - 6s 6s/step - loss: 0.5929
Epoch 13/2000
1/1 [==============================] - 3s 3s/step - loss: 0.5882
Epoch 14/2000
1/1 [==============================] - 3s 3s/step - loss: 0.5837
Epoch 15/2000
1/1 [==============================] - 5s 5s/step - loss: 0.5792
Epoch 16/2000
1/1 [==============================] - 5s 5s/step - loss: 0.5749
Epoch 17/2000
1/1 [==============================] - 4s 4s/step - loss: 0.5706
Epoch 18/2000
1/1 [==============================] - 6s 6s/step - loss: 0.5666
Epoch 19/2000
1/1 [==============================] - 9s 9s/step - loss: 0.5626
Epoch 20/2000
1/1 [==============================] - 7s 7s/step - loss: 0.5588
Epoch 21/2000
```

```
1/1 [==============================] - 5s 5s/step - loss: 0.5551
Epoch 22/2000
1/1 [==============================] - 10s 10s/step - loss: 0.5515
Epoch 23/2000
1/1 [==============================] - 6s 6s/step - loss: 0.5481
Epoch 24/2000
1/1 [==============================] - 5s 5s/step - loss: 0.5448
Epoch 25/2000
1/1 [==============================] - 6s 6s/step - loss: 0.5415
Epoch 26/2000
1/1 [==============================] - 5s 5s/step - loss: 0.5384
Epoch 27/2000
1/1 [==============================] - 3s 3s/step - loss: 0.5353
Epoch 28/2000
1/1 [==============================] - 3s 3s/step - loss: 0.5323
Epoch 29/2000
1/1 [==============================] - 4s 4s/step - loss: 0.5293
Epoch 30/2000
1/1 [==============================] - 6s 6s/step - loss: 0.5263
Epoch 31/2000
1/1 [==============================] - 4s 4s/step - loss: 0.5234
Epoch 32/2000
1/1 [==============================] - 3s 3s/step - loss: 0.5204
Epoch 33/2000
1/1 [==============================] - 3s 3s/step - loss: 0.5175
Epoch 34/2000
1/1 [==============================] - 5s 5s/step - loss: 0.5146
Epoch 35/2000
1/1 [==============================] - 6s 6s/step - loss: 0.5116
Epoch 36/2000
1/1 [==============================] - 3s 3s/step - loss: 0.5087
Epoch 37/2000
1/1 [==============================] - 3s 3s/step - loss: 0.5057
Epoch 38/2000
1/1 [==============================] - 6s 6s/step - loss: 0.5028
Epoch 39/2000
1/1 [==============================] - 11s 11s/step - loss: 0.4998
Epoch 40/2000
1/1 [==============================] - 6s 6s/step - loss: 0.4968
Epoch 41/2000
1/1 [==============================] - 10s 10s/step - loss: 0.4938
Epoch 42/2000
1/1 [==============================] - 12s 12s/step - loss: 0.4909
Epoch 43/2000
1/1 [==============================] - 10s 10s/step - loss: 0.4879
Epoch 44/2000
1/1 [==============================] - 6s 6s/step - loss: 0.4849
Epoch 45/2000
1/1 [==============================] - 5s 5s/step - loss: 0.4819
Epoch 46/2000
1/1 [==============================] - 5s 5s/step - loss: 0.4789
Epoch 47/2000
1/1 [==============================] - 6s 6s/step - loss: 0.4759
Epoch 48/2000
1/1 [==============================] - 4s 4s/step - loss: 0.4729
Epoch 49/2000
1/1 [==============================] - 3s 3s/step - loss: 0.4700
Epoch 50/2000
1/1 [==============================] - 3s 3s/step - loss: 0.4670
Epoch 51/2000
1/1 [==============================] - 5s 5s/step - loss: 0.4641
Epoch 52/2000
1/1 [==============================] - 5s 5s/step - loss: 0.4611
Epoch 53/2000
1/1 [==============================] - 3s 3s/step - loss: 0.4582
Epoch 54/2000
1/1 [==============================] - 3s 3s/step - loss: 0.4554
Epoch 55/2000
1/1 [==============================] - 4s 4s/step - loss: 0.4525
Epoch 56/2000
1/1 [==============================] - 6s 6s/step - loss: 0.4497
Epoch 57/2000
```

```
1/1 [==============================] - 8s 8s/step - loss: 0.4469
Epoch 58/2000
1/1 [==============================] - 7s 7s/step - loss: 0.4442
Epoch 59/2000
1/1 [==============================] - 11s 11s/step - loss: 0.4415
Epoch 60/2000
1/1 [==============================] - 5s 5s/step - loss: 0.4388
Epoch 61/2000
1/1 [==============================] - 5s 5s/step - loss: 0.4362
Epoch 62/2000
1/1 [==============================] - 10s 10s/step - loss: 0.4337
Epoch 63/2000
1/1 [==============================] - 4s 4s/step - loss: 0.4312
Epoch 64/2000
1/1 [==============================] - 5s 5s/step - loss: 0.4287
Epoch 65/2000
1/1 [==============================] - 12s 12s/step - loss: 0.4264
Epoch 66/2000
1/1 [==============================] - 5s 5s/step - loss: 0.4240
Epoch 67/2000
1/1 [==============================] - 3s 3s/step - loss: 0.4218
Epoch 68/2000
1/1 [==============================] - 4s 4s/step - loss: 0.4196
Epoch 69/2000
1/1 [==============================] - 9s 9s/step - loss: 0.4174
Epoch 70/2000
1/1 [==============================] - 6s 6s/step - loss: 0.4153
Epoch 71/2000
1/1 [==============================] - 5s 5s/step - loss: 0.4132
Epoch 72/2000
1/1 [==============================] - 8s 8s/step - loss: 0.4112
Epoch 73/2000
1/1 [==============================] - 5s 5s/step - loss: 0.4093
Epoch 74/2000
1/1 [==============================] - 3s 3s/step - loss: 0.4074
Epoch 75/2000
1/1 [==============================] - 3s 3s/step - loss: 0.4055
Epoch 76/2000
1/1 [==============================] - 6s 6s/step - loss: 0.4037
Epoch 77/2000
1/1 [==============================] - 9s 9s/step - loss: 0.4019
Epoch 78/2000
1/1 [==============================] - 6s 6s/step - loss: 0.4002
Epoch 79/2000
1/1 [==============================] - 10s 10s/step - loss: 0.3984
Epoch 80/2000
1/1 [==============================] - 4s 4s/step - loss: 0.3968
Epoch 81/2000
1/1 [==============================] - 3s 3s/step - loss: 0.3951
Epoch 82/2000
1/1 [==============================] - 3s 3s/step - loss: 0.3935
Epoch 83/2000
1/1 [==============================] - 5s 5s/step - loss: 0.3919
Epoch 84/2000
1/1 [==============================] - 6s 6s/step - loss: 0.3903
Epoch 85/2000
1/1 [==============================] - 3s 3s/step - loss: 0.3888
Epoch 86/2000
1/1 [==============================] - 3s 3s/step - loss: 0.3872
Epoch 87/2000
1/1 [==============================] - 4s 4s/step - loss: 0.3857
Epoch 88/2000
1/1 [==============================] - 6s 6s/step - loss: 0.3842
Epoch 89/2000
1/1 [==============================] - 4s 4s/step - loss: 0.3828
Epoch 90/2000
1/1 [==============================] - 3s 3s/step - loss: 0.3813
Epoch 91/2000
1/1 [==============================] - 3s 3s/step - loss: 0.3799
Epoch 92/2000
1/1 [==============================] - 6s 6s/step - loss: 0.3785
Epoch 93/2000
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1/1 [==============================] - 9s 9s/step - loss: 0.3771
Epoch 94/2000
1/1 [==============================] - 3s 3s/step - loss: 0.3757
Epoch 95/2000
1/1 [==============================] - 3s 3s/step - loss: 0.3743
Epoch 96/2000
1/1 [==============================] - 3s 3s/step - loss: 0.3730
Epoch 97/2000
1/1 [==============================] - 6s 6s/step - loss: 0.3716
Epoch 98/2000
1/1 [==============================] - 4s 4s/step - loss: 0.3703
Epoch 99/2000
1/1 [==============================] - 3s 3s/step - loss: 0.3690
Epoch 100/2000
1/1 [==============================] - 4s 4s/step - loss: 0.3677
Epoch 101/2000
1/1 [==============================] - 5s 5s/step - loss: 0.3664
Epoch 102/2000
1/1 [==============================] - 5s 5s/step - loss: 0.3651
Epoch 103/2000
1/1 [==============================] - 3s 3s/step - loss: 0.3638
Epoch 104/2000
1/1 [==============================] - 3s 3s/step - loss: 0.3626
Epoch 105/2000
1/1 [==============================] - 3s 3s/step - loss: 0.3613
Epoch 106/2000
1/1 [==============================] - 6s 6s/step - loss: 0.3601
Epoch 107/2000
1/1 [==============================] - 5s 5s/step - loss: 0.3588
Epoch 108/2000
1/1 [==============================] - 3s 3s/step - loss: 0.3576
Epoch 109/2000
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Epoch 110/2000
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Epoch 111/2000
1/1 [==============================] - 6s 6s/step - loss: 0.3540
Epoch 112/2000
1/1 [==============================] - 4s 4s/step - loss: 0.3528
Epoch 113/2000
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Epoch 114/2000
1/1 [==============================] - 3s 3s/step - loss: 0.3504
Epoch 115/2000
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Epoch 119/2000
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Epoch 120/2000
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Epoch 121/2000
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Epoch 123/2000
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Epoch 125/2000
1/1 [==============================] - 5s 5s/step - loss: 0.3384
Epoch 126/2000
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Epoch 127/2000
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Epoch 128/2000
1/1 [==============================] - 3s 3s/step - loss: 0.3354
Epoch 129/2000
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1/1 [==============================] - 5s 5s/step - loss: 0.3344
Epoch 130/2000
1/1 [==============================] - 5s 5s/step - loss: 0.3335
Epoch 131/2000
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Epoch 134/2000
1/1 [==============================] - 6s 6s/step - loss: 0.3297
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Epoch 137/2000
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Epoch 138/2000
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Epoch 139/2000
1/1 [==============================] - 6s 6s/step - loss: 0.3251
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Epoch 142/2000
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Epoch 143/2000
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Epoch 144/2000
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Epoch 146/2000
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Epoch 148/2000
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Epoch 149/2000
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Epoch 150/2000
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Epoch 151/2000
1/1 [==============================] - 3s 3s/step - loss: 0.3149
Epoch 152/2000
1/1 [==============================] - 5s 5s/step - loss: 0.3141
Epoch 153/2000
1/1 [==============================] - 6s 6s/step - loss: 0.3132
Epoch 154/2000
1/1 [==============================] - 4s 4s/step - loss: 0.3124
Epoch 155/2000
1/1 [==============================] - 3s 3s/step - loss: 0.3116
Epoch 156/2000
1/1 [==============================] - 3s 3s/step - loss: 0.3108
Epoch 157/2000
1/1 [==============================] - 5s 5s/step - loss: 0.3100
Epoch 158/2000
1/1 [==============================] - 5s 5s/step - loss: 0.3092
Epoch 159/2000
1/1 [==============================] - 3s 3s/step - loss: 0.3083
Epoch 160/2000
1/1 [==============================] - 3s 3s/step - loss: 0.3075
Epoch 161/2000
1/1 [==============================] - 4s 4s/step - loss: 0.3067
Epoch 162/2000
1/1 [==============================] - 6s 6s/step - loss: 0.3059
Epoch 163/2000
1/1 [==============================] - 4s 4s/step - loss: 0.3052
Epoch 164/2000
1/1 [==============================] - 3s 3s/step - loss: 0.3044
Epoch 165/2000
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1/1 [==============================] - 3s 3s/step - loss: 0.3036
Epoch 166/2000
1/1 [==============================] - 5s 5s/step - loss: 0.3028
Epoch 167/2000
1/1 [==============================] - 6s 6s/step - loss: 0.3020
Epoch 168/2000
1/1 [==============================] - 4s 4s/step - loss: 0.3013
Epoch 169/2000
1/1 [==============================] - 3s 3s/step - loss: 0.3005
Epoch 170/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2997
Epoch 171/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2990
Epoch 172/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2982
Epoch 173/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2975
Epoch 174/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2968
Epoch 175/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2960
Epoch 176/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2953
Epoch 177/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2946
Epoch 178/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2939
Epoch 179/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2932
Epoch 180/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2925
Epoch 181/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2918
Epoch 182/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2912
Epoch 183/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2905
Epoch 184/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2898
Epoch 185/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2892
Epoch 186/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2885
Epoch 187/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2879
Epoch 188/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2873
Epoch 189/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2866
Epoch 190/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2860
Epoch 191/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2854
Epoch 192/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2848
Epoch 193/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2842
Epoch 194/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2836
Epoch 195/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2831
Epoch 196/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2825
Epoch 197/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2819
Epoch 198/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2814
Epoch 199/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2808
Epoch 200/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2803
Epoch 201/2000
```

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1/1 [==============================] - 3s 3s/step - loss: 0.2797
Epoch 202/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2792
Epoch 203/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2787
Epoch 204/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2782
Epoch 205/2000
1/1 [==============================] - 7s 7s/step - loss: 0.2777
Epoch 206/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2772
Epoch 207/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2767
Epoch 208/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2762
Epoch 209/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2757
Epoch 210/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2752
Epoch 211/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2747
Epoch 212/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2743
Epoch 213/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2738
Epoch 214/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2734
Epoch 215/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2729
Epoch 216/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2725
Epoch 217/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2720
Epoch 218/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2716
Epoch 219/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2712
Epoch 220/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2707
Epoch 221/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2703
Epoch 222/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2699
Epoch 223/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2695
Epoch 224/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2691
Epoch 225/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2687
Epoch 226/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2683
Epoch 227/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2679
Epoch 228/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2675
Epoch 229/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2671
Epoch 230/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2667
Epoch 231/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2664
Epoch 232/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2660
Epoch 233/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2656
Epoch 234/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2652
Epoch 235/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2649
Epoch 236/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2645
Epoch 237/2000
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1/1 [==============================] - 3s 3s/step - loss: 0.2642
Epoch 238/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2638
Epoch 239/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2634
Epoch 240/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2631
Epoch 241/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2627
Epoch 242/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2624
Epoch 243/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2620
Epoch 244/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2617
Epoch 245/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2614
Epoch 246/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2610
Epoch 247/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2607
Epoch 248/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2603
Epoch 249/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2600
Epoch 250/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2597
Epoch 251/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2593
Epoch 252/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2590
Epoch 253/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2587
Epoch 254/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2584
Epoch 255/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2580
Epoch 256/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2577
Epoch 257/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2574
Epoch 258/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2571
Epoch 259/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2567
Epoch 260/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2564
Epoch 261/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2561
Epoch 262/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2558
Epoch 263/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2555
Epoch 264/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2551
Epoch 265/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2548
Epoch 266/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2545
Epoch 267/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2542
Epoch 268/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2539
Epoch 269/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2536
Epoch 270/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2532
Epoch 271/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2529
Epoch 272/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2526
Epoch 273/2000
```

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1/1 [==============================] - 3s 3s/step - loss: 0.2523
Epoch 274/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2520
Epoch 275/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2517
Epoch 276/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2514
Epoch 277/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2511
Epoch 278/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2508
Epoch 279/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2504
Epoch 280/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2501
Epoch 281/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2498
Epoch 282/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2495
Epoch 283/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2492
Epoch 284/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2489
Epoch 285/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2486
Epoch 286/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2483
Epoch 287/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2480
Epoch 288/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2477
Epoch 289/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2474
Epoch 290/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2471
Epoch 291/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2468
Epoch 292/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2465
Epoch 293/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2462
Epoch 294/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2459
Epoch 295/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2456
Epoch 296/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2453
Epoch 297/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2450
Epoch 298/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2447
Epoch 299/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2444
Epoch 300/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2441
Epoch 301/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2438
Epoch 302/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2435
Epoch 303/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2432
Epoch 304/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2429
Epoch 305/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2426
Epoch 306/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2423
Epoch 307/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2420
Epoch 308/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2417
Epoch 309/2000
```

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1/1 [==============================] - 5s 5s/step - loss: 0.2414
Epoch 310/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2411
Epoch 311/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2408
Epoch 312/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2405
Epoch 313/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2402
Epoch 314/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2399
Epoch 315/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2396
Epoch 316/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2393
Epoch 317/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2390
Epoch 318/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2387
Epoch 319/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2384
Epoch 320/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2381
Epoch 321/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2378
Epoch 322/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2375
Epoch 323/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2372
Epoch 324/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2369
Epoch 325/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2366
Epoch 326/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2363
Epoch 327/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2360
Epoch 328/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2357
Epoch 329/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2353
Epoch 330/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2350
Epoch 331/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2347
Epoch 332/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2344
Epoch 333/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2341
Epoch 334/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2338
Epoch 335/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2335
Epoch 336/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2332
Epoch 337/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2329
Epoch 338/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2326
Epoch 339/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2323
Epoch 340/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2319
Epoch 341/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2316
Epoch 342/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2313
Epoch 343/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2310
Epoch 344/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2307
Epoch 345/2000
```

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1/1 [==============================] - 5s 5s/step - loss: 0.2303
Epoch 346/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2300
Epoch 347/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2297
Epoch 348/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2294
Epoch 349/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2290
Epoch 350/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2287
Epoch 351/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2284
Epoch 352/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2281
Epoch 353/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2277
Epoch 354/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2274
Epoch 355/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2271
Epoch 356/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2267
Epoch 357/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2264
Epoch 358/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2260
Epoch 359/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2257
Epoch 360/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2253
Epoch 361/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2250
Epoch 362/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2246
Epoch 363/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2243
Epoch 364/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2239
Epoch 365/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2236
Epoch 366/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2232
Epoch 367/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2228
Epoch 368/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2225
Epoch 369/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2221
Epoch 370/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2217
Epoch 371/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2214
Epoch 372/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2210
Epoch 373/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2206
Epoch 374/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2202
Epoch 375/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2199
Epoch 376/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2195
Epoch 377/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2191
Epoch 378/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2187
Epoch 379/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2183
Epoch 380/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2179
Epoch 381/2000
```

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1/1 [==============================] - 3s 3s/step - loss: 0.2175
Epoch 382/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2171
Epoch 383/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2167
Epoch 384/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2163
Epoch 385/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2159
Epoch 386/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2155
Epoch 387/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2151
Epoch 388/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2147
Epoch 389/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2143
Epoch 390/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2139
Epoch 391/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2135
Epoch 392/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2131
Epoch 393/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2127
Epoch 394/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2123
Epoch 395/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2119
Epoch 396/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2115
Epoch 397/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2111
Epoch 398/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2107
Epoch 399/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2103
Epoch 400/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2099
Epoch 401/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2095
Epoch 402/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2091
Epoch 403/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2087
Epoch 404/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2083
Epoch 405/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2079
Epoch 406/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2075
Epoch 407/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2071
Epoch 408/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2067
Epoch 409/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2063
Epoch 410/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2060
Epoch 411/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2056
Epoch 412/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2052
Epoch 413/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2048
Epoch 414/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2045
Epoch 415/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2041
Epoch 416/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2037
Epoch 417/2000
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1/1 [==============================] - 3s 3s/step - loss: 0.2034
Epoch 418/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2030
Epoch 419/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2027
Epoch 420/2000
1/1 [==============================] - 5s 5s/step - loss: 0.2023
Epoch 421/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2020
Epoch 422/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2017
Epoch 423/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2013
Epoch 424/2000
1/1 [==============================] - 6s 6s/step - loss: 0.2010
Epoch 425/2000
1/1 [==============================] - 4s 4s/step - loss: 0.2007
Epoch 426/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2004
Epoch 427/2000
1/1 [==============================] - 3s 3s/step - loss: 0.2001
Epoch 428/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1998
Epoch 429/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1995
Epoch 430/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1992
Epoch 431/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1989
Epoch 432/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1986
Epoch 433/2000
1/1 [==============================] - 7s 7s/step - loss: 0.1983
Epoch 434/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1980
Epoch 435/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1978
Epoch 436/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1975
Epoch 437/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1972
Epoch 438/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1970
Epoch 439/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1967
Epoch 440/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1965
Epoch 441/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1962
Epoch 442/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1960
Epoch 443/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1958
Epoch 444/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1955
Epoch 445/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1953
Epoch 446/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1951
Epoch 447/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1948
Epoch 448/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1946
Epoch 449/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1944
Epoch 450/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1942
Epoch 451/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1940
Epoch 452/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1938
Epoch 453/2000
```

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1/1 [==============================] - 3s 3s/step - loss: 0.1936
Epoch 454/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1934
Epoch 455/2000
1/1 [==============================] - 11s 11s/step - loss: 0.1932
Epoch 456/2000
1/1 [==============================] - 7s 7s/step - loss: 0.1930
Epoch 457/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1928
Epoch 458/2000
1/1 [==============================] - 7s 7s/step - loss: 0.1926
Epoch 459/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1925
Epoch 460/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1923
Epoch 461/2000
1/1 [==============================] - 9s 9s/step - loss: 0.1921
Epoch 462/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1919
Epoch 463/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1918
Epoch 464/2000
1/1 [==============================] - 7s 7s/step - loss: 0.1916
Epoch 465/2000
1/1 [==============================] - 9s 9s/step - loss: 0.1914
Epoch 466/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1912
Epoch 467/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1911
Epoch 468/2000
1/1 [==============================] - 10s 10s/step - loss: 0.1909
Epoch 469/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1907
Epoch 470/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1906
Epoch 471/2000
1/1 [==============================] - 9s 9s/step - loss: 0.1904
Epoch 472/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1903
Epoch 473/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1901
Epoch 474/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1900
Epoch 475/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1898
Epoch 476/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1897
Epoch 477/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1895
Epoch 478/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1894
Epoch 479/2000
1/1 [==============================] - 7s 7s/step - loss: 0.1892
Epoch 480/2000
1/1 [==============================] - 8s 8s/step - loss: 0.1891
Epoch 481/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1889
Epoch 482/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1888
Epoch 483/2000
1/1 [==============================] - 8s 8s/step - loss: 0.1886
Epoch 484/2000
1/1 [==============================] - 7s 7s/step - loss: 0.1885
Epoch 485/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1884
Epoch 486/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1882
Epoch 487/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1881
Epoch 488/2000
1/1 [==============================] - 8s 8s/step - loss: 0.1879
Epoch 489/2000
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1/1 [==============================] - 4s 4s/step - loss: 0.1878
Epoch 490/2000
1/1 [==============================] - 9s 9s/step - loss: 0.1877
Epoch 491/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1875
Epoch 492/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1874
Epoch 493/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1873
Epoch 494/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1871
Epoch 495/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1870
Epoch 496/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1869
Epoch 497/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1868
Epoch 498/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1866
Epoch 499/2000
1/1 [==============================] - 8s 8s/step - loss: 0.1865
Epoch 500/2000
1/1 [==============================] - 7s 7s/step - loss: 0.1864
Epoch 501/2000
1/1 [==============================] - 7s 7s/step - loss: 0.1863
Epoch 502/2000
1/1 [==============================] - 9s 9s/step - loss: 0.1861
Epoch 503/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1860
Epoch 504/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1859
Epoch 505/2000
1/1 [==============================] - 7s 7s/step - loss: 0.1858
Epoch 506/2000
1/1 [==============================] - 7s 7s/step - loss: 0.1857
Epoch 507/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1855
Epoch 508/2000
1/1 [==============================] - 7s 7s/step - loss: 0.1854
Epoch 509/2000
1/1 [==============================] - 8s 8s/step - loss: 0.1853
Epoch 510/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1852
Epoch 511/2000
1/1 [==============================] - 7s 7s/step - loss: 0.1851
Epoch 512/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1850
Epoch 513/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1849
Epoch 514/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1847
Epoch 515/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1846
Epoch 516/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1845
Epoch 517/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1844
Epoch 518/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1843
Epoch 519/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1842
Epoch 520/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1841
Epoch 521/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1840
Epoch 522/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1839
Epoch 523/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1838
Epoch 524/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1837
Epoch 525/2000
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1/1 [==============================] - 5s 5s/step - loss: 0.1836
Epoch 526/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1835
Epoch 527/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1834
Epoch 528/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1833
Epoch 529/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1832
Epoch 530/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1831
Epoch 531/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1830
Epoch 532/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1829
Epoch 533/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1828
Epoch 534/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1827
Epoch 535/2000
1/1 [==============================] - 7s 7s/step - loss: 0.1826
Epoch 536/2000
1/1 [==============================] - 10s 10s/step - loss: 0.1825
Epoch 537/2000
1/1 [==============================] - 7s 7s/step - loss: 0.1824
Epoch 538/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1823
Epoch 539/2000
1/1 [==============================] - 14s 14s/step - loss: 0.1822
Epoch 540/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1821
Epoch 541/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1820
Epoch 542/2000
1/1 [==============================] - 9s 9s/step - loss: 0.1820
Epoch 543/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1819
Epoch 544/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1818
Epoch 545/2000
1/1 [==============================] - 9s 9s/step - loss: 0.1817
Epoch 546/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1816
Epoch 547/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1815
Epoch 548/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1814
Epoch 549/2000
1/1 [==============================] - 8s 8s/step - loss: 0.1813
Epoch 550/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1813
Epoch 551/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1812
Epoch 552/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1811
Epoch 553/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1810
Epoch 554/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1809
Epoch 555/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1809
Epoch 556/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1808
Epoch 557/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1807
Epoch 558/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1806
Epoch 559/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1805
Epoch 560/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1805
Epoch 561/2000
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1/1 [==============================] - 4s 4s/step - loss: 0.1804
Epoch 562/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1803
Epoch 563/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1802
Epoch 564/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1802
Epoch 565/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1801
Epoch 566/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1800
Epoch 567/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1799
Epoch 568/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1799
Epoch 569/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1798
Epoch 570/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1797
Epoch 571/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1796
Epoch 572/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1796
Epoch 573/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1795
Epoch 574/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1794
Epoch 575/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1794
Epoch 576/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1793
Epoch 577/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1792
Epoch 578/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1792
Epoch 579/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1791
Epoch 580/2000
1/1 [==============================] - 12s 12s/step - loss: 0.1790
Epoch 581/2000
1/1 [==============================] - 9s 9s/step - loss: 0.1789
Epoch 582/2000
1/1 [==============================] - 8s 8s/step - loss: 0.1789
Epoch 583/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1788
Epoch 584/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1787
Epoch 585/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1787
Epoch 586/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1786
Epoch 587/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1785
Epoch 588/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1785
Epoch 589/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1784
Epoch 590/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1784
Epoch 591/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1783
Epoch 592/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1782
Epoch 593/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1782
Epoch 594/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1781
Epoch 595/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1780
Epoch 596/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1780
Epoch 597/2000
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1/1 [==============================] - 4s 4s/step - loss: 0.1779
Epoch 598/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1778
Epoch 599/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1778
Epoch 600/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1777
Epoch 601/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1777
Epoch 602/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1776
Epoch 603/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1775
Epoch 604/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1775
Epoch 605/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1774
Epoch 606/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1773
Epoch 607/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1773
Epoch 608/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1772
Epoch 609/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1772
Epoch 610/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1771
Epoch 611/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1770
Epoch 612/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1770
Epoch 613/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1769
Epoch 614/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1768
Epoch 615/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1768
Epoch 616/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1767
Epoch 617/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1767
Epoch 618/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1766
Epoch 619/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1765
Epoch 620/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1765
Epoch 621/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1764
Epoch 622/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1764
Epoch 623/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1763
Epoch 624/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1762
Epoch 625/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1762
Epoch 626/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1761
Epoch 627/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1760
Epoch 628/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1760
Epoch 629/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1759
Epoch 630/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1759
Epoch 631/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1758
Epoch 632/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1757
Epoch 633/2000
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1/1 [==============================] - 6s 6s/step - loss: 0.1757
Epoch 634/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1756
Epoch 635/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1755
Epoch 636/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1755
Epoch 637/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1754
Epoch 638/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1753
Epoch 639/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1753
Epoch 640/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1752
Epoch 641/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1751
Epoch 642/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1751
Epoch 643/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1750
Epoch 644/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1749
Epoch 645/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1749
Epoch 646/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1748
Epoch 647/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1747
Epoch 648/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1747
Epoch 649/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1746
Epoch 650/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1745
Epoch 651/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1745
Epoch 652/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1744
Epoch 653/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1743
Epoch 654/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1743
Epoch 655/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1742
Epoch 656/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1741
Epoch 657/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1740
Epoch 658/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1740
Epoch 659/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1739
Epoch 660/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1738
Epoch 661/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1737
Epoch 662/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1737
Epoch 663/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1736
Epoch 664/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1735
Epoch 665/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1734
Epoch 666/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1734
Epoch 667/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1733
Epoch 668/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1732
Epoch 669/2000
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1/1 [==============================] - 4s 4s/step - loss: 0.1731
Epoch 670/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1731
Epoch 671/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1730
Epoch 672/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1729
Epoch 673/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1728
Epoch 674/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1727
Epoch 675/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1727
Epoch 676/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1726
Epoch 677/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1725
Epoch 678/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1724
Epoch 679/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1723
Epoch 680/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1722
Epoch 681/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1722
Epoch 682/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1721
Epoch 683/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1720
Epoch 684/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1719
Epoch 685/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1718
Epoch 686/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1717
Epoch 687/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1716
Epoch 688/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1716
Epoch 689/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1715
Epoch 690/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1714
Epoch 691/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1713
Epoch 692/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1712
Epoch 693/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1711
Epoch 694/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1710
Epoch 695/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1709
Epoch 696/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1708
Epoch 697/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1707
Epoch 698/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1706
Epoch 699/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1705
Epoch 700/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1705
Epoch 701/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1704
Epoch 702/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1703
Epoch 703/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1702
Epoch 704/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1701
Epoch 705/2000
```

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1/1 [==============================] - 3s 3s/step - loss: 0.1700
Epoch 706/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1699
Epoch 707/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1698
Epoch 708/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1697
Epoch 709/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1696
Epoch 710/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1695
Epoch 711/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1694
Epoch 712/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1693
Epoch 713/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1692
Epoch 714/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1691
Epoch 715/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1690
Epoch 716/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1689
Epoch 717/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1688
Epoch 718/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1687
Epoch 719/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1686
Epoch 720/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1685
Epoch 721/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1684
Epoch 722/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1683
Epoch 723/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1682
Epoch 724/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1681
Epoch 725/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1680
Epoch 726/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1679
Epoch 727/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1678
Epoch 728/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1677
Epoch 729/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1675
Epoch 730/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1674
Epoch 731/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1673
Epoch 732/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1672
Epoch 733/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1671
Epoch 734/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1670
Epoch 735/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1669
Epoch 736/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1668
Epoch 737/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1667
Epoch 738/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1666
Epoch 739/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1665
Epoch 740/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1664
Epoch 741/2000
```

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1/1 [==============================] - 3s 3s/step - loss: 0.1663
Epoch 742/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1662
Epoch 743/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1661
Epoch 744/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1660
Epoch 745/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1659
Epoch 746/2000
1/1 [==============================] - 7s 7s/step - loss: 0.1658
Epoch 747/2000
1/1 [==============================] - 11s 11s/step - loss: 0.1656
Epoch 748/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1655
Epoch 749/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1654
Epoch 750/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1653
Epoch 751/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1652
Epoch 752/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1651
Epoch 753/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1650
Epoch 754/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1649
Epoch 755/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1648
Epoch 756/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1647
Epoch 757/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1646
Epoch 758/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1645
Epoch 759/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1644
Epoch 760/2000
1/1 [==============================] - 9s 9s/step - loss: 0.1643
Epoch 761/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1642
Epoch 762/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1641
Epoch 763/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1640
Epoch 764/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1639
Epoch 765/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1638
Epoch 766/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1637
Epoch 767/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1636
Epoch 768/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1634
Epoch 769/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1633
Epoch 770/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1632
Epoch 771/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1631
Epoch 772/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1630
Epoch 773/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1629
Epoch 774/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1628
Epoch 775/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1627
Epoch 776/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1626
Epoch 777/2000
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1/1 [==============================] - 4s 4s/step - loss: 0.1625
Epoch 778/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1624
Epoch 779/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1623
Epoch 780/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1622
Epoch 781/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1621
Epoch 782/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1620
Epoch 783/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1620
Epoch 784/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1619
Epoch 785/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1618
Epoch 786/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1617
Epoch 787/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1616
Epoch 788/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1615
Epoch 789/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1614
Epoch 790/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1613
Epoch 791/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1612
Epoch 792/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1611
Epoch 793/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1610
Epoch 794/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1609
Epoch 795/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1608
Epoch 796/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1607
Epoch 797/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1606
Epoch 798/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1606
Epoch 799/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1605
Epoch 800/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1604
Epoch 801/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1603
Epoch 802/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1602
Epoch 803/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1601
Epoch 804/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1600
Epoch 805/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1600
Epoch 806/2000
1/1 [==============================] - 7s 7s/step - loss: 0.1599
Epoch 807/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1598
Epoch 808/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1597
Epoch 809/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1596
Epoch 810/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1595
Epoch 811/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1595
Epoch 812/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1594
Epoch 813/2000
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1/1 [==============================] - 3s 3s/step - loss: 0.1593
Epoch 814/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1592
Epoch 815/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1591
Epoch 816/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1591
Epoch 817/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1590
Epoch 818/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1589
Epoch 819/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1588
Epoch 820/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1588
Epoch 821/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1587
Epoch 822/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1586
Epoch 823/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1585
Epoch 824/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1585
Epoch 825/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1584
Epoch 826/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1583
Epoch 827/2000
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Epoch 828/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1582
Epoch 829/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1581
Epoch 830/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1580
Epoch 831/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1580
Epoch 832/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1579
Epoch 833/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1578
Epoch 834/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1578
Epoch 835/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1577
Epoch 836/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1576
Epoch 837/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1576
Epoch 838/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1575
Epoch 839/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1574
Epoch 840/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1574
Epoch 841/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1573
Epoch 842/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1573
Epoch 843/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1572
Epoch 844/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1571
Epoch 845/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1571
Epoch 846/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1570
Epoch 847/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1570
Epoch 848/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1569
Epoch 849/2000
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1/1 [==============================] - 3s 3s/step - loss: 0.1568
Epoch 850/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1568
Epoch 851/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1567
Epoch 852/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1567
Epoch 853/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1566
Epoch 854/2000
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Epoch 855/2000
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Epoch 856/2000
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Epoch 857/2000
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Epoch 858/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1563
Epoch 859/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1563
Epoch 860/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1562
Epoch 861/2000
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Epoch 862/2000
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Epoch 863/2000
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Epoch 864/2000
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Epoch 865/2000
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Epoch 866/2000
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Epoch 867/2000
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Epoch 872/2000
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Epoch 874/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1555
Epoch 875/2000
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Epoch 876/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1554
Epoch 877/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1553
Epoch 878/2000
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Epoch 879/2000
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Epoch 880/2000
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Epoch 881/2000
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Epoch 882/2000
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Epoch 883/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1550
Epoch 884/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1550
Epoch 885/2000
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1/1 [==============================] - 3s 3s/step - loss: 0.1549
Epoch 886/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1549
Epoch 887/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1548
Epoch 888/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1548
Epoch 889/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1548
Epoch 890/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1547
Epoch 891/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1547
Epoch 892/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1546
Epoch 893/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1546
Epoch 894/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1545
Epoch 895/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1545
Epoch 896/2000
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Epoch 897/2000
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Epoch 898/2000
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Epoch 899/2000
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Epoch 900/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1542
Epoch 901/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1542
Epoch 902/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1541
Epoch 903/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1541
Epoch 904/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1541
Epoch 905/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1540
Epoch 906/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1540
Epoch 907/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1539
Epoch 908/2000
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Epoch 909/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1538
Epoch 910/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1538
Epoch 911/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1537
Epoch 912/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1537
Epoch 913/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1536
Epoch 914/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1536
Epoch 915/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1536
Epoch 916/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1535
Epoch 917/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1535
Epoch 918/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1534
Epoch 919/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1534
Epoch 920/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1533
Epoch 921/2000
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1/1 [==============================] - 4s 4s/step - loss: 0.1533
Epoch 922/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1532
Epoch 923/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1532
Epoch 924/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1532
Epoch 925/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1531
Epoch 926/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1531
Epoch 927/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1530
Epoch 928/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1530
Epoch 929/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1529
Epoch 930/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1529
Epoch 931/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1528
Epoch 932/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1528
Epoch 933/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1528
Epoch 934/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1527
Epoch 935/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1527
Epoch 936/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1526
Epoch 937/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1526
Epoch 938/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1525
Epoch 939/2000
1/1 [==============================] - 9s 9s/step - loss: 0.1525
Epoch 940/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1524
Epoch 941/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1524
Epoch 942/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1524
Epoch 943/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1523
Epoch 944/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1523
Epoch 945/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1522
Epoch 946/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1522
Epoch 947/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1521
Epoch 948/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1521
Epoch 949/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1521
Epoch 950/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1520
Epoch 951/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1520
Epoch 952/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1519
Epoch 953/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1519
Epoch 954/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1518
Epoch 955/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1518
Epoch 956/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1518
Epoch 957/2000
```

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1/1 [==============================] - 6s 6s/step - loss: 0.1517
Epoch 958/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1517
Epoch 959/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1516
Epoch 960/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1516
Epoch 961/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1515
Epoch 962/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1515
Epoch 963/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1514
Epoch 964/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1514
Epoch 965/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1514
Epoch 966/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1513
Epoch 967/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1513
Epoch 968/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1512
Epoch 969/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1512
Epoch 970/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1511
Epoch 971/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1511
Epoch 972/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1511
Epoch 973/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1510
Epoch 974/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1510
Epoch 975/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1509
Epoch 976/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1509
Epoch 977/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1508
Epoch 978/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1508
Epoch 979/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1508
Epoch 980/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1507
Epoch 981/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1507
Epoch 982/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1506
Epoch 983/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1506
Epoch 984/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1505
Epoch 985/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1505
Epoch 986/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1504
Epoch 987/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1504
Epoch 988/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1504
Epoch 989/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1503
Epoch 990/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1503
Epoch 991/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1502
Epoch 992/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1502
Epoch 993/2000
```

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1/1 [==============================] - 4s 4s/step - loss: 0.1501
Epoch 994/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1501
Epoch 995/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1500
Epoch 996/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1500
Epoch 997/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1500
Epoch 998/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1499
Epoch 999/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1499
Epoch 1000/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1498
Epoch 1001/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1498
Epoch 1002/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1497
Epoch 1003/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1497
Epoch 1004/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1496
Epoch 1005/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1496
Epoch 1006/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1495
Epoch 1007/2000
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Epoch 1008/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1495
Epoch 1009/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1494
Epoch 1010/2000
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Epoch 1011/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1493
Epoch 1012/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1493
Epoch 1013/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1492
Epoch 1014/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1492
Epoch 1015/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1491
Epoch 1016/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1491
Epoch 1017/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1490
Epoch 1018/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1490
Epoch 1019/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1489
Epoch 1020/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1489
Epoch 1021/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1489
Epoch 1022/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1488
Epoch 1023/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1488
Epoch 1024/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1487
Epoch 1025/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1487
Epoch 1026/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1486
Epoch 1027/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1486
Epoch 1028/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1485
Epoch 1029/2000
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1/1 [==============================] - 3s 3s/step - loss: 0.1485
Epoch 1030/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1484
Epoch 1031/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1484
Epoch 1032/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1483
Epoch 1033/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1483
Epoch 1034/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1482
Epoch 1035/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1482
Epoch 1036/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1481
Epoch 1037/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1481
Epoch 1038/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1480
Epoch 1039/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1480
Epoch 1040/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1479
Epoch 1041/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1479
Epoch 1042/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1478
Epoch 1043/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1478
Epoch 1044/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1477
Epoch 1045/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1477
Epoch 1046/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1476
Epoch 1047/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1476
Epoch 1048/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1475
Epoch 1049/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1475
Epoch 1050/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1474
Epoch 1051/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1474
Epoch 1052/2000
1/1 [==============================] - 8s 8s/step - loss: 0.1473
Epoch 1053/2000
1/1 [==============================] - 9s 9s/step - loss: 0.1473
Epoch 1054/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1472
Epoch 1055/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1472
Epoch 1056/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1471
Epoch 1057/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1471
Epoch 1058/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1470
Epoch 1059/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1470
Epoch 1060/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1469
Epoch 1061/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1469
Epoch 1062/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1468
Epoch 1063/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1468
Epoch 1064/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1467
Epoch 1065/2000
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1/1 [==============================] - 6s 6s/step - loss: 0.1467
Epoch 1066/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1466
Epoch 1067/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1466
Epoch 1068/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1465
Epoch 1069/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1465
Epoch 1070/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1464
Epoch 1071/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1464
Epoch 1072/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1463
Epoch 1073/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1463
Epoch 1074/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1462
Epoch 1075/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1462
Epoch 1076/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1461
Epoch 1077/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1461
Epoch 1078/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1460
Epoch 1079/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1460
Epoch 1080/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1459
Epoch 1081/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1459
Epoch 1082/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1458
Epoch 1083/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1458
Epoch 1084/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1457
Epoch 1085/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1457
Epoch 1086/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1456
Epoch 1087/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1456
Epoch 1088/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1455
Epoch 1089/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1455
Epoch 1090/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1454
Epoch 1091/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1454
Epoch 1092/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1454
Epoch 1093/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1453
Epoch 1094/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1453
Epoch 1095/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1452
Epoch 1096/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1452
Epoch 1097/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1451
Epoch 1098/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1451
Epoch 1099/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1450
Epoch 1100/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1450
Epoch 1101/2000
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1/1 [==============================] - 3s 3s/step - loss: 0.1449
Epoch 1102/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1449
Epoch 1103/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1448
Epoch 1104/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1448
Epoch 1105/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1447
Epoch 1106/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1447
Epoch 1107/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1446
Epoch 1108/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1446
Epoch 1109/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1446
Epoch 1110/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1445
Epoch 1111/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1445
Epoch 1112/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1444
Epoch 1113/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1444
Epoch 1114/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1443
Epoch 1115/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1443
Epoch 1116/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1442
Epoch 1117/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1442
Epoch 1118/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1442
Epoch 1119/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1441
Epoch 1120/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1441
Epoch 1121/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1440
Epoch 1122/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1440
Epoch 1123/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1439
Epoch 1124/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1439
Epoch 1125/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1439
Epoch 1126/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1438
Epoch 1127/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1438
Epoch 1128/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1437
Epoch 1129/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1437
Epoch 1130/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1436
Epoch 1131/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1436
Epoch 1132/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1436
Epoch 1133/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1435
Epoch 1134/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1435
Epoch 1135/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1435
Epoch 1136/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1434
Epoch 1137/2000
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1/1 [==============================] - 3s 3s/step - loss: 0.1434
Epoch 1138/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1433
Epoch 1139/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1433
Epoch 1140/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1433
Epoch 1141/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1432
Epoch 1142/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1432
Epoch 1143/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1431
Epoch 1144/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1431
Epoch 1145/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1431
Epoch 1146/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1430
Epoch 1147/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1430
Epoch 1148/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1430
Epoch 1149/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1429
Epoch 1150/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1429
Epoch 1151/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1429
Epoch 1152/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1428
Epoch 1153/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1428
Epoch 1154/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1428
Epoch 1155/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1427
Epoch 1156/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1427
Epoch 1157/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1427
Epoch 1158/2000
1/1 [==============================] - 8s 8s/step - loss: 0.1426
Epoch 1159/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1426
Epoch 1160/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1426
Epoch 1161/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1425
Epoch 1162/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1425
Epoch 1163/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1425
Epoch 1164/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1424
Epoch 1165/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1424
Epoch 1166/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1424
Epoch 1167/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1423
Epoch 1168/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1423
Epoch 1169/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1423
Epoch 1170/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1422
Epoch 1171/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1422
Epoch 1172/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1422
Epoch 1173/2000
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1/1 [==============================] - 3s 3s/step - loss: 0.1421
Epoch 1174/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1421
Epoch 1175/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1421
Epoch 1176/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1421
Epoch 1177/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1420
Epoch 1178/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1420
Epoch 1179/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1420
Epoch 1180/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1419
Epoch 1181/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1419
Epoch 1182/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1419
Epoch 1183/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1419
Epoch 1184/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1418
Epoch 1185/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1418
Epoch 1186/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1418
Epoch 1187/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1418
Epoch 1188/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1417
Epoch 1189/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1417
Epoch 1190/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1417
Epoch 1191/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1416
Epoch 1192/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1416
Epoch 1193/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1416
Epoch 1194/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1416
Epoch 1195/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1415
Epoch 1196/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1415
Epoch 1197/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1415
Epoch 1198/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1415
Epoch 1199/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1414
Epoch 1200/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1414
Epoch 1201/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1414
Epoch 1202/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1414
Epoch 1203/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1413
Epoch 1204/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1413
Epoch 1205/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1413
Epoch 1206/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1413
Epoch 1207/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1412
Epoch 1208/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1412
Epoch 1209/2000
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1/1 [==============================] - 5s 5s/step - loss: 0.1412
Epoch 1210/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1412
Epoch 1211/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1412
Epoch 1212/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1411
Epoch 1213/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1411
Epoch 1214/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1411
Epoch 1215/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1411
Epoch 1216/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1410
Epoch 1217/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1410
Epoch 1218/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1410
Epoch 1219/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1410
Epoch 1220/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1410
Epoch 1221/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1409
Epoch 1222/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1409
Epoch 1223/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1409
Epoch 1224/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1409
Epoch 1225/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1408
Epoch 1226/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1408
Epoch 1227/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1408
Epoch 1228/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1408
Epoch 1229/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1408
Epoch 1230/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1407
Epoch 1231/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1407
Epoch 1232/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1407
Epoch 1233/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1407
Epoch 1234/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1407
Epoch 1235/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1406
Epoch 1236/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1406
Epoch 1237/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1406
Epoch 1238/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1406
Epoch 1239/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1406
Epoch 1240/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1405
Epoch 1241/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1405
Epoch 1242/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1405
Epoch 1243/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1405
Epoch 1244/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1405
Epoch 1245/2000
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1/1 [==============================] - 6s 6s/step - loss: 0.1404
Epoch 1246/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1404
Epoch 1247/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1404
Epoch 1248/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1404
Epoch 1249/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1404
Epoch 1250/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1403
Epoch 1251/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1403
Epoch 1252/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1403
Epoch 1253/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1403
Epoch 1254/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1403
Epoch 1255/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1403
Epoch 1256/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1402
Epoch 1257/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1402
Epoch 1258/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1402
Epoch 1259/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1402
Epoch 1260/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1402
Epoch 1261/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1401
Epoch 1262/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1401
Epoch 1263/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1401
Epoch 1264/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1401
Epoch 1265/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1401
Epoch 1266/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1401
Epoch 1267/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1400
Epoch 1268/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1400
Epoch 1269/2000
1/1 [==============================] - 5s 5s/step - loss: 0.1400
Epoch 1270/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1400
Epoch 1271/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1400
Epoch 1272/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1400
Epoch 1273/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1399
Epoch 1274/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1399
Epoch 1275/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1399
Epoch 1276/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1399
Epoch 1277/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1399
Epoch 1278/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1399
Epoch 1279/2000
1/1 [==============================] - 4s 4s/step - loss: 0.1398
Epoch 1280/2000
1/1 [==============================] - 3s 3s/step - loss: 0.1398
Epoch 1281/2000
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1/1 [==============================] - 3s 3s/step - loss: 0.1398
Epoch 1282/2000
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Epoch 2000/2000
1/1 [==============================] - 6s 6s/step - loss: 0.1366
```

In [ ]:

```python
plt.plot(H.history['loss'])
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.title("Generator's Loss for the first cycle")
plt.show()
```

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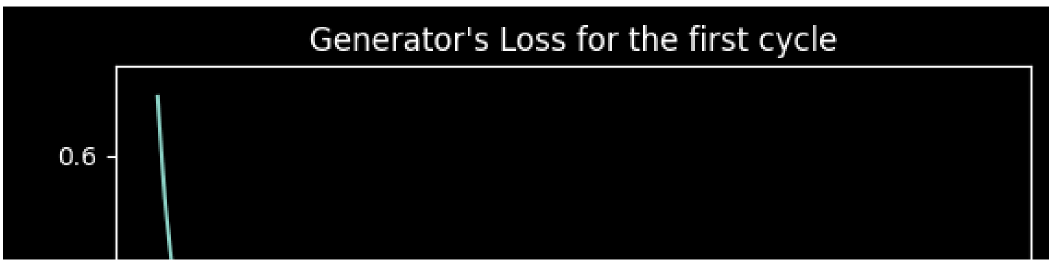

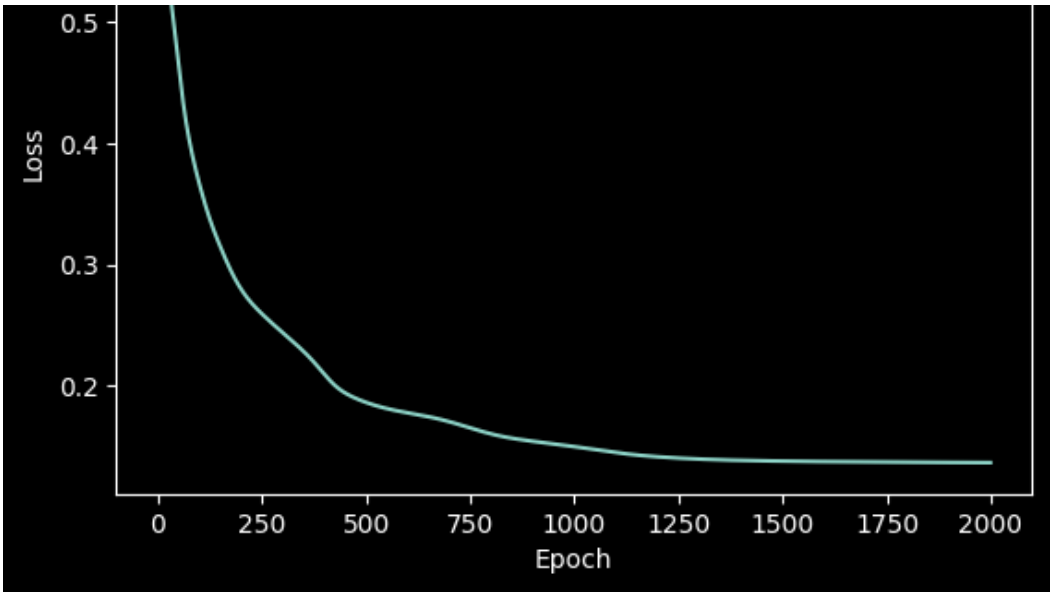

In [ ]:

```
# Generate Real + Fake Data

gen_data_train = tfq.convert_to_tensor(generate_data(x_train, qgan_qubits) + generate_fa
ke_data(x_train, qgan_qubits, qgen_model.get_weights()[0], layer=gen_layer))
gen_data_test = tfq.convert_to_tensor(generate_data(x_test, qgan_qubits) + generate_fake_
data(x_test, qgan_qubits, qgen_model.get_weights()[0], layer=gen_layer))

y_gen_train = np.concatenate((y_train, y_true_fake), axis = 0)
y_gen_test = np.concatenate((y_test, y_true_fake), axis = 0)

print(len(gen_data_train), len(gen_data_test))
print(y_gen_train.shape, y_gen_test.shape)
```

```
200 200
(200, 3) (200, 3)
```

In [ ]:

```
# Fit the Discriminator Model
H = train_qdisc(300, 64, 1)
```

```
Epoch 1/300
4/4 [==============================] - 8s 2s/step - loss: 0.6946 - custom_accuracy: 0.458
6 - val_loss: 0.5666 - val_custom_accuracy: 0.2830
Epoch 2/300
4/4 [==============================] - 8s 2s/step - loss: 0.6869 - custom_accuracy: 0.514
4 - val_loss: 0.5626 - val_custom_accuracy: 0.2830
Epoch 3/300
4/4 [==============================] - 8s 2s/step - loss: 0.6799 - custom_accuracy: 0.609
2 - val_loss: 0.5588 - val_custom_accuracy: 0.2830
Epoch 4/300
4/4 [==============================] - 6s 2s/step - loss: 0.6749 - custom_accuracy: 0.676
7 - val_loss: 0.5552 - val_custom_accuracy: 0.2899
Epoch 5/300
4/4 [==============================] - 10s 2s/step - loss: 0.6699 - custom_accuracy: 0.57
63 - val_loss: 0.5520 - val_custom_accuracy: 0.2899
Epoch 6/300
4/4 [==============================] - 6s 2s/step - loss: 0.6653 - custom_accuracy: 0.501
9 - val_loss: 0.5490 - val_custom_accuracy: 0.2899
Epoch 7/300
4/4 [==============================] - 8s 2s/step - loss: 0.6598 - custom_accuracy: 0.763
9 - val_loss: 0.5459 - val_custom_accuracy: 0.2969
Epoch 8/300
4/4 [==============================] - 8s 2s/step - loss: 0.6550 - custom_accuracy: 0.640
0 - val_loss: 0.5430 - val_custom_accuracy: 0.2969
Epoch 9/300
4/4 [==============================] - 6s 2s/step - loss: 0.6441 - custom_accuracy: 0.728
0 - val_loss: 0.5402 - val_custom_accuracy: 0.2969
Epoch 10/300
4/4 [==============================] - 10s 2s/step - loss: 0.6496 - custom_accuracy: 0.61
```

```
90 - val_loss: 0.5372 - val_custom_accuracy: 0.2969
Epoch 11/300
4/4 [==============================] - 6s 2s/step - loss: 0.6372 - custom_accuracy: 0.679
8 - val_loss: 0.5344 - val_custom_accuracy: 0.2969
Epoch 12/300
4/4 [==============================] - 8s 2s/step - loss: 0.6383 - custom_accuracy: 0.559
2 - val_loss: 0.5318 - val_custom_accuracy: 0.2969
Epoch 13/300
4/4 [==============================] - 7s 2s/step - loss: 0.6441 - custom_accuracy: 0.682
4 - val_loss: 0.5294 - val_custom_accuracy: 0.2969
Epoch 14/300
4/4 [==============================] - 6s 2s/step - loss: 0.6327 - custom_accuracy: 0.772
5 - val_loss: 0.5269 - val_custom_accuracy: 0.2969
Epoch 15/300
4/4 [==============================] - 10s 2s/step - loss: 0.6230 - custom_accuracy: 0.77
01 - val_loss: 0.5249 - val_custom_accuracy: 0.2969
Epoch 16/300
4/4 [==============================] - 6s 2s/step - loss: 0.6230 - custom_accuracy: 0.545
0 - val_loss: 0.5234 - val_custom_accuracy: 0.2969
Epoch 17/300
4/4 [==============================] - 9s 2s/step - loss: 0.6209 - custom_accuracy: 0.688
3 - val_loss: 0.5218 - val_custom_accuracy: 0.2969
Epoch 18/300
4/4 [==============================] - 7s 2s/step - loss: 0.6208 - custom_accuracy: 0.606
4 - val_loss: 0.5203 - val_custom_accuracy: 0.2969
Epoch 19/300
4/4 [==============================] - 6s 2s/step - loss: 0.6131 - custom_accuracy: 0.614
3 - val_loss: 0.5189 - val_custom_accuracy: 0.2969
Epoch 20/300
4/4 [==============================] - 9s 2s/step - loss: 0.6130 - custom_accuracy: 0.792
1 - val_loss: 0.5176 - val_custom_accuracy: 0.2969
Epoch 21/300
4/4 [==============================] - 6s 2s/step - loss: 0.6043 - custom_accuracy: 0.658
2 - val_loss: 0.5168 - val_custom_accuracy: 0.2969
Epoch 22/300
4/4 [==============================] - 9s 2s/step - loss: 0.6055 - custom_accuracy: 0.810
1 - val_loss: 0.5158 - val_custom_accuracy: 0.3016
Epoch 23/300
4/4 [==============================] - 7s 2s/step - loss: 0.6105 - custom_accuracy: 0.694
1 - val_loss: 0.5147 - val_custom_accuracy: 0.3008
Epoch 24/300
4/4 [==============================] - 6s 2s/step - loss: 0.6021 - custom_accuracy: 0.652
4 - val_loss: 0.5135 - val_custom_accuracy: 0.2969
Epoch 25/300
4/4 [==============================] - 10s 2s/step - loss: 0.5928 - custom_accuracy: 0.75
02 - val_loss: 0.5126 - val_custom_accuracy: 0.3446
Epoch 26/300
4/4 [==============================] - 6s 2s/step - loss: 0.5906 - custom_accuracy: 0.804
0 - val_loss: 0.5120 - val_custom_accuracy: 0.3511
Epoch 27/300
4/4 [==============================] - 9s 2s/step - loss: 0.5872 - custom_accuracy: 0.778
3 - val_loss: 0.5116 - val_custom_accuracy: 0.3442
Epoch 28/300
4/4 [==============================] - 7s 2s/step - loss: 0.5991 - custom_accuracy: 0.744
8 - val_loss: 0.5106 - val_custom_accuracy: 0.3442
Epoch 29/300
4/4 [==============================] - 6s 2s/step - loss: 0.5988 - custom_accuracy: 0.766
6 - val_loss: 0.5094 - val_custom_accuracy: 0.3442
Epoch 30/300
4/4 [==============================] - 10s 2s/step - loss: 0.5813 - custom_accuracy: 0.74
08 - val_loss: 0.5079 - val_custom_accuracy: 0.3442
Epoch 31/300
4/4 [==============================] - 6s 2s/step - loss: 0.5745 - custom_accuracy: 0.579
7 - val_loss: 0.5065 - val_custom_accuracy: 0.3442
Epoch 32/300
4/4 [==============================] - 9s 2s/step - loss: 0.5801 - custom_accuracy: 0.777
2 - val_loss: 0.5048 - val_custom_accuracy: 0.3442
Epoch 33/300
4/4 [==============================] - 7s 2s/step - loss: 0.5801 - custom_accuracy: 0.813
0 - val_loss: 0.5033 - val_custom_accuracy: 0.3511
Epoch 34/300
4/4 [==============================] - 7s 2s/step - loss: 0.5847 - custom_accuracy: 0.811
```

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3 - val_loss: 0.5016 - val_custom_accuracy: 0.3442
Epoch 35/300
4/4 [==============================] - 9s 2s/step - loss: 0.5893 - custom_accuracy: 0.706
1 - val_loss: 0.5003 - val_custom_accuracy: 0.3442
Epoch 36/300
4/4 [==============================] - 6s 2s/step - loss: 0.5733 - custom_accuracy: 0.816
4 - val_loss: 0.4991 - val_custom_accuracy: 0.3442
Epoch 37/300
4/4 [==============================] - 9s 3s/step - loss: 0.5708 - custom_accuracy: 0.815
1 - val_loss: 0.4973 - val_custom_accuracy: 0.3442
Epoch 38/300
4/4 [==============================] - 7s 2s/step - loss: 0.5695 - custom_accuracy: 0.814
6 - val_loss: 0.4953 - val_custom_accuracy: 0.3442
Epoch 39/300
4/4 [==============================] - 7s 2s/step - loss: 0.5690 - custom_accuracy: 0.760
5 - val_loss: 0.4932 - val_custom_accuracy: 0.3442
Epoch 40/300
4/4 [==============================] - 9s 2s/step - loss: 0.5648 - custom_accuracy: 0.774
4 - val_loss: 0.4906 - val_custom_accuracy: 0.3442
Epoch 41/300
4/4 [==============================] - 6s 2s/step - loss: 0.5669 - custom_accuracy: 0.810
5 - val_loss: 0.4871 - val_custom_accuracy: 0.3442
Epoch 42/300
4/4 [==============================] - 9s 3s/step - loss: 0.5605 - custom_accuracy: 0.816
5 - val_loss: 0.4835 - val_custom_accuracy: 0.3442
Epoch 43/300
4/4 [==============================] - 7s 2s/step - loss: 0.5475 - custom_accuracy: 0.696
3 - val_loss: 0.4798 - val_custom_accuracy: 0.3529
Epoch 44/300
4/4 [==============================] - 7s 2s/step - loss: 0.5418 - custom_accuracy: 0.686
1 - val_loss: 0.4759 - val_custom_accuracy: 0.3559
Epoch 45/300
4/4 [==============================] - 9s 2s/step - loss: 0.5484 - custom_accuracy: 0.816
7 - val_loss: 0.4718 - val_custom_accuracy: 0.3559
Epoch 46/300
4/4 [==============================] - 6s 2s/step - loss: 0.5525 - custom_accuracy: 0.687
5 - val_loss: 0.4681 - val_custom_accuracy: 0.3559
Epoch 47/300
4/4 [==============================] - 10s 3s/step - loss: 0.5419 - custom_accuracy: 0.64
91 - val_loss: 0.4646 - val_custom_accuracy: 0.3559
Epoch 48/300
4/4 [==============================] - 7s 2s/step - loss: 0.5411 - custom_accuracy: 0.741
2 - val_loss: 0.4614 - val_custom_accuracy: 0.3559
Epoch 49/300
4/4 [==============================] - 7s 2s/step - loss: 0.5473 - custom_accuracy: 0.716
3 - val_loss: 0.4585 - val_custom_accuracy: 0.3559
Epoch 50/300
4/4 [==============================] - 8s 2s/step - loss: 0.5395 - custom_accuracy: 0.671
0 - val_loss: 0.4561 - val_custom_accuracy: 0.3559
Epoch 51/300
4/4 [==============================] - 6s 2s/step - loss: 0.5432 - custom_accuracy: 0.667
2 - val_loss: 0.4537 - val_custom_accuracy: 0.3559
Epoch 52/300
4/4 [==============================] - 10s 3s/step - loss: 0.5428 - custom_accuracy: 0.71
67 - val_loss: 0.4516 - val_custom_accuracy: 0.3559
Epoch 53/300
4/4 [==============================] - 6s 2s/step - loss: 0.5260 - custom_accuracy: 0.766
5 - val_loss: 0.4492 - val_custom_accuracy: 0.3559
Epoch 54/300
4/4 [==============================] - 8s 2s/step - loss: 0.5400 - custom_accuracy: 0.670
9 - val_loss: 0.4463 - val_custom_accuracy: 0.3559
Epoch 55/300
4/4 [==============================] - 8s 2s/step - loss: 0.5313 - custom_accuracy: 0.711
0 - val_loss: 0.4430 - val_custom_accuracy: 0.3559
Epoch 56/300
4/4 [==============================] - 6s 2s/step - loss: 0.5192 - custom_accuracy: 0.778
4 - val_loss: 0.4392 - val_custom_accuracy: 0.3559
Epoch 57/300
4/4 [==============================] - 10s 3s/step - loss: 0.5158 - custom_accuracy: 0.70
04 - val_loss: 0.4356 - val_custom_accuracy: 0.3559
Epoch 58/300
4/4 [==============================] - 6s 2s/step - loss: 0.5116 - custom_accuracy: 0.705
```

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4 - val_loss: 0.4325 - val_custom_accuracy: 0.3559
Epoch 59/300
4/4 [==============================] - 7s 2s/step - loss: 0.5248 - custom_accuracy: 0.725
2 - val_loss: 0.4298 - val_custom_accuracy: 0.3559
Epoch 60/300
4/4 [==============================] - 8s 2s/step - loss: 0.5147 - custom_accuracy: 0.742
6 - val_loss: 0.4276 - val_custom_accuracy: 0.3559
Epoch 61/300
4/4 [==============================] - 6s 2s/step - loss: 0.5041 - custom_accuracy: 0.655
2 - val_loss: 0.4256 - val_custom_accuracy: 0.3559
Epoch 62/300
4/4 [==============================] - 10s 3s/step - loss: 0.5060 - custom_accuracy: 0.70
38 - val_loss: 0.4238 - val_custom_accuracy: 0.3559
Epoch 63/300
4/4 [==============================] - 6s 2s/step - loss: 0.4994 - custom_accuracy: 0.648
2 - val_loss: 0.4221 - val_custom_accuracy: 0.3559
Epoch 64/300
4/4 [==============================] - 8s 2s/step - loss: 0.5046 - custom_accuracy: 0.809
3 - val_loss: 0.4201 - val_custom_accuracy: 0.3559
Epoch 65/300
4/4 [==============================] - 8s 2s/step - loss: 0.5104 - custom_accuracy: 0.760
2 - val_loss: 0.4184 - val_custom_accuracy: 0.3559
Epoch 66/300
4/4 [==============================] - 6s 2s/step - loss: 0.5078 - custom_accuracy: 0.711
6 - val_loss: 0.4169 - val_custom_accuracy: 0.3559
Epoch 67/300
4/4 [==============================] - 10s 3s/step - loss: 0.4945 - custom_accuracy: 0.69
51 - val_loss: 0.4150 - val_custom_accuracy: 0.3559
Epoch 68/300
4/4 [==============================] - 6s 2s/step - loss: 0.5092 - custom_accuracy: 0.656
8 - val_loss: 0.4139 - val_custom_accuracy: 0.3559
Epoch 69/300
4/4 [==============================] - 10s 3s/step - loss: 0.4957 - custom_accuracy: 0.81
03 - val_loss: 0.4126 - val_custom_accuracy: 0.3559
Epoch 70/300
4/4 [==============================] - 7s 2s/step - loss: 0.4933 - custom_accuracy: 0.736
7 - val_loss: 0.4106 - val_custom_accuracy: 0.3559
Epoch 71/300
4/4 [==============================] - 7s 2s/step - loss: 0.4923 - custom_accuracy: 0.785
2 - val_loss: 0.4092 - val_custom_accuracy: 0.3559
Epoch 72/300
4/4 [==============================] - 9s 2s/step - loss: 0.5060 - custom_accuracy: 0.646
5 - val_loss: 0.4077 - val_custom_accuracy: 0.3559
Epoch 73/300
4/4 [==============================] - 6s 2s/step - loss: 0.5023 - custom_accuracy: 0.655
5 - val_loss: 0.4063 - val_custom_accuracy: 0.3559
Epoch 74/300
4/4 [==============================] - 9s 2s/step - loss: 0.4873 - custom_accuracy: 0.807
4 - val_loss: 0.4049 - val_custom_accuracy: 0.3559
Epoch 75/300
4/4 [==============================] - 7s 2s/step - loss: 0.4883 - custom_accuracy: 0.730
0 - val_loss: 0.4036 - val_custom_accuracy: 0.3559
Epoch 76/300
4/4 [==============================] - 6s 2s/step - loss: 0.4868 - custom_accuracy: 0.703
0 - val_loss: 0.4025 - val_custom_accuracy: 0.3559
Epoch 77/300
4/4 [==============================] - 10s 2s/step - loss: 0.4649 - custom_accuracy: 0.69
35 - val_loss: 0.4016 - val_custom_accuracy: 0.3559
Epoch 78/300
4/4 [==============================] - 6s 2s/step - loss: 0.4654 - custom_accuracy: 0.677
3 - val_loss: 0.4006 - val_custom_accuracy: 0.3559
Epoch 79/300
4/4 [==============================] - 9s 2s/step - loss: 0.4808 - custom_accuracy: 0.661
6 - val_loss: 0.3997 - val_custom_accuracy: 0.3559
Epoch 80/300
4/4 [==============================] - 7s 2s/step - loss: 0.4851 - custom_accuracy: 0.706
9 - val_loss: 0.3988 - val_custom_accuracy: 0.3559
Epoch 81/300
4/4 [==============================] - 7s 2s/step - loss: 0.4594 - custom_accuracy: 0.763
6 - val_loss: 0.3982 - val_custom_accuracy: 0.3559
Epoch 82/300
4/4 [==============================] - 9s 2s/step - loss: 0.4746 - custom_accuracy: 0.799
```

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3 - val_loss: 0.3977 - val_custom_accuracy: 0.3559
Epoch 83/300
4/4 [==============================] - 6s 2s/step - loss: 0.4830 - custom_accuracy: 0.654
5 - val_loss: 0.3977 - val_custom_accuracy: 0.3559
Epoch 84/300
4/4 [==============================] - 9s 3s/step - loss: 0.4730 - custom_accuracy: 0.617
4 - val_loss: 0.3980 - val_custom_accuracy: 0.3559
Epoch 85/300
4/4 [==============================] - 7s 2s/step - loss: 0.4812 - custom_accuracy: 0.669
6 - val_loss: 0.3985 - val_custom_accuracy: 0.3559
Epoch 86/300
4/4 [==============================] - 7s 2s/step - loss: 0.4766 - custom_accuracy: 0.800
4 - val_loss: 0.3986 - val_custom_accuracy: 0.3559
Epoch 87/300
4/4 [==============================] - 9s 2s/step - loss: 0.4650 - custom_accuracy: 0.731
7 - val_loss: 0.3983 - val_custom_accuracy: 0.3559
Epoch 88/300
4/4 [==============================] - 6s 2s/step - loss: 0.4751 - custom_accuracy: 0.651
8 - val_loss: 0.3978 - val_custom_accuracy: 0.3559
Epoch 89/300
4/4 [==============================] - 9s 3s/step - loss: 0.4487 - custom_accuracy: 0.710
1 - val_loss: 0.3976 - val_custom_accuracy: 0.3559
Epoch 90/300
4/4 [==============================] - 6s 2s/step - loss: 0.4720 - custom_accuracy: 0.770
7 - val_loss: 0.3977 - val_custom_accuracy: 0.3641
Epoch 91/300
4/4 [==============================] - 7s 2s/step - loss: 0.4690 - custom_accuracy: 0.728
6 - val_loss: 0.3978 - val_custom_accuracy: 0.3511
Epoch 92/300
4/4 [==============================] - 9s 2s/step - loss: 0.4684 - custom_accuracy: 0.771
0 - val_loss: 0.3977 - val_custom_accuracy: 0.3511
Epoch 93/300
4/4 [==============================] - 6s 2s/step - loss: 0.4620 - custom_accuracy: 0.813
7 - val_loss: 0.3972 - val_custom_accuracy: 0.3511
Epoch 94/300
4/4 [==============================] - 9s 3s/step - loss: 0.4690 - custom_accuracy: 0.817
7 - val_loss: 0.3966 - val_custom_accuracy: 0.3511
Epoch 95/300
4/4 [==============================] - 6s 2s/step - loss: 0.4743 - custom_accuracy: 0.818
0 - val_loss: 0.3957 - val_custom_accuracy: 0.3511
Epoch 96/300
4/4 [==============================] - 8s 2s/step - loss: 0.4628 - custom_accuracy: 0.808
7 - val_loss: 0.3947 - val_custom_accuracy: 0.3542
Epoch 97/300
4/4 [==============================] - 8s 2s/step - loss: 0.4581 - custom_accuracy: 0.754
9 - val_loss: 0.3933 - val_custom_accuracy: 0.3694
Epoch 98/300
4/4 [==============================] - 6s 2s/step - loss: 0.4605 - custom_accuracy: 0.790
1 - val_loss: 0.3922 - val_custom_accuracy: 0.3685
Epoch 99/300
4/4 [==============================] - 10s 3s/step - loss: 0.4654 - custom_accuracy: 0.73
46 - val_loss: 0.3916 - val_custom_accuracy: 0.3733
Epoch 100/300
4/4 [==============================] - 6s 2s/step - loss: 0.4601 - custom_accuracy: 0.676
0 - val_loss: 0.3915 - val_custom_accuracy: 0.3572
Epoch 101/300
4/4 [==============================] - 7s 2s/step - loss: 0.4629 - custom_accuracy: 0.751
3 - val_loss: 0.3906 - val_custom_accuracy: 0.3681
Epoch 102/300
4/4 [==============================] - 8s 2s/step - loss: 0.4647 - custom_accuracy: 0.720
8 - val_loss: 0.3894 - val_custom_accuracy: 0.3663
Epoch 103/300
4/4 [==============================] - 6s 2s/step - loss: 0.4645 - custom_accuracy: 0.750
1 - val_loss: 0.3882 - val_custom_accuracy: 0.3724
Epoch 104/300
4/4 [==============================] - 9s 3s/step - loss: 0.4489 - custom_accuracy: 0.669
8 - val_loss: 0.3876 - val_custom_accuracy: 0.3763
Epoch 105/300
4/4 [==============================] - 6s 2s/step - loss: 0.4573 - custom_accuracy: 0.777
3 - val_loss: 0.3878 - val_custom_accuracy: 0.3641
Epoch 106/300
4/4 [==============================] - 7s 2s/step - loss: 0.4463 - custom_accuracy: 0.768
```

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0 - val_loss: 0.3879 - val_custom_accuracy: 0.3464
Epoch 107/300
4/4 [==============================] - 8s 2s/step - loss: 0.4714 - custom_accuracy: 0.798
3 - val_loss: 0.3881 - val_custom_accuracy: 0.3581
Epoch 108/300
4/4 [==============================] - 6s 2s/step - loss: 0.4550 - custom_accuracy: 0.778
3 - val_loss: 0.3897 - val_custom_accuracy: 0.3511
Epoch 109/300
4/4 [==============================] - 9s 3s/step - loss: 0.4419 - custom_accuracy: 0.758
6 - val_loss: 0.3911 - val_custom_accuracy: 0.3511
Epoch 110/300
4/4 [==============================] - 7s 2s/step - loss: 0.4468 - custom_accuracy: 0.702
8 - val_loss: 0.3925 - val_custom_accuracy: 0.3511
Epoch 111/300
4/4 [==============================] - 7s 2s/step - loss: 0.4622 - custom_accuracy: 0.757
7 - val_loss: 0.3939 - val_custom_accuracy: 0.3442
Epoch 112/300
4/4 [==============================] - 9s 2s/step - loss: 0.4304 - custom_accuracy: 0.592
9 - val_loss: 0.3934 - val_custom_accuracy: 0.3442
Epoch 113/300
4/4 [==============================] - 6s 2s/step - loss: 0.4489 - custom_accuracy: 0.817
0 - val_loss: 0.3931 - val_custom_accuracy: 0.3442
Epoch 114/300
4/4 [==============================] - 9s 3s/step - loss: 0.4625 - custom_accuracy: 0.820
7 - val_loss: 0.3928 - val_custom_accuracy: 0.3511
Epoch 115/300
4/4 [==============================] - 7s 2s/step - loss: 0.4425 - custom_accuracy: 0.575
6 - val_loss: 0.3915 - val_custom_accuracy: 0.3511
Epoch 116/300
4/4 [==============================] - 7s 2s/step - loss: 0.4455 - custom_accuracy: 0.703
4 - val_loss: 0.3886 - val_custom_accuracy: 0.3511
Epoch 117/300
4/4 [==============================] - 9s 2s/step - loss: 0.4519 - custom_accuracy: 0.655
2 - val_loss: 0.3859 - val_custom_accuracy: 0.3681
Epoch 118/300
4/4 [==============================] - 6s 2s/step - loss: 0.4335 - custom_accuracy: 0.781
7 - val_loss: 0.3838 - val_custom_accuracy: 0.3559
Epoch 119/300
4/4 [==============================] - 9s 3s/step - loss: 0.4401 - custom_accuracy: 0.676
7 - val_loss: 0.3826 - val_custom_accuracy: 0.3559
Epoch 120/300
4/4 [==============================] - 7s 2s/step - loss: 0.4573 - custom_accuracy: 0.693
2 - val_loss: 0.3824 - val_custom_accuracy: 0.3559
Epoch 121/300
4/4 [==============================] - 7s 2s/step - loss: 0.4566 - custom_accuracy: 0.806
1 - val_loss: 0.3822 - val_custom_accuracy: 0.3559
Epoch 122/300
4/4 [==============================] - 9s 2s/step - loss: 0.4412 - custom_accuracy: 0.761
3 - val_loss: 0.3818 - val_custom_accuracy: 0.3559
Epoch 123/300
4/4 [==============================] - 6s 1s/step - loss: 0.4563 - custom_accuracy: 0.681
7 - val_loss: 0.3813 - val_custom_accuracy: 0.3559
Epoch 124/300
4/4 [==============================] - 9s 2s/step - loss: 0.4463 - custom_accuracy: 0.728
7 - val_loss: 0.3810 - val_custom_accuracy: 0.3559
Epoch 125/300
4/4 [==============================] - 7s 2s/step - loss: 0.4445 - custom_accuracy: 0.822
7 - val_loss: 0.3805 - val_custom_accuracy: 0.3559
Epoch 126/300
4/4 [==============================] - 7s 2s/step - loss: 0.4367 - custom_accuracy: 0.808
2 - val_loss: 0.3797 - val_custom_accuracy: 0.3559
Epoch 127/300
4/4 [==============================] - 9s 2s/step - loss: 0.4504 - custom_accuracy: 0.746
3 - val_loss: 0.3787 - val_custom_accuracy: 0.3559
Epoch 128/300
4/4 [==============================] - 6s 2s/step - loss: 0.4459 - custom_accuracy: 0.781
1 - val_loss: 0.3781 - val_custom_accuracy: 0.3559
Epoch 129/300
4/4 [==============================] - 9s 2s/step - loss: 0.4359 - custom_accuracy: 0.755
5 - val_loss: 0.3780 - val_custom_accuracy: 0.3559
Epoch 130/300
4/4 [==============================] - 7s 2s/step - loss: 0.4487 - custom_accuracy: 0.624
```

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3 - val_loss: 0.3784 - val_custom_accuracy: 0.3559
Epoch 131/300
4/4 [==============================] - 7s 2s/step - loss: 0.4341 - custom_accuracy: 0.708
5 - val_loss: 0.3798 - val_custom_accuracy: 0.3598
Epoch 132/300
4/4 [==============================] - 9s 2s/step - loss: 0.4419 - custom_accuracy: 0.822
4 - val_loss: 0.3819 - val_custom_accuracy: 0.3503
Epoch 133/300
4/4 [==============================] - 6s 2s/step - loss: 0.4424 - custom_accuracy: 0.669
9 - val_loss: 0.3847 - val_custom_accuracy: 0.3511
Epoch 134/300
4/4 [==============================] - 9s 2s/step - loss: 0.4346 - custom_accuracy: 0.738
5 - val_loss: 0.3872 - val_custom_accuracy: 0.3511
Epoch 135/300
4/4 [==============================] - 7s 2s/step - loss: 0.4622 - custom_accuracy: 0.809
3 - val_loss: 0.3879 - val_custom_accuracy: 0.3511
Epoch 136/300
4/4 [==============================] - 7s 2s/step - loss: 0.4460 - custom_accuracy: 0.698
7 - val_loss: 0.3864 - val_custom_accuracy: 0.3511
Epoch 137/300
4/4 [==============================] - 9s 2s/step - loss: 0.4493 - custom_accuracy: 0.707
5 - val_loss: 0.3858 - val_custom_accuracy: 0.3511
Epoch 138/300
4/4 [==============================] - 6s 2s/step - loss: 0.4276 - custom_accuracy: 0.702
6 - val_loss: 0.3855 - val_custom_accuracy: 0.3511
Epoch 139/300
4/4 [==============================] - 9s 2s/step - loss: 0.4317 - custom_accuracy: 0.743
6 - val_loss: 0.3865 - val_custom_accuracy: 0.3511
Epoch 140/300
4/4 [==============================] - 7s 2s/step - loss: 0.4310 - custom_accuracy: 0.776
9 - val_loss: 0.3866 - val_custom_accuracy: 0.3511
Epoch 141/300
4/4 [==============================] - 6s 2s/step - loss: 0.4484 - custom_accuracy: 0.701
6 - val_loss: 0.3855 - val_custom_accuracy: 0.3511
Epoch 142/300
4/4 [==============================] - 10s 2s/step - loss: 0.4319 - custom_accuracy: 0.72
00 - val_loss: 0.3842 - val_custom_accuracy: 0.3511
Epoch 143/300
4/4 [==============================] - 6s 2s/step - loss: 0.4315 - custom_accuracy: 0.815
0 - val_loss: 0.3842 - val_custom_accuracy: 0.3511
Epoch 144/300
4/4 [==============================] - 9s 3s/step - loss: 0.4491 - custom_accuracy: 0.817
2 - val_loss: 0.3827 - val_custom_accuracy: 0.3511
Epoch 145/300
4/4 [==============================] - 7s 2s/step - loss: 0.4339 - custom_accuracy: 0.741
4 - val_loss: 0.3812 - val_custom_accuracy: 0.3511
Epoch 146/300
4/4 [==============================] - 7s 2s/step - loss: 0.4400 - custom_accuracy: 0.725
6 - val_loss: 0.3805 - val_custom_accuracy: 0.3503
Epoch 147/300
4/4 [==============================] - 9s 2s/step - loss: 0.4292 - custom_accuracy: 0.737
8 - val_loss: 0.3793 - val_custom_accuracy: 0.3464
Epoch 148/300
4/4 [==============================] - 6s 2s/step - loss: 0.4411 - custom_accuracy: 0.585
3 - val_loss: 0.3789 - val_custom_accuracy: 0.3464
Epoch 149/300
4/4 [==============================] - 9s 2s/step - loss: 0.4282 - custom_accuracy: 0.593
2 - val_loss: 0.3794 - val_custom_accuracy: 0.3503
Epoch 150/300
4/4 [==============================] - 7s 2s/step - loss: 0.4363 - custom_accuracy: 0.783
2 - val_loss: 0.3813 - val_custom_accuracy: 0.3511
Epoch 151/300
4/4 [==============================] - 7s 2s/step - loss: 0.4367 - custom_accuracy: 0.738
2 - val_loss: 0.3809 - val_custom_accuracy: 0.3542
Epoch 152/300
4/4 [==============================] - 9s 2s/step - loss: 0.4351 - custom_accuracy: 0.695
2 - val_loss: 0.3808 - val_custom_accuracy: 0.3464
Epoch 153/300
4/4 [==============================] - 6s 2s/step - loss: 0.4317 - custom_accuracy: 0.824
4 - val_loss: 0.3805 - val_custom_accuracy: 0.3494
Epoch 154/300
4/4 [==============================] - 9s 3s/step - loss: 0.4415 - custom_accuracy: 0.821
```

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7 - val_loss: 0.3795 - val_custom_accuracy: 0.3763
Epoch 155/300
4/4 [==============================] - 7s 1s/step - loss: 0.4499 - custom_accuracy: 0.787
7 - val_loss: 0.3786 - val_custom_accuracy: 0.3559
Epoch 156/300
4/4 [==============================] - 7s 2s/step - loss: 0.4292 - custom_accuracy: 0.815
8 - val_loss: 0.3771 - val_custom_accuracy: 0.3559
Epoch 157/300
4/4 [==============================] - 9s 2s/step - loss: 0.4321 - custom_accuracy: 0.792
4 - val_loss: 0.3755 - val_custom_accuracy: 0.3559
Epoch 158/300
4/4 [==============================] - 6s 2s/step - loss: 0.4429 - custom_accuracy: 0.694
5 - val_loss: 0.3746 - val_custom_accuracy: 0.3559
Epoch 159/300
4/4 [==============================] - 9s 3s/step - loss: 0.4211 - custom_accuracy: 0.835
3 - val_loss: 0.3742 - val_custom_accuracy: 0.3559
Epoch 160/300
4/4 [==============================] - 7s 2s/step - loss: 0.4400 - custom_accuracy: 0.769
6 - val_loss: 0.3750 - val_custom_accuracy: 0.3559
Epoch 161/300
4/4 [==============================] - 7s 2s/step - loss: 0.4237 - custom_accuracy: 0.765
5 - val_loss: 0.3752 - val_custom_accuracy: 0.3559
Epoch 162/300
4/4 [==============================] - 9s 2s/step - loss: 0.4249 - custom_accuracy: 0.574
2 - val_loss: 0.3759 - val_custom_accuracy: 0.3559
Epoch 163/300
4/4 [==============================] - 6s 2s/step - loss: 0.4367 - custom_accuracy: 0.790
7 - val_loss: 0.3781 - val_custom_accuracy: 0.3464
Epoch 164/300
4/4 [==============================] - 9s 2s/step - loss: 0.4330 - custom_accuracy: 0.679
7 - val_loss: 0.3786 - val_custom_accuracy: 0.3511
Epoch 165/300
4/4 [==============================] - 7s 2s/step - loss: 0.4312 - custom_accuracy: 0.816
9 - val_loss: 0.3793 - val_custom_accuracy: 0.3511
Epoch 166/300
4/4 [==============================] - 7s 2s/step - loss: 0.4281 - custom_accuracy: 0.819
6 - val_loss: 0.3827 - val_custom_accuracy: 0.3511
Epoch 167/300
4/4 [==============================] - 9s 2s/step - loss: 0.4372 - custom_accuracy: 0.758
7 - val_loss: 0.3849 - val_custom_accuracy: 0.3442
Epoch 168/300
4/4 [==============================] - 6s 2s/step - loss: 0.4353 - custom_accuracy: 0.773
6 - val_loss: 0.3843 - val_custom_accuracy: 0.3442
Epoch 169/300
4/4 [==============================] - 9s 3s/step - loss: 0.4316 - custom_accuracy: 0.762
1 - val_loss: 0.3829 - val_custom_accuracy: 0.3442
Epoch 170/300
4/4 [==============================] - 7s 2s/step - loss: 0.4444 - custom_accuracy: 0.757
7 - val_loss: 0.3813 - val_custom_accuracy: 0.3511
Epoch 171/300
4/4 [==============================] - 7s 2s/step - loss: 0.4399 - custom_accuracy: 0.766
5 - val_loss: 0.3806 - val_custom_accuracy: 0.3511
Epoch 172/300
4/4 [==============================] - 9s 2s/step - loss: 0.4382 - custom_accuracy: 0.741
6 - val_loss: 0.3809 - val_custom_accuracy: 0.3511
Epoch 173/300
4/4 [==============================] - 6s 2s/step - loss: 0.4342 - custom_accuracy: 0.812
9 - val_loss: 0.3827 - val_custom_accuracy: 0.3442
Epoch 174/300
4/4 [==============================] - 9s 3s/step - loss: 0.4393 - custom_accuracy: 0.772
5 - val_loss: 0.3833 - val_custom_accuracy: 0.3442
Epoch 175/300
4/4 [==============================] - 7s 2s/step - loss: 0.4198 - custom_accuracy: 0.686
4 - val_loss: 0.3827 - val_custom_accuracy: 0.3442
Epoch 176/300
4/4 [==============================] - 7s 2s/step - loss: 0.4362 - custom_accuracy: 0.812
6 - val_loss: 0.3815 - val_custom_accuracy: 0.3442
Epoch 177/300
4/4 [==============================] - 9s 2s/step - loss: 0.4421 - custom_accuracy: 0.810
0 - val_loss: 0.3818 - val_custom_accuracy: 0.3442
Epoch 178/300
4/4 [==============================] - 6s 2s/step - loss: 0.4308 - custom_accuracy: 0.810
```

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7 - val_loss: 0.3838 - val_custom_accuracy: 0.3442
Epoch 179/300
4/4 [==============================] - 9s 3s/step - loss: 0.4322 - custom_accuracy: 0.813
4 - val_loss: 0.3835 - val_custom_accuracy: 0.3442
Epoch 180/300
4/4 [==============================] - 7s 2s/step - loss: 0.4353 - custom_accuracy: 0.767
3 - val_loss: 0.3816 - val_custom_accuracy: 0.3442
Epoch 181/300
4/4 [==============================] - 7s 2s/step - loss: 0.4308 - custom_accuracy: 0.816
2 - val_loss: 0.3784 - val_custom_accuracy: 0.3511
Epoch 182/300
4/4 [==============================] - 9s 2s/step - loss: 0.4425 - custom_accuracy: 0.801
8 - val_loss: 0.3746 - val_custom_accuracy: 0.3511
Epoch 183/300
4/4 [==============================] - 6s 2s/step - loss: 0.4376 - custom_accuracy: 0.815
6 - val_loss: 0.3726 - val_custom_accuracy: 0.3511
Epoch 184/300
4/4 [==============================] - 9s 3s/step - loss: 0.4350 - custom_accuracy: 0.710
6 - val_loss: 0.3716 - val_custom_accuracy: 0.3511
Epoch 185/300
4/4 [==============================] - 7s 2s/step - loss: 0.4461 - custom_accuracy: 0.815
6 - val_loss: 0.3720 - val_custom_accuracy: 0.3511
Epoch 186/300
4/4 [==============================] - 7s 2s/step - loss: 0.4304 - custom_accuracy: 0.580
3 - val_loss: 0.3749 - val_custom_accuracy: 0.3511
Epoch 187/300
4/4 [==============================] - 9s 2s/step - loss: 0.4354 - custom_accuracy: 0.765
0 - val_loss: 0.3810 - val_custom_accuracy: 0.3442
Epoch 188/300
4/4 [==============================] - 6s 2s/step - loss: 0.4254 - custom_accuracy: 0.739
6 - val_loss: 0.3861 - val_custom_accuracy: 0.3442
Epoch 189/300
4/4 [==============================] - 9s 3s/step - loss: 0.4205 - custom_accuracy: 0.703
7 - val_loss: 0.3902 - val_custom_accuracy: 0.3442
Epoch 190/300
4/4 [==============================] - 7s 2s/step - loss: 0.4283 - custom_accuracy: 0.646
2 - val_loss: 0.3893 - val_custom_accuracy: 0.3442
Epoch 191/300
4/4 [==============================] - 7s 2s/step - loss: 0.4145 - custom_accuracy: 0.759
3 - val_loss: 0.3876 - val_custom_accuracy: 0.3442
Epoch 192/300
4/4 [==============================] - 9s 2s/step - loss: 0.4191 - custom_accuracy: 0.589
1 - val_loss: 0.3859 - val_custom_accuracy: 0.3442
Epoch 193/300
4/4 [==============================] - 6s 2s/step - loss: 0.4214 - custom_accuracy: 0.739
1 - val_loss: 0.3848 - val_custom_accuracy: 0.3442
Epoch 194/300
4/4 [==============================] - 9s 3s/step - loss: 0.4236 - custom_accuracy: 0.738
1 - val_loss: 0.3853 - val_custom_accuracy: 0.3442
Epoch 195/300
4/4 [==============================] - 6s 2s/step - loss: 0.4209 - custom_accuracy: 0.705
1 - val_loss: 0.3827 - val_custom_accuracy: 0.3442
Epoch 196/300
4/4 [==============================] - 7s 2s/step - loss: 0.4239 - custom_accuracy: 0.818
5 - val_loss: 0.3819 - val_custom_accuracy: 0.3442
Epoch 197/300
4/4 [==============================] - 9s 2s/step - loss: 0.4232 - custom_accuracy: 0.681
3 - val_loss: 0.3821 - val_custom_accuracy: 0.3442
Epoch 198/300
4/4 [==============================] - 6s 1s/step - loss: 0.4202 - custom_accuracy: 0.729
7 - val_loss: 0.3827 - val_custom_accuracy: 0.3442
Epoch 199/300
4/4 [==============================] - 9s 3s/step - loss: 0.4190 - custom_accuracy: 0.665
3 - val_loss: 0.3831 - val_custom_accuracy: 0.3442
Epoch 200/300
4/4 [==============================] - 7s 2s/step - loss: 0.4163 - custom_accuracy: 0.771
0 - val_loss: 0.3846 - val_custom_accuracy: 0.3442
Epoch 201/300
4/4 [==============================] - 7s 2s/step - loss: 0.4196 - custom_accuracy: 0.760
5 - val_loss: 0.3870 - val_custom_accuracy: 0.3442
Epoch 202/300
4/4 [==============================] - 9s 2s/step - loss: 0.4181 - custom_accuracy: 0.739
```

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4 - val_loss: 0.3898 - val_custom_accuracy: 0.3442
Epoch 203/300
4/4 [==============================] - 6s 2s/step - loss: 0.4356 - custom_accuracy: 0.808
7 - val_loss: 0.3947 - val_custom_accuracy: 0.3442
Epoch 204/300
4/4 [==============================] - 9s 3s/step - loss: 0.4347 - custom_accuracy: 0.753
6 - val_loss: 0.3999 - val_custom_accuracy: 0.2717
Epoch 205/300
4/4 [==============================] - 7s 2s/step - loss: 0.4233 - custom_accuracy: 0.693
5 - val_loss: 0.4026 - val_custom_accuracy: 0.2687
Epoch 206/300
4/4 [==============================] - 7s 2s/step - loss: 0.4241 - custom_accuracy: 0.666
2 - val_loss: 0.4026 - val_custom_accuracy: 0.2687
Epoch 207/300
4/4 [==============================] - 9s 2s/step - loss: 0.4245 - custom_accuracy: 0.721
1 - val_loss: 0.3995 - val_custom_accuracy: 0.2865
Epoch 208/300
4/4 [==============================] - 6s 2s/step - loss: 0.4179 - custom_accuracy: 0.770
0 - val_loss: 0.3981 - val_custom_accuracy: 0.3073
Epoch 209/300
4/4 [==============================] - 9s 3s/step - loss: 0.4188 - custom_accuracy: 0.664
2 - val_loss: 0.3968 - val_custom_accuracy: 0.3442
Epoch 210/300
4/4 [==============================] - 7s 2s/step - loss: 0.4270 - custom_accuracy: 0.810
2 - val_loss: 0.3946 - val_custom_accuracy: 0.3442
Epoch 211/300
4/4 [==============================] - 7s 2s/step - loss: 0.4150 - custom_accuracy: 0.587
4 - val_loss: 0.3917 - val_custom_accuracy: 0.3442
Epoch 212/300
4/4 [==============================] - 9s 2s/step - loss: 0.4226 - custom_accuracy: 0.740
1 - val_loss: 0.3912 - val_custom_accuracy: 0.3442
Epoch 213/300
4/4 [==============================] - 6s 2s/step - loss: 0.4318 - custom_accuracy: 0.768
0 - val_loss: 0.3905 - val_custom_accuracy: 0.3442
Epoch 214/300
4/4 [==============================] - 9s 3s/step - loss: 0.4264 - custom_accuracy: 0.813
4 - val_loss: 0.3884 - val_custom_accuracy: 0.3442
Epoch 215/300
4/4 [==============================] - 7s 2s/step - loss: 0.4190 - custom_accuracy: 0.766
5 - val_loss: 0.3847 - val_custom_accuracy: 0.3442
Epoch 216/300
4/4 [==============================] - 7s 2s/step - loss: 0.4285 - custom_accuracy: 0.767
8 - val_loss: 0.3811 - val_custom_accuracy: 0.3442
Epoch 217/300
4/4 [==============================] - 9s 2s/step - loss: 0.4156 - custom_accuracy: 0.758
2 - val_loss: 0.3790 - val_custom_accuracy: 0.3442
Epoch 218/300
4/4 [==============================] - 6s 2s/step - loss: 0.4157 - custom_accuracy: 0.742
0 - val_loss: 0.3788 - val_custom_accuracy: 0.3442
Epoch 219/300
4/4 [==============================] - 10s 3s/step - loss: 0.4212 - custom_accuracy: 0.77
29 - val_loss: 0.3754 - val_custom_accuracy: 0.3442
Epoch 220/300
4/4 [==============================] - 6s 2s/step - loss: 0.4179 - custom_accuracy: 0.664
1 - val_loss: 0.3738 - val_custom_accuracy: 0.3511
Epoch 221/300
4/4 [==============================] - 8s 2s/step - loss: 0.4137 - custom_accuracy: 0.815
7 - val_loss: 0.3717 - val_custom_accuracy: 0.3511
Epoch 222/300
4/4 [==============================] - 8s 2s/step - loss: 0.4055 - custom_accuracy: 0.767
4 - val_loss: 0.3692 - val_custom_accuracy: 0.3542
Epoch 223/300
4/4 [==============================] - 6s 1s/step - loss: 0.4355 - custom_accuracy: 0.699
8 - val_loss: 0.3677 - val_custom_accuracy: 0.3819
Epoch 224/300
4/4 [==============================] - 10s 3s/step - loss: 0.4298 - custom_accuracy: 0.72
56 - val_loss: 0.3675 - val_custom_accuracy: 0.3802
Epoch 225/300
4/4 [==============================] - 6s 2s/step - loss: 0.4144 - custom_accuracy: 0.694
8 - val_loss: 0.3679 - val_custom_accuracy: 0.3424
Epoch 226/300
4/4 [==============================] - 8s 2s/step - loss: 0.4106 - custom_accuracy: 0.806
```

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3 - val_loss: 0.3713 - val_custom_accuracy: 0.3511
Epoch 227/300
4/4 [==============================] - 8s 2s/step - loss: 0.4085 - custom_accuracy: 0.831
4 - val_loss: 0.3791 - val_custom_accuracy: 0.3442
Epoch 228/300
4/4 [==============================] - 6s 2s/step - loss: 0.4215 - custom_accuracy: 0.818
3 - val_loss: 0.3878 - val_custom_accuracy: 0.3442
Epoch 229/300
4/4 [==============================] - 10s 3s/step - loss: 0.4380 - custom_accuracy: 0.81
50 - val_loss: 0.3963 - val_custom_accuracy: 0.3442
Epoch 230/300
4/4 [==============================] - 6s 2s/step - loss: 0.4305 - custom_accuracy: 0.650
2 - val_loss: 0.4000 - val_custom_accuracy: 0.3442
Epoch 231/300
4/4 [==============================] - 7s 2s/step - loss: 0.4271 - custom_accuracy: 0.760
4 - val_loss: 0.4001 - val_custom_accuracy: 0.3442
Epoch 232/300
4/4 [==============================] - 8s 2s/step - loss: 0.4257 - custom_accuracy: 0.756
7 - val_loss: 0.3996 - val_custom_accuracy: 0.3442
Epoch 233/300
4/4 [==============================] - 6s 2s/step - loss: 0.4063 - custom_accuracy: 0.810
7 - val_loss: 0.3975 - val_custom_accuracy: 0.3442
Epoch 234/300
4/4 [==============================] - 10s 3s/step - loss: 0.4044 - custom_accuracy: 0.70
48 - val_loss: 0.3968 - val_custom_accuracy: 0.3442
Epoch 235/300
4/4 [==============================] - 6s 1s/step - loss: 0.4236 - custom_accuracy: 0.584
3 - val_loss: 0.3963 - val_custom_accuracy: 0.3442
Epoch 236/300
4/4 [==============================] - 8s 2s/step - loss: 0.4230 - custom_accuracy: 0.811
8 - val_loss: 0.3930 - val_custom_accuracy: 0.3442
Epoch 237/300
4/4 [==============================] - 8s 2s/step - loss: 0.4196 - custom_accuracy: 0.811
1 - val_loss: 0.3880 - val_custom_accuracy: 0.3442
Epoch 238/300
4/4 [==============================] - 6s 2s/step - loss: 0.4351 - custom_accuracy: 0.772
9 - val_loss: 0.3832 - val_custom_accuracy: 0.3442
Epoch 239/300
4/4 [==============================] - 10s 3s/step - loss: 0.4165 - custom_accuracy: 0.76
05 - val_loss: 0.3809 - val_custom_accuracy: 0.3442
Epoch 240/300
4/4 [==============================] - 6s 2s/step - loss: 0.4408 - custom_accuracy: 0.810
9 - val_loss: 0.3802 - val_custom_accuracy: 0.3442
Epoch 241/300
4/4 [==============================] - 8s 2s/step - loss: 0.4226 - custom_accuracy: 0.770
5 - val_loss: 0.3789 - val_custom_accuracy: 0.3442
Epoch 242/300
4/4 [==============================] - 8s 2s/step - loss: 0.4042 - custom_accuracy: 0.755
5 - val_loss: 0.3805 - val_custom_accuracy: 0.3442
Epoch 243/300
4/4 [==============================] - 6s 1s/step - loss: 0.4249 - custom_accuracy: 0.757
4 - val_loss: 0.3849 - val_custom_accuracy: 0.3442
Epoch 244/300
4/4 [==============================] - 10s 3s/step - loss: 0.4251 - custom_accuracy: 0.73
65 - val_loss: 0.3885 - val_custom_accuracy: 0.3442
Epoch 245/300
4/4 [==============================] - 6s 2s/step - loss: 0.4224 - custom_accuracy: 0.658
2 - val_loss: 0.3904 - val_custom_accuracy: 0.3442
Epoch 246/300
4/4 [==============================] - 7s 2s/step - loss: 0.4260 - custom_accuracy: 0.765
4 - val_loss: 0.3933 - val_custom_accuracy: 0.3442
Epoch 247/300
4/4 [==============================] - 8s 2s/step - loss: 0.4327 - custom_accuracy: 0.760
3 - val_loss: 0.3954 - val_custom_accuracy: 0.3442
Epoch 248/300
4/4 [==============================] - 6s 2s/step - loss: 0.4163 - custom_accuracy: 0.818
2 - val_loss: 0.3975 - val_custom_accuracy: 0.3442
Epoch 249/300
4/4 [==============================] - 9s 3s/step - loss: 0.4347 - custom_accuracy: 0.723
3 - val_loss: 0.3967 - val_custom_accuracy: 0.3442
Epoch 250/300
4/4 [==============================] - 6s 2s/step - loss: 0.4265 - custom_accuracy: 0.814
```

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2 - val_loss: 0.3937 - val_custom_accuracy: 0.3442
Epoch 251/300
4/4 [==============================] - 7s 2s/step - loss: 0.4169 - custom_accuracy: 0.812
1 - val_loss: 0.3942 - val_custom_accuracy: 0.3442
Epoch 252/300
4/4 [==============================] - 9s 2s/step - loss: 0.4299 - custom_accuracy: 0.771
5 - val_loss: 0.3938 - val_custom_accuracy: 0.3442
Epoch 253/300
4/4 [==============================] - 6s 2s/step - loss: 0.4265 - custom_accuracy: 0.808
3 - val_loss: 0.3940 - val_custom_accuracy: 0.3442
Epoch 254/300
4/4 [==============================] - 9s 3s/step - loss: 0.4322 - custom_accuracy: 0.812
4 - val_loss: 0.3930 - val_custom_accuracy: 0.3442
Epoch 255/300
4/4 [==============================] - 6s 2s/step - loss: 0.4197 - custom_accuracy: 0.700
5 - val_loss: 0.3906 - val_custom_accuracy: 0.3442
Epoch 256/300
4/4 [==============================] - 8s 2s/step - loss: 0.4270 - custom_accuracy: 0.755
0 - val_loss: 0.3836 - val_custom_accuracy: 0.3442
Epoch 257/300
4/4 [==============================] - 8s 2s/step - loss: 0.4177 - custom_accuracy: 0.705
4 - val_loss: 0.3769 - val_custom_accuracy: 0.3442
Epoch 258/300
4/4 [==============================] - 6s 2s/step - loss: 0.4167 - custom_accuracy: 0.770
2 - val_loss: 0.3723 - val_custom_accuracy: 0.3442
Epoch 259/300
4/4 [==============================] - 9s 3s/step - loss: 0.4236 - custom_accuracy: 0.775
8 - val_loss: 0.3694 - val_custom_accuracy: 0.3511
Epoch 260/300
4/4 [==============================] - 7s 2s/step - loss: 0.4177 - custom_accuracy: 0.815
0 - val_loss: 0.3675 - val_custom_accuracy: 0.3511
Epoch 261/300
4/4 [==============================] - 7s 2s/step - loss: 0.4138 - custom_accuracy: 0.710
1 - val_loss: 0.3683 - val_custom_accuracy: 0.3511
Epoch 262/300
4/4 [==============================] - 8s 2s/step - loss: 0.4187 - custom_accuracy: 0.756
8 - val_loss: 0.3691 - val_custom_accuracy: 0.3511
Epoch 263/300
4/4 [==============================] - 6s 2s/step - loss: 0.4144 - custom_accuracy: 0.666
1 - val_loss: 0.3699 - val_custom_accuracy: 0.3511
Epoch 264/300
4/4 [==============================] - 10s 3s/step - loss: 0.4277 - custom_accuracy: 0.81
32 - val_loss: 0.3685 - val_custom_accuracy: 0.3511
Epoch 265/300
4/4 [==============================] - 6s 2s/step - loss: 0.4070 - custom_accuracy: 0.770
6 - val_loss: 0.3675 - val_custom_accuracy: 0.3511
Epoch 266/300
4/4 [==============================] - 7s 2s/step - loss: 0.4146 - custom_accuracy: 0.665
0 - val_loss: 0.3661 - val_custom_accuracy: 0.3511
Epoch 267/300
4/4 [==============================] - 8s 2s/step - loss: 0.4252 - custom_accuracy: 0.740
9 - val_loss: 0.3655 - val_custom_accuracy: 0.3511
Epoch 268/300
4/4 [==============================] - 6s 2s/step - loss: 0.4238 - custom_accuracy: 0.810
4 - val_loss: 0.3655 - val_custom_accuracy: 0.3511
Epoch 269/300
4/4 [==============================] - 9s 3s/step - loss: 0.4303 - custom_accuracy: 0.807
4 - val_loss: 0.3676 - val_custom_accuracy: 0.3511
Epoch 270/300
4/4 [==============================] - 6s 2s/step - loss: 0.4346 - custom_accuracy: 0.810
8 - val_loss: 0.3698 - val_custom_accuracy: 0.3511
Epoch 271/300
4/4 [==============================] - 8s 2s/step - loss: 0.4103 - custom_accuracy: 0.701
7 - val_loss: 0.3708 - val_custom_accuracy: 0.3511
Epoch 272/300
4/4 [==============================] - 8s 2s/step - loss: 0.4250 - custom_accuracy: 0.737
4 - val_loss: 0.3703 - val_custom_accuracy: 0.3511
Epoch 273/300
4/4 [==============================] - 6s 2s/step - loss: 0.4175 - custom_accuracy: 0.729
2 - val_loss: 0.3705 - val_custom_accuracy: 0.3511
Epoch 274/300
4/4 [==============================] - 9s 3s/step - loss: 0.4266 - custom_accuracy: 0.812
```

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5 - val_loss: 0.3719 - val_custom_accuracy: 0.3511
Epoch 275/300
4/4 [==============================] - 6s 2s/step - loss: 0.4156 - custom_accuracy: 0.765
0 - val_loss: 0.3733 - val_custom_accuracy: 0.3511
Epoch 276/300
4/4 [==============================] - 7s 2s/step - loss: 0.4151 - custom_accuracy: 0.742
9 - val_loss: 0.3724 - val_custom_accuracy: 0.3511
Epoch 277/300
4/4 [==============================] - 9s 2s/step - loss: 0.4187 - custom_accuracy: 0.810
0 - val_loss: 0.3701 - val_custom_accuracy: 0.3511
Epoch 278/300
4/4 [==============================] - 6s 2s/step - loss: 0.4256 - custom_accuracy: 0.806
6 - val_loss: 0.3694 - val_custom_accuracy: 0.3511
Epoch 279/300
4/4 [==============================] - 9s 3s/step - loss: 0.4145 - custom_accuracy: 0.813
4 - val_loss: 0.3697 - val_custom_accuracy: 0.3511
Epoch 280/300
4/4 [==============================] - 7s 2s/step - loss: 0.4175 - custom_accuracy: 0.729
4 - val_loss: 0.3684 - val_custom_accuracy: 0.3511
Epoch 281/300
4/4 [==============================] - 7s 2s/step - loss: 0.4146 - custom_accuracy: 0.813
2 - val_loss: 0.3661 - val_custom_accuracy: 0.3511
Epoch 282/300
4/4 [==============================] - 9s 2s/step - loss: 0.4016 - custom_accuracy: 0.756
1 - val_loss: 0.3652 - val_custom_accuracy: 0.3511
Epoch 283/300
4/4 [==============================] - 6s 2s/step - loss: 0.4205 - custom_accuracy: 0.814
6 - val_loss: 0.3658 - val_custom_accuracy: 0.3511
Epoch 284/300
4/4 [==============================] - 9s 3s/step - loss: 0.4337 - custom_accuracy: 0.750
6 - val_loss: 0.3686 - val_custom_accuracy: 0.3511
Epoch 285/300
4/4 [==============================] - 6s 2s/step - loss: 0.4198 - custom_accuracy: 0.766
3 - val_loss: 0.3706 - val_custom_accuracy: 0.3442
Epoch 286/300
4/4 [==============================] - 7s 2s/step - loss: 0.4290 - custom_accuracy: 0.736
1 - val_loss: 0.3705 - val_custom_accuracy: 0.3442
Epoch 287/300
4/4 [==============================] - 9s 2s/step - loss: 0.4191 - custom_accuracy: 0.758
4 - val_loss: 0.3725 - val_custom_accuracy: 0.3442
Epoch 288/300
4/4 [==============================] - 6s 2s/step - loss: 0.4220 - custom_accuracy: 0.699
0 - val_loss: 0.3739 - val_custom_accuracy: 0.3442
Epoch 289/300
4/4 [==============================] - 10s 3s/step - loss: 0.4084 - custom_accuracy: 0.75
98 - val_loss: 0.3724 - val_custom_accuracy: 0.3442
Epoch 290/300
4/4 [==============================] - 6s 2s/step - loss: 0.4264 - custom_accuracy: 0.773
4 - val_loss: 0.3720 - val_custom_accuracy: 0.3442
Epoch 291/300
4/4 [==============================] - 8s 2s/step - loss: 0.4123 - custom_accuracy: 0.706
4 - val_loss: 0.3695 - val_custom_accuracy: 0.3511
Epoch 292/300
4/4 [==============================] - 8s 2s/step - loss: 0.4141 - custom_accuracy: 0.775
1 - val_loss: 0.3664 - val_custom_accuracy: 0.3511
Epoch 293/300
4/4 [==============================] - 6s 2s/step - loss: 0.4225 - custom_accuracy: 0.813
3 - val_loss: 0.3647 - val_custom_accuracy: 0.3511
Epoch 294/300
4/4 [==============================] - 10s 3s/step - loss: 0.4198 - custom_accuracy: 0.77
64 - val_loss: 0.3650 - val_custom_accuracy: 0.3511
Epoch 295/300
4/4 [==============================] - 6s 2s/step - loss: 0.4131 - custom_accuracy: 0.776
5 - val_loss: 0.3661 - val_custom_accuracy: 0.3511
Epoch 296/300
4/4 [==============================] - 10s 3s/step - loss: 0.4156 - custom_accuracy: 0.81
90 - val_loss: 0.3666 - val_custom_accuracy: 0.3511
Epoch 297/300
4/4 [==============================] - 7s 2s/step - loss: 0.4058 - custom_accuracy: 0.756
1 - val_loss: 0.3673 - val_custom_accuracy: 0.3511
Epoch 298/300
4/4 [==============================] - 7s 2s/step - loss: 0.4104 - custom_accuracy: 0.729
```

```
0 - val_loss: 0.3673 - val_custom_accuracy: 0.3511
Epoch 299/300
4/4 [==============================] - 9s 2s/step - loss: 0.4077 - custom_accuracy: 0.824
0 - val_loss: 0.3688 - val_custom_accuracy: 0.3442
Epoch 300/300
4/4 [==============================] - 6s 2s/step - loss: 0.4128 - custom_accuracy: 0.740
5 - val_loss: 0.3706 - val_custom_accuracy: 0.3442
```

In [ ]:

```
plt.plot(H.history['loss'])
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.title("Discriminator's Loss for the First Cycle")
plt.show()
```

```
WARNING:matplotlib.font_manager:findfont: Font family 'Arial' not found.
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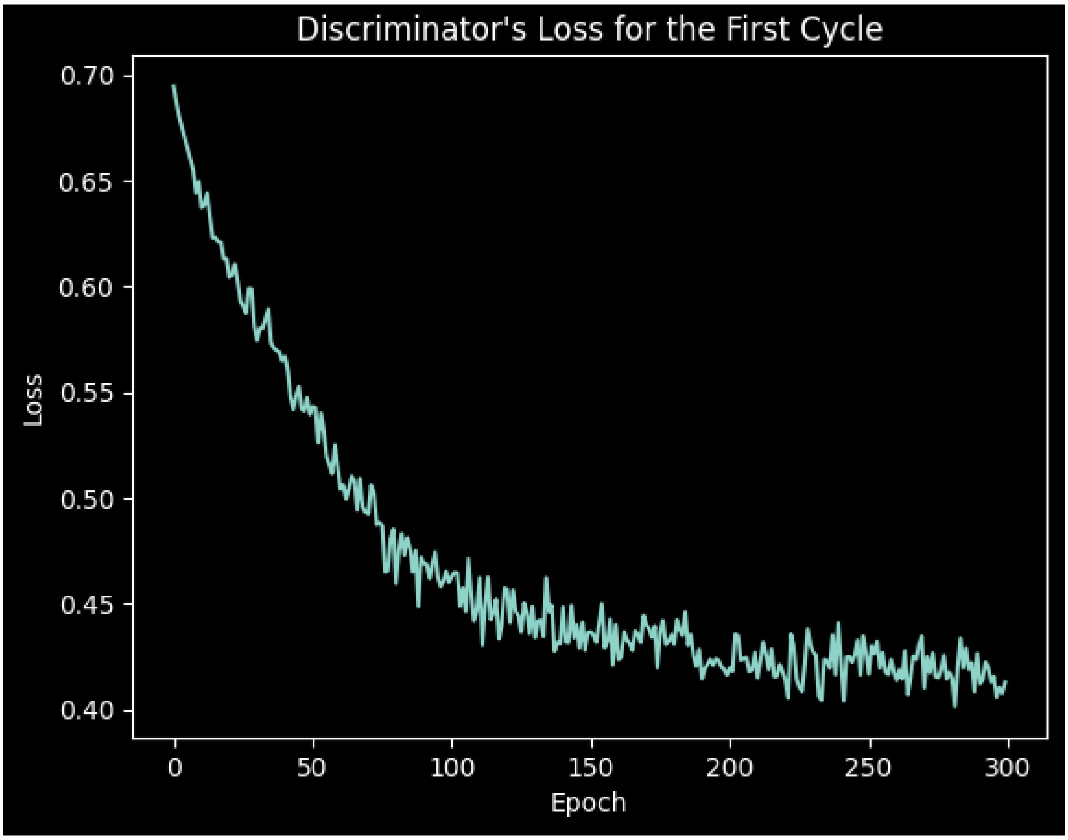
```



In [ ]:

```
plt.plot(H.history['custom_accuracy'])
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.title("Discriminator's Accuracy in the First Cycle")
plt.show()
```

```
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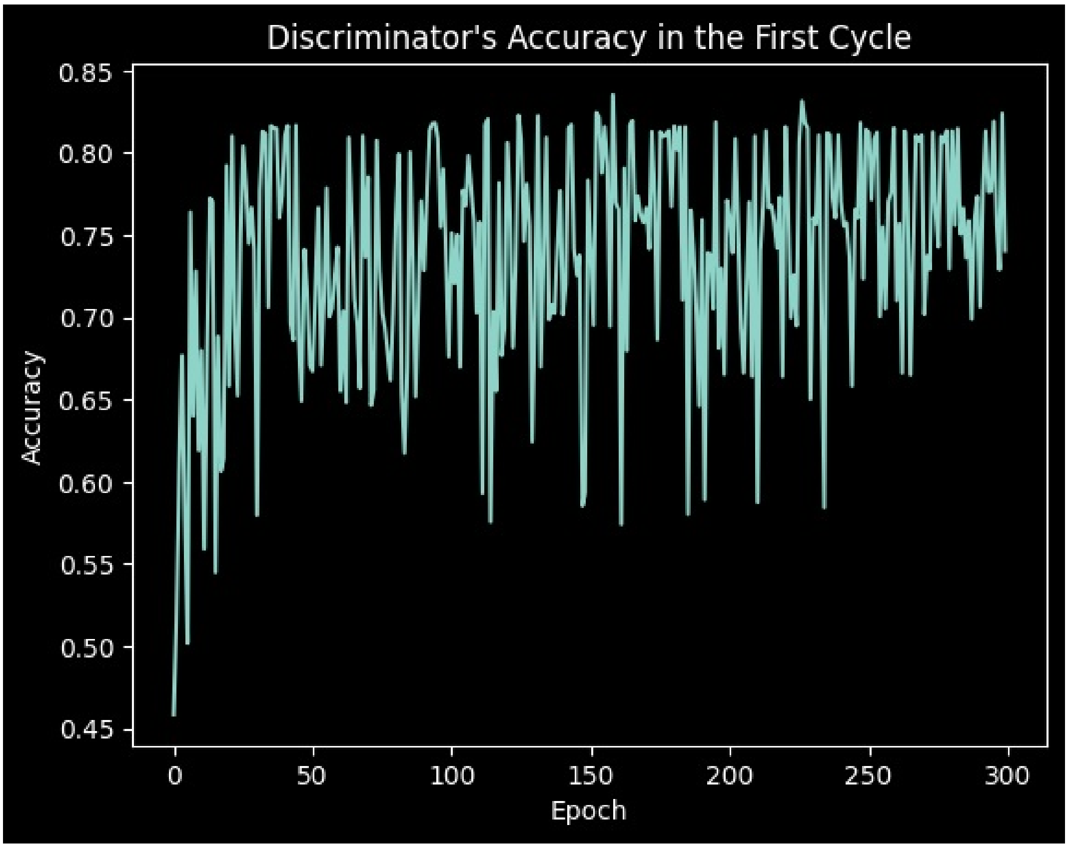
```



In [ ]:

```
custom_accuracy(np.array(y_gen_test, dtype=np.float32), qdisc_model.predict(gen_data_tes
t))
```

Out[ ]:

```
<tf.Tensor: shape=(), dtype=float32, numpy=0.71>
```

In [ ]:

```
best_qdisc_weights = qdisc_model.get_weights()[0]
best_qgen_weights = qgen_model.get_weights()[0]
qgen_model = generator_model(symbols_gen, qdisc_model.get_weights()[0])

qgen_model.get_layer('qgen_layer').set_weights([best_qgen_weights])
qdisc_model.get_layer('qdisc_layer').set_weights([best_qdisc_weights])
```

In [ ]:

```
gen_model_cp, disc_model_cp = checkpoints(cycle=2)
```

In [ ]:

```
# Fit the Generator Model
H = train_qgen(500, 100, 1)
```

```
Epoch 1/500
1/1 [==============================] - 6s 6s/step - loss: 0.7027
Epoch 2/500
1/1 [==============================] - 4s 4s/step - loss: 0.6953
Epoch 3/500
1/1 [==============================] - 3s 3s/step - loss: 0.6879
Epoch 4/500
1/1 [==============================] - 3s 3s/step - loss: 0.6806
Epoch 5/500
1/1 [==============================] - 5s 5s/step - loss: 0.6733
Epoch 6/500
1/1 [==============================] - 5s 5s/step - loss: 0.6660
Epoch 7/500
1/1 [==============================] - 3s 3s/step - loss: 0.6588
Epoch 8/500
1/1 [==============================] - 3s 3s/step - loss: 0.6516
Epoch 9/500
1/1 [==============================] - 3s 3s/step - loss: 0.6444
Epoch 10/500
1/1 [==============================] - 6s 6s/step - loss: 0.6373
Epoch 11/500
1/1 [==============================] - 4s 4s/step - loss: 0.6303
Epoch 12/500
1/1 [==============================] - 3s 3s/step - loss: 0.6233
Epoch 13/500
1/1 [==============================] - 3s 3s/step - loss: 0.6163
Epoch 14/500
1/1 [==============================] - 4s 4s/step - loss: 0.6094
Epoch 15/500
1/1 [==============================] - 6s 6s/step - loss: 0.6026
Epoch 16/500
1/1 [==============================] - 4s 4s/step - loss: 0.5958
Epoch 17/500
1/1 [==============================] - 3s 3s/step - loss: 0.5891
Epoch 18/500
1/1 [==============================] - 3s 3s/step - loss: 0.5826
Epoch 19/500
1/1 [==============================] - 5s 5s/step - loss: 0.5761
Epoch 20/500
1/1 [==============================] - 5s 5s/step - loss: 0.5697
Epoch 21/500
1/1 [==============================] - 3s 3s/step - loss: 0.5635
Epoch 22/500
1/1 [==============================] - 3s 3s/step - loss: 0.5574
Epoch 23/500
1/1 [==============================] - 3s 3s/step - loss: 0.5514
Epoch 24/500
1/1 [==============================] - 6s 6s/step - loss: 0.5456
Epoch 25/500
1/1 [==============================] - 4s 4s/step - loss: 0.5400
Epoch 26/500
1/1 [==============================] - 3s 3s/step - loss: 0.5345
Epoch 27/500
1/1 [==============================] - 3s 3s/step - loss: 0.5293
Epoch 28/500
1/1 [==============================] - 4s 4s/step - loss: 0.5242
Epoch 29/500
1/1 [==============================] - 6s 6s/step - loss: 0.5193
Epoch 30/500
1/1 [==============================] - 4s 4s/step - loss: 0.5145
Epoch 31/500
1/1 [==============================] - 3s 3s/step - loss: 0.5100
Epoch 32/500
```

```
1/1 [==============================] - 3s 3s/step - loss: 0.5056
Epoch 33/500
1/1 [==============================] - 5s 5s/step - loss: 0.5014
Epoch 34/500
1/1 [==============================] - 5s 5s/step - loss: 0.4974
Epoch 35/500
1/1 [==============================] - 3s 3s/step - loss: 0.4936
Epoch 36/500
1/1 [==============================] - 3s 3s/step - loss: 0.4899
Epoch 37/500
1/1 [==============================] - 3s 3s/step - loss: 0.4863
Epoch 38/500
1/1 [==============================] - 6s 6s/step - loss: 0.4829
Epoch 39/500
1/1 [==============================] - 4s 4s/step - loss: 0.4796
Epoch 40/500
1/1 [==============================] - 3s 3s/step - loss: 0.4764
Epoch 41/500
1/1 [==============================] - 3s 3s/step - loss: 0.4733
Epoch 42/500
1/1 [==============================] - 5s 5s/step - loss: 0.4703
Epoch 43/500
1/1 [==============================] - 6s 6s/step - loss: 0.4674
Epoch 44/500
1/1 [==============================] - 3s 3s/step - loss: 0.4646
Epoch 45/500
1/1 [==============================] - 3s 3s/step - loss: 0.4618
Epoch 46/500
1/1 [==============================] - 3s 3s/step - loss: 0.4591
Epoch 47/500
1/1 [==============================] - 5s 5s/step - loss: 0.4564
Epoch 48/500
1/1 [==============================] - 5s 5s/step - loss: 0.4538
Epoch 49/500
1/1 [==============================] - 3s 3s/step - loss: 0.4513
Epoch 50/500
1/1 [==============================] - 3s 3s/step - loss: 0.4488
Epoch 51/500
1/1 [==============================] - 4s 4s/step - loss: 0.4464
Epoch 52/500
1/1 [==============================] - 6s 6s/step - loss: 0.4440
Epoch 53/500
1/1 [==============================] - 4s 4s/step - loss: 0.4416
Epoch 54/500
1/1 [==============================] - 3s 3s/step - loss: 0.4394
Epoch 55/500
1/1 [==============================] - 3s 3s/step - loss: 0.4371
Epoch 56/500
1/1 [==============================] - 5s 5s/step - loss: 0.4350
Epoch 57/500
1/1 [==============================] - 6s 6s/step - loss: 0.4328
Epoch 58/500
1/1 [==============================] - 3s 3s/step - loss: 0.4307
Epoch 59/500
1/1 [==============================] - 3s 3s/step - loss: 0.4287
Epoch 60/500
1/1 [==============================] - 3s 3s/step - loss: 0.4267
Epoch 61/500
1/1 [==============================] - 6s 6s/step - loss: 0.4247
Epoch 62/500
1/1 [==============================] - 5s 5s/step - loss: 0.4228
Epoch 63/500
1/1 [==============================] - 3s 3s/step - loss: 0.4209
Epoch 64/500
1/1 [==============================] - 3s 3s/step - loss: 0.4191
Epoch 65/500
1/1 [==============================] - 4s 4s/step - loss: 0.4173
Epoch 66/500
1/1 [==============================] - 6s 6s/step - loss: 0.4155
Epoch 67/500
1/1 [==============================] - 4s 4s/step - loss: 0.4137
Epoch 68/500
```

```
1/1 [==============================] - 3s 3s/step - loss: 0.4120
Epoch 69/500
1/1 [==============================] - 3s 3s/step - loss: 0.4103
Epoch 70/500
1/1 [==============================] - 5s 5s/step - loss: 0.4086
Epoch 71/500
1/1 [==============================] - 5s 5s/step - loss: 0.4069
Epoch 72/500
1/1 [==============================] - 3s 3s/step - loss: 0.4053
Epoch 73/500
1/1 [==============================] - 3s 3s/step - loss: 0.4036
Epoch 74/500
1/1 [==============================] - 3s 3s/step - loss: 0.4020
Epoch 75/500
1/1 [==============================] - 6s 6s/step - loss: 0.4004
Epoch 76/500
1/1 [==============================] - 4s 4s/step - loss: 0.3988
Epoch 77/500
1/1 [==============================] - 3s 3s/step - loss: 0.3973
Epoch 78/500
1/1 [==============================] - 3s 3s/step - loss: 0.3957
Epoch 79/500
1/1 [==============================] - 4s 4s/step - loss: 0.3942
Epoch 80/500
1/1 [==============================] - 6s 6s/step - loss: 0.3926
Epoch 81/500
1/1 [==============================] - 4s 4s/step - loss: 0.3911
Epoch 82/500
1/1 [==============================] - 3s 3s/step - loss: 0.3896
Epoch 83/500
1/1 [==============================] - 3s 3s/step - loss: 0.3881
Epoch 84/500
1/1 [==============================] - 5s 5s/step - loss: 0.3867
Epoch 85/500
1/1 [==============================] - 5s 5s/step - loss: 0.3852
Epoch 86/500
1/1 [==============================] - 3s 3s/step - loss: 0.3838
Epoch 87/500
1/1 [==============================] - 3s 3s/step - loss: 0.3823
Epoch 88/500
1/1 [==============================] - 3s 3s/step - loss: 0.3809
Epoch 89/500
1/1 [==============================] - 6s 6s/step - loss: 0.3795
Epoch 90/500
1/1 [==============================] - 4s 4s/step - loss: 0.3781
Epoch 91/500
1/1 [==============================] - 3s 3s/step - loss: 0.3768
Epoch 92/500
1/1 [==============================] - 3s 3s/step - loss: 0.3754
Epoch 93/500
1/1 [==============================] - 4s 4s/step - loss: 0.3741
Epoch 94/500
1/1 [==============================] - 6s 6s/step - loss: 0.3727
Epoch 95/500
1/1 [==============================] - 4s 4s/step - loss: 0.3714
Epoch 96/500
1/1 [==============================] - 3s 3s/step - loss: 0.3701
Epoch 97/500
1/1 [==============================] - 3s 3s/step - loss: 0.3688
Epoch 98/500
1/1 [==============================] - 5s 5s/step - loss: 0.3675
Epoch 99/500
1/1 [==============================] - 5s 5s/step - loss: 0.3662
Epoch 100/500
1/1 [==============================] - 3s 3s/step - loss: 0.3650
Epoch 101/500
1/1 [==============================] - 3s 3s/step - loss: 0.3637
Epoch 102/500
1/1 [==============================] - 3s 3s/step - loss: 0.3625
Epoch 103/500
1/1 [==============================] - 5s 5s/step - loss: 0.3613
Epoch 104/500
```

```
1/1 [==============================] - 5s 5s/step - loss: 0.3600
Epoch 105/500
1/1 [==============================] - 3s 3s/step - loss: 0.3588
Epoch 106/500
1/1 [==============================] - 3s 3s/step - loss: 0.3576
Epoch 107/500
1/1 [==============================] - 4s 4s/step - loss: 0.3565
Epoch 108/500
1/1 [==============================] - 6s 6s/step - loss: 0.3553
Epoch 109/500
1/1 [==============================] - 4s 4s/step - loss: 0.3541
Epoch 110/500
1/1 [==============================] - 3s 3s/step - loss: 0.3530
Epoch 111/500
1/1 [==============================] - 3s 3s/step - loss: 0.3518
Epoch 112/500
1/1 [==============================] - 5s 5s/step - loss: 0.3507
Epoch 113/500
1/1 [==============================] - 5s 5s/step - loss: 0.3496
Epoch 114/500
1/1 [==============================] - 3s 3s/step - loss: 0.3484
Epoch 115/500
1/1 [==============================] - 3s 3s/step - loss: 0.3473
Epoch 116/500
1/1 [==============================] - 3s 3s/step - loss: 0.3462
Epoch 117/500
1/1 [==============================] - 6s 6s/step - loss: 0.3451
Epoch 118/500
1/1 [==============================] - 5s 5s/step - loss: 0.3440
Epoch 119/500
1/1 [==============================] - 3s 3s/step - loss: 0.3429
Epoch 120/500
1/1 [==============================] - 3s 3s/step - loss: 0.3419
Epoch 121/500
1/1 [==============================] - 4s 4s/step - loss: 0.3408
Epoch 122/500
1/1 [==============================] - 6s 6s/step - loss: 0.3397
Epoch 123/500
1/1 [==============================] - 4s 4s/step - loss: 0.3386
Epoch 124/500
1/1 [==============================] - 3s 3s/step - loss: 0.3376
Epoch 125/500
1/1 [==============================] - 3s 3s/step - loss: 0.3365
Epoch 126/500
1/1 [==============================] - 5s 5s/step - loss: 0.3354
Epoch 127/500
1/1 [==============================] - 5s 5s/step - loss: 0.3344
Epoch 128/500
1/1 [==============================] - 3s 3s/step - loss: 0.3333
Epoch 129/500
1/1 [==============================] - 3s 3s/step - loss: 0.3323
Epoch 130/500
1/1 [==============================] - 3s 3s/step - loss: 0.3312
Epoch 131/500
1/1 [==============================] - 6s 6s/step - loss: 0.3302
Epoch 132/500
1/1 [==============================] - 4s 4s/step - loss: 0.3291
Epoch 133/500
1/1 [==============================] - 3s 3s/step - loss: 0.3281
Epoch 134/500
1/1 [==============================] - 3s 3s/step - loss: 0.3270
Epoch 135/500
1/1 [==============================] - 4s 4s/step - loss: 0.3260
Epoch 136/500
1/1 [==============================] - 6s 6s/step - loss: 0.3250
Epoch 137/500
1/1 [==============================] - 4s 4s/step - loss: 0.3239
Epoch 138/500
1/1 [==============================] - 3s 3s/step - loss: 0.3229
Epoch 139/500
1/1 [==============================] - 3s 3s/step - loss: 0.3219
Epoch 140/500
```

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1/1 [==============================] - 5s 5s/step - loss: 0.3208
Epoch 141/500
1/1 [==============================] - 5s 5s/step - loss: 0.3198
Epoch 142/500
1/1 [==============================] - 3s 3s/step - loss: 0.3188
Epoch 143/500
1/1 [==============================] - 3s 3s/step - loss: 0.3177
Epoch 144/500
1/1 [==============================] - 3s 3s/step - loss: 0.3167
Epoch 145/500
1/1 [==============================] - 6s 6s/step - loss: 0.3157
Epoch 146/500
1/1 [==============================] - 4s 4s/step - loss: 0.3147
Epoch 147/500
1/1 [==============================] - 3s 3s/step - loss: 0.3137
Epoch 148/500
1/1 [==============================] - 3s 3s/step - loss: 0.3127
Epoch 149/500
1/1 [==============================] - 4s 4s/step - loss: 0.3116
Epoch 150/500
1/1 [==============================] - 6s 6s/step - loss: 0.3106
Epoch 151/500
1/1 [==============================] - 3s 3s/step - loss: 0.3096
Epoch 152/500
1/1 [==============================] - 3s 3s/step - loss: 0.3087
Epoch 153/500
1/1 [==============================] - 3s 3s/step - loss: 0.3077
Epoch 154/500
1/1 [==============================] - 5s 5s/step - loss: 0.3067
Epoch 155/500
1/1 [==============================] - 5s 5s/step - loss: 0.3057
Epoch 156/500
1/1 [==============================] - 3s 3s/step - loss: 0.3047
Epoch 157/500
1/1 [==============================] - 3s 3s/step - loss: 0.3038
Epoch 158/500
1/1 [==============================] - 4s 4s/step - loss: 0.3028
Epoch 159/500
1/1 [==============================] - 6s 6s/step - loss: 0.3018
Epoch 160/500
1/1 [==============================] - 4s 4s/step - loss: 0.3009
Epoch 161/500
1/1 [==============================] - 3s 3s/step - loss: 0.2999
Epoch 162/500
1/1 [==============================] - 3s 3s/step - loss: 0.2990
Epoch 163/500
1/1 [==============================] - 5s 5s/step - loss: 0.2981
Epoch 164/500
1/1 [==============================] - 6s 6s/step - loss: 0.2971
Epoch 165/500
1/1 [==============================] - 4s 4s/step - loss: 0.2962
Epoch 166/500
1/1 [==============================] - 3s 3s/step - loss: 0.2953
Epoch 167/500
1/1 [==============================] - 3s 3s/step - loss: 0.2944
Epoch 168/500
1/1 [==============================] - 5s 5s/step - loss: 0.2935
Epoch 169/500
1/1 [==============================] - 5s 5s/step - loss: 0.2926
Epoch 170/500
1/1 [==============================] - 3s 3s/step - loss: 0.2917
Epoch 171/500
1/1 [==============================] - 3s 3s/step - loss: 0.2908
Epoch 172/500
1/1 [==============================] - 4s 4s/step - loss: 0.2899
Epoch 173/500
1/1 [==============================] - 6s 6s/step - loss: 0.2891
Epoch 174/500
1/1 [==============================] - 4s 4s/step - loss: 0.2882
Epoch 175/500
1/1 [==============================] - 3s 3s/step - loss: 0.2874
Epoch 176/500
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1/1 [==============================] - 3s 3s/step - loss: 0.2865
Epoch 177/500
1/1 [==============================] - 4s 4s/step - loss: 0.2857
Epoch 178/500
1/1 [==============================] - 5s 5s/step - loss: 0.2849
Epoch 179/500
1/1 [==============================] - 4s 4s/step - loss: 0.2840
Epoch 180/500
1/1 [==============================] - 3s 3s/step - loss: 0.2832
Epoch 181/500
1/1 [==============================] - 3s 3s/step - loss: 0.2824
Epoch 182/500
1/1 [==============================] - 5s 5s/step - loss: 0.2816
Epoch 183/500
1/1 [==============================] - 5s 5s/step - loss: 0.2808
Epoch 184/500
1/1 [==============================] - 3s 3s/step - loss: 0.2801
Epoch 185/500
1/1 [==============================] - 3s 3s/step - loss: 0.2793
Epoch 186/500
1/1 [==============================] - 3s 3s/step - loss: 0.2785
Epoch 187/500
1/1 [==============================] - 6s 6s/step - loss: 0.2777
Epoch 188/500
1/1 [==============================] - 4s 4s/step - loss: 0.2770
Epoch 189/500
1/1 [==============================] - 3s 3s/step - loss: 0.2762
Epoch 190/500
1/1 [==============================] - 3s 3s/step - loss: 0.2755
Epoch 191/500
1/1 [==============================] - 4s 4s/step - loss: 0.2748
Epoch 192/500
1/1 [==============================] - 6s 6s/step - loss: 0.2740
Epoch 193/500
1/1 [==============================] - 4s 4s/step - loss: 0.2733
Epoch 194/500
1/1 [==============================] - 3s 3s/step - loss: 0.2726
Epoch 195/500
1/1 [==============================] - 3s 3s/step - loss: 0.2719
Epoch 196/500
1/1 [==============================] - 5s 5s/step - loss: 0.2712
Epoch 197/500
1/1 [==============================] - 5s 5s/step - loss: 0.2705
Epoch 198/500
1/1 [==============================] - 3s 3s/step - loss: 0.2698
Epoch 199/500
1/1 [==============================] - 3s 3s/step - loss: 0.2691
Epoch 200/500
1/1 [==============================] - 3s 3s/step - loss: 0.2685
Epoch 201/500
1/1 [==============================] - 6s 6s/step - loss: 0.2678
Epoch 202/500
1/1 [==============================] - 4s 4s/step - loss: 0.2671
Epoch 203/500
1/1 [==============================] - 3s 3s/step - loss: 0.2665
Epoch 204/500
1/1 [==============================] - 3s 3s/step - loss: 0.2658
Epoch 205/500
1/1 [==============================] - 4s 4s/step - loss: 0.2652
Epoch 206/500
1/1 [==============================] - 6s 6s/step - loss: 0.2646
Epoch 207/500
1/1 [==============================] - 4s 4s/step - loss: 0.2639
Epoch 208/500
1/1 [==============================] - 3s 3s/step - loss: 0.2633
Epoch 209/500
1/1 [==============================] - 3s 3s/step - loss: 0.2627
Epoch 210/500
1/1 [==============================] - 5s 5s/step - loss: 0.2621
Epoch 211/500
1/1 [==============================] - 5s 5s/step - loss: 0.2615
Epoch 212/500
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1/1 [==============================] - 3s 3s/step - loss: 0.2609
Epoch 213/500
1/1 [==============================] - 3s 3s/step - loss: 0.2603
Epoch 214/500
1/1 [==============================] - 3s 3s/step - loss: 0.2597
Epoch 215/500
1/1 [==============================] - 6s 6s/step - loss: 0.2591
Epoch 216/500
1/1 [==============================] - 5s 5s/step - loss: 0.2585
Epoch 217/500
1/1 [==============================] - 3s 3s/step - loss: 0.2580
Epoch 218/500
1/1 [==============================] - 3s 3s/step - loss: 0.2574
Epoch 219/500
1/1 [==============================] - 4s 4s/step - loss: 0.2568
Epoch 220/500
1/1 [==============================] - 6s 6s/step - loss: 0.2563
Epoch 221/500
1/1 [==============================] - 4s 4s/step - loss: 0.2557
Epoch 222/500
1/1 [==============================] - 3s 3s/step - loss: 0.2552
Epoch 223/500
1/1 [==============================] - 3s 3s/step - loss: 0.2547
Epoch 224/500
1/1 [==============================] - 5s 5s/step - loss: 0.2541
Epoch 225/500
1/1 [==============================] - 6s 6s/step - loss: 0.2536
Epoch 226/500
1/1 [==============================] - 3s 3s/step - loss: 0.2531
Epoch 227/500
1/1 [==============================] - 3s 3s/step - loss: 0.2526
Epoch 228/500
1/1 [==============================] - 3s 3s/step - loss: 0.2521
Epoch 229/500
1/1 [==============================] - 6s 6s/step - loss: 0.2516
Epoch 230/500
1/1 [==============================] - 4s 4s/step - loss: 0.2511
Epoch 231/500
1/1 [==============================] - 3s 3s/step - loss: 0.2506
Epoch 232/500
1/1 [==============================] - 3s 3s/step - loss: 0.2501
Epoch 233/500
1/1 [==============================] - 4s 4s/step - loss: 0.2496
Epoch 234/500
1/1 [==============================] - 6s 6s/step - loss: 0.2491
Epoch 235/500
1/1 [==============================] - 3s 3s/step - loss: 0.2486
Epoch 236/500
1/1 [==============================] - 3s 3s/step - loss: 0.2482
Epoch 237/500
1/1 [==============================] - 3s 3s/step - loss: 0.2477
Epoch 238/500
1/1 [==============================] - 6s 6s/step - loss: 0.2472
Epoch 239/500
1/1 [==============================] - 5s 5s/step - loss: 0.2468
Epoch 240/500
1/1 [==============================] - 3s 3s/step - loss: 0.2463
Epoch 241/500
1/1 [==============================] - 3s 3s/step - loss: 0.2459
Epoch 242/500
1/1 [==============================] - 4s 4s/step - loss: 0.2454
Epoch 243/500
1/1 [==============================] - 6s 6s/step - loss: 0.2450
Epoch 244/500
1/1 [==============================] - 4s 4s/step - loss: 0.2445
Epoch 245/500
1/1 [==============================] - 3s 3s/step - loss: 0.2441
Epoch 246/500
1/1 [==============================] - 3s 3s/step - loss: 0.2437
Epoch 247/500
1/1 [==============================] - 5s 5s/step - loss: 0.2433
Epoch 248/500
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1/1 [==============================] - 5s 5s/step - loss: 0.2429
Epoch 249/500
1/1 [==============================] - 3s 3s/step - loss: 0.2424
Epoch 250/500
1/1 [==============================] - 3s 3s/step - loss: 0.2420
Epoch 251/500
1/1 [==============================] - 4s 4s/step - loss: 0.2416
Epoch 252/500
1/1 [==============================] - 6s 6s/step - loss: 0.2412
Epoch 253/500
1/1 [==============================] - 4s 4s/step - loss: 0.2408
Epoch 254/500
1/1 [==============================] - 3s 3s/step - loss: 0.2404
Epoch 255/500
1/1 [==============================] - 3s 3s/step - loss: 0.2400
Epoch 256/500
1/1 [==============================] - 5s 5s/step - loss: 0.2397
Epoch 257/500
1/1 [==============================] - 6s 6s/step - loss: 0.2393
Epoch 258/500
1/1 [==============================] - 3s 3s/step - loss: 0.2389
Epoch 259/500
1/1 [==============================] - 3s 3s/step - loss: 0.2385
Epoch 260/500
1/1 [==============================] - 3s 3s/step - loss: 0.2381
Epoch 261/500
1/1 [==============================] - 6s 6s/step - loss: 0.2378
Epoch 262/500
1/1 [==============================] - 4s 4s/step - loss: 0.2374
Epoch 263/500
1/1 [==============================] - 3s 3s/step - loss: 0.2371
Epoch 264/500
1/1 [==============================] - 3s 3s/step - loss: 0.2367
Epoch 265/500
1/1 [==============================] - 5s 5s/step - loss: 0.2363
Epoch 266/500
1/1 [==============================] - 6s 6s/step - loss: 0.2360
Epoch 267/500
1/1 [==============================] - 3s 3s/step - loss: 0.2356
Epoch 268/500
1/1 [==============================] - 3s 3s/step - loss: 0.2353
Epoch 269/500
1/1 [==============================] - 3s 3s/step - loss: 0.2350
Epoch 270/500
1/1 [==============================] - 5s 5s/step - loss: 0.2346
Epoch 271/500
1/1 [==============================] - 5s 5s/step - loss: 0.2343
Epoch 272/500
1/1 [==============================] - 3s 3s/step - loss: 0.2340
Epoch 273/500
1/1 [==============================] - 3s 3s/step - loss: 0.2336
Epoch 274/500
1/1 [==============================] - 4s 4s/step - loss: 0.2333
Epoch 275/500
1/1 [==============================] - 6s 6s/step - loss: 0.2330
Epoch 276/500
1/1 [==============================] - 4s 4s/step - loss: 0.2326
Epoch 277/500
1/1 [==============================] - 3s 3s/step - loss: 0.2323
Epoch 278/500
1/1 [==============================] - 3s 3s/step - loss: 0.2320
Epoch 279/500
1/1 [==============================] - 5s 5s/step - loss: 0.2317
Epoch 280/500
1/1 [==============================] - 5s 5s/step - loss: 0.2314
Epoch 281/500
1/1 [==============================] - 3s 3s/step - loss: 0.2311
Epoch 282/500
1/1 [==============================] - 3s 3s/step - loss: 0.2308
Epoch 283/500
1/1 [==============================] - 3s 3s/step - loss: 0.2305
Epoch 284/500
```

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1/1 [==============================] - 6s 6s/step - loss: 0.2302
Epoch 285/500
1/1 [==============================] - 4s 4s/step - loss: 0.2299
Epoch 286/500
1/1 [==============================] - 3s 3s/step - loss: 0.2296
Epoch 287/500
1/1 [==============================] - 3s 3s/step - loss: 0.2293
Epoch 288/500
1/1 [==============================] - 5s 5s/step - loss: 0.2290
Epoch 289/500
1/1 [==============================] - 6s 6s/step - loss: 0.2287
Epoch 290/500
1/1 [==============================] - 3s 3s/step - loss: 0.2284
Epoch 291/500
1/1 [==============================] - 3s 3s/step - loss: 0.2281
Epoch 292/500
1/1 [==============================] - 3s 3s/step - loss: 0.2278
Epoch 293/500
1/1 [==============================] - 6s 6s/step - loss: 0.2276
Epoch 294/500
1/1 [==============================] - 5s 5s/step - loss: 0.2273
Epoch 295/500
1/1 [==============================] - 3s 3s/step - loss: 0.2270
Epoch 296/500
1/1 [==============================] - 3s 3s/step - loss: 0.2267
Epoch 297/500
1/1 [==============================] - 4s 4s/step - loss: 0.2264
Epoch 298/500
1/1 [==============================] - 6s 6s/step - loss: 0.2262
Epoch 299/500
1/1 [==============================] - 4s 4s/step - loss: 0.2259
Epoch 300/500
1/1 [==============================] - 3s 3s/step - loss: 0.2256
Epoch 301/500
1/1 [==============================] - 3s 3s/step - loss: 0.2254
Epoch 302/500
1/1 [==============================] - 5s 5s/step - loss: 0.2251
Epoch 303/500
1/1 [==============================] - 5s 5s/step - loss: 0.2248
Epoch 304/500
1/1 [==============================] - 3s 3s/step - loss: 0.2246
Epoch 305/500
1/1 [==============================] - 3s 3s/step - loss: 0.2243
Epoch 306/500
1/1 [==============================] - 4s 4s/step - loss: 0.2241
Epoch 307/500
1/1 [==============================] - 6s 6s/step - loss: 0.2238
Epoch 308/500
1/1 [==============================] - 4s 4s/step - loss: 0.2235
Epoch 309/500
1/1 [==============================] - 3s 3s/step - loss: 0.2233
Epoch 310/500
1/1 [==============================] - 3s 3s/step - loss: 0.2230
Epoch 311/500
1/1 [==============================] - 5s 5s/step - loss: 0.2228
Epoch 312/500
1/1 [==============================] - 6s 6s/step - loss: 0.2225
Epoch 313/500
1/1 [==============================] - 3s 3s/step - loss: 0.2223
Epoch 314/500
1/1 [==============================] - 3s 3s/step - loss: 0.2220
Epoch 315/500
1/1 [==============================] - 3s 3s/step - loss: 0.2218
Epoch 316/500
1/1 [==============================] - 6s 6s/step - loss: 0.2215
Epoch 317/500
1/1 [==============================] - 4s 4s/step - loss: 0.2213
Epoch 318/500
1/1 [==============================] - 3s 3s/step - loss: 0.2211
Epoch 319/500
1/1 [==============================] - 3s 3s/step - loss: 0.2208
Epoch 320/500
```

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1/1 [==============================] - 5s 5s/step - loss: 0.2206
Epoch 321/500
1/1 [==============================] - 6s 6s/step - loss: 0.2203
Epoch 322/500
1/1 [==============================] - 3s 3s/step - loss: 0.2201
Epoch 323/500
1/1 [==============================] - 3s 3s/step - loss: 0.2199
Epoch 324/500
1/1 [==============================] - 3s 3s/step - loss: 0.2196
Epoch 325/500
1/1 [==============================] - 6s 6s/step - loss: 0.2194
Epoch 326/500
1/1 [==============================] - 5s 5s/step - loss: 0.2192
Epoch 327/500
1/1 [==============================] - 3s 3s/step - loss: 0.2189
Epoch 328/500
1/1 [==============================] - 3s 3s/step - loss: 0.2187
Epoch 329/500
1/1 [==============================] - 4s 4s/step - loss: 0.2185
Epoch 330/500
1/1 [==============================] - 6s 6s/step - loss: 0.2183
Epoch 331/500
1/1 [==============================] - 4s 4s/step - loss: 0.2180
Epoch 332/500
1/1 [==============================] - 3s 3s/step - loss: 0.2178
Epoch 333/500
1/1 [==============================] - 3s 3s/step - loss: 0.2176
Epoch 334/500
1/1 [==============================] - 5s 5s/step - loss: 0.2174
Epoch 335/500
1/1 [==============================] - 5s 5s/step - loss: 0.2172
Epoch 336/500
1/1 [==============================] - 3s 3s/step - loss: 0.2169
Epoch 337/500
1/1 [==============================] - 3s 3s/step - loss: 0.2167
Epoch 338/500
1/1 [==============================] - 4s 4s/step - loss: 0.2165
Epoch 339/500
1/1 [==============================] - 6s 6s/step - loss: 0.2163
Epoch 340/500
1/1 [==============================] - 4s 4s/step - loss: 0.2161
Epoch 341/500
1/1 [==============================] - 3s 3s/step - loss: 0.2159
Epoch 342/500
1/1 [==============================] - 3s 3s/step - loss: 0.2157
Epoch 343/500
1/1 [==============================] - 5s 5s/step - loss: 0.2155
Epoch 344/500
1/1 [==============================] - 6s 6s/step - loss: 0.2153
Epoch 345/500
1/1 [==============================] - 4s 4s/step - loss: 0.2150
Epoch 346/500
1/1 [==============================] - 3s 3s/step - loss: 0.2148
Epoch 347/500
1/1 [==============================] - 3s 3s/step - loss: 0.2146
Epoch 348/500
1/1 [==============================] - 5s 5s/step - loss: 0.2144
Epoch 349/500
1/1 [==============================] - 5s 5s/step - loss: 0.2142
Epoch 350/500
1/1 [==============================] - 3s 3s/step - loss: 0.2140
Epoch 351/500
1/1 [==============================] - 3s 3s/step - loss: 0.2138
Epoch 352/500
1/1 [==============================] - 4s 4s/step - loss: 0.2136
Epoch 353/500
1/1 [==============================] - 6s 6s/step - loss: 0.2135
Epoch 354/500
1/1 [==============================] - 4s 4s/step - loss: 0.2133
Epoch 355/500
1/1 [==============================] - 3s 3s/step - loss: 0.2131
Epoch 356/500
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1/1 [==============================] - 3s 3s/step - loss: 0.2129
Epoch 357/500
1/1 [==============================] - 5s 5s/step - loss: 0.2127
Epoch 358/500
1/1 [==============================] - 6s 6s/step - loss: 0.2125
Epoch 359/500
1/1 [==============================] - 4s 4s/step - loss: 0.2123
Epoch 360/500
1/1 [==============================] - 3s 3s/step - loss: 0.2121
Epoch 361/500
1/1 [==============================] - 3s 3s/step - loss: 0.2120
Epoch 362/500
1/1 [==============================] - 5s 5s/step - loss: 0.2118
Epoch 363/500
1/1 [==============================] - 5s 5s/step - loss: 0.2116
Epoch 364/500
1/1 [==============================] - 3s 3s/step - loss: 0.2114
Epoch 365/500
1/1 [==============================] - 3s 3s/step - loss: 0.2112
Epoch 366/500
1/1 [==============================] - 3s 3s/step - loss: 0.2111
Epoch 367/500
1/1 [==============================] - 6s 6s/step - loss: 0.2109
Epoch 368/500
1/1 [==============================] - 4s 4s/step - loss: 0.2107
Epoch 369/500
1/1 [==============================] - 3s 3s/step - loss: 0.2105
Epoch 370/500
1/1 [==============================] - 3s 3s/step - loss: 0.2104
Epoch 371/500
1/1 [==============================] - 5s 5s/step - loss: 0.2102
Epoch 372/500
1/1 [==============================] - 6s 6s/step - loss: 0.2100
Epoch 373/500
1/1 [==============================] - 3s 3s/step - loss: 0.2099
Epoch 374/500
1/1 [==============================] - 3s 3s/step - loss: 0.2097
Epoch 375/500
1/1 [==============================] - 3s 3s/step - loss: 0.2095
Epoch 376/500
1/1 [==============================] - 5s 5s/step - loss: 0.2094
Epoch 377/500
1/1 [==============================] - 5s 5s/step - loss: 0.2092
Epoch 378/500
1/1 [==============================] - 3s 3s/step - loss: 0.2090
Epoch 379/500
1/1 [==============================] - 3s 3s/step - loss: 0.2089
Epoch 380/500
1/1 [==============================] - 4s 4s/step - loss: 0.2087
Epoch 381/500
1/1 [==============================] - 6s 6s/step - loss: 0.2086
Epoch 382/500
1/1 [==============================] - 4s 4s/step - loss: 0.2084
Epoch 383/500
1/1 [==============================] - 3s 3s/step - loss: 0.2083
Epoch 384/500
1/1 [==============================] - 3s 3s/step - loss: 0.2081
Epoch 385/500
1/1 [==============================] - 5s 5s/step - loss: 0.2080
Epoch 386/500
1/1 [==============================] - 5s 5s/step - loss: 0.2078
Epoch 387/500
1/1 [==============================] - 3s 3s/step - loss: 0.2077
Epoch 388/500
1/1 [==============================] - 3s 3s/step - loss: 0.2075
Epoch 389/500
1/1 [==============================] - 3s 3s/step - loss: 0.2074
Epoch 390/500
1/1 [==============================] - 6s 6s/step - loss: 0.2072
Epoch 391/500
1/1 [==============================] - 4s 4s/step - loss: 0.2071
Epoch 392/500
```

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1/1 [==============================] - 3s 3s/step - loss: 0.2069
Epoch 393/500
1/1 [==============================] - 3s 3s/step - loss: 0.2068
Epoch 394/500
1/1 [==============================] - 4s 4s/step - loss: 0.2067
Epoch 395/500
1/1 [==============================] - 6s 6s/step - loss: 0.2065
Epoch 396/500
1/1 [==============================] - 4s 4s/step - loss: 0.2064
Epoch 397/500
1/1 [==============================] - 3s 3s/step - loss: 0.2063
Epoch 398/500
1/1 [==============================] - 3s 3s/step - loss: 0.2061
Epoch 399/500
1/1 [==============================] - 5s 5s/step - loss: 0.2060
Epoch 400/500
1/1 [==============================] - 5s 5s/step - loss: 0.2059
Epoch 401/500
1/1 [==============================] - 3s 3s/step - loss: 0.2057
Epoch 402/500
1/1 [==============================] - 3s 3s/step - loss: 0.2056
Epoch 403/500
1/1 [==============================] - 4s 4s/step - loss: 0.2055
Epoch 404/500
1/1 [==============================] - 6s 6s/step - loss: 0.2054
Epoch 405/500
1/1 [==============================] - 4s 4s/step - loss: 0.2052
Epoch 406/500
1/1 [==============================] - 3s 3s/step - loss: 0.2051
Epoch 407/500
1/1 [==============================] - 3s 3s/step - loss: 0.2050
Epoch 408/500
1/1 [==============================] - 5s 5s/step - loss: 0.2049
Epoch 409/500
1/1 [==============================] - 5s 5s/step - loss: 0.2048
Epoch 410/500
1/1 [==============================] - 3s 3s/step - loss: 0.2046
Epoch 411/500
1/1 [==============================] - 3s 3s/step - loss: 0.2045
Epoch 412/500
1/1 [==============================] - 3s 3s/step - loss: 0.2044
Epoch 413/500
1/1 [==============================] - 6s 6s/step - loss: 0.2043
Epoch 414/500
1/1 [==============================] - 4s 4s/step - loss: 0.2042
Epoch 415/500
1/1 [==============================] - 3s 3s/step - loss: 0.2041
Epoch 416/500
1/1 [==============================] - 3s 3s/step - loss: 0.2040
Epoch 417/500
1/1 [==============================] - 5s 5s/step - loss: 0.2039
Epoch 418/500
1/1 [==============================] - 6s 6s/step - loss: 0.2038
Epoch 419/500
1/1 [==============================] - 3s 3s/step - loss: 0.2037
Epoch 420/500
1/1 [==============================] - 3s 3s/step - loss: 0.2035
Epoch 421/500
1/1 [==============================] - 3s 3s/step - loss: 0.2034
Epoch 422/500
1/1 [==============================] - 5s 5s/step - loss: 0.2033
Epoch 423/500
1/1 [==============================] - 5s 5s/step - loss: 0.2032
Epoch 424/500
1/1 [==============================] - 3s 3s/step - loss: 0.2031
Epoch 425/500
1/1 [==============================] - 3s 3s/step - loss: 0.2030
Epoch 426/500
1/1 [==============================] - 4s 4s/step - loss: 0.2030
Epoch 427/500
1/1 [==============================] - 6s 6s/step - loss: 0.2029
Epoch 428/500
```

```
1/1 [==============================] - 4s 4s/step - loss: 0.2028
Epoch 429/500
1/1 [==============================] - 3s 3s/step - loss: 0.2027
Epoch 430/500
1/1 [==============================] - 3s 3s/step - loss: 0.2026
Epoch 431/500
1/1 [==============================] - 5s 5s/step - loss: 0.2025
Epoch 432/500
1/1 [==============================] - 5s 5s/step - loss: 0.2024
Epoch 433/500
1/1 [==============================] - 3s 3s/step - loss: 0.2023
Epoch 434/500
1/1 [==============================] - 3s 3s/step - loss: 0.2022
Epoch 435/500
1/1 [==============================] - 3s 3s/step - loss: 0.2021
Epoch 436/500
1/1 [==============================] - 6s 6s/step - loss: 0.2021
Epoch 437/500
1/1 [==============================] - 4s 4s/step - loss: 0.2020
Epoch 438/500
1/1 [==============================] - 3s 3s/step - loss: 0.2019
Epoch 439/500
1/1 [==============================] - 3s 3s/step - loss: 0.2018
Epoch 440/500
1/1 [==============================] - 5s 5s/step - loss: 0.2017
Epoch 441/500
1/1 [==============================] - 6s 6s/step - loss: 0.2016
Epoch 442/500
1/1 [==============================] - 3s 3s/step - loss: 0.2016
Epoch 443/500
1/1 [==============================] - 3s 3s/step - loss: 0.2015
Epoch 444/500
1/1 [==============================] - 3s 3s/step - loss: 0.2014
Epoch 445/500
1/1 [==============================] - 6s 6s/step - loss: 0.2013
Epoch 446/500
1/1 [==============================] - 5s 5s/step - loss: 0.2013
Epoch 447/500
1/1 [==============================] - 3s 3s/step - loss: 0.2012
Epoch 448/500
1/1 [==============================] - 3s 3s/step - loss: 0.2011
Epoch 449/500
1/1 [==============================] - 4s 4s/step - loss: 0.2011
Epoch 450/500
1/1 [==============================] - 6s 6s/step - loss: 0.2010
Epoch 451/500
1/1 [==============================] - 4s 4s/step - loss: 0.2009
Epoch 452/500
1/1 [==============================] - 3s 3s/step - loss: 0.2008
Epoch 453/500
1/1 [==============================] - 3s 3s/step - loss: 0.2008
Epoch 454/500
1/1 [==============================] - 5s 5s/step - loss: 0.2007
Epoch 455/500
1/1 [==============================] - 5s 5s/step - loss: 0.2006
Epoch 456/500
1/1 [==============================] - 3s 3s/step - loss: 0.2006
Epoch 457/500
1/1 [==============================] - 3s 3s/step - loss: 0.2005
Epoch 458/500
1/1 [==============================] - 4s 4s/step - loss: 0.2004
Epoch 459/500
1/1 [==============================] - 6s 6s/step - loss: 0.2004
Epoch 460/500
1/1 [==============================] - 4s 4s/step - loss: 0.2003
Epoch 461/500
1/1 [==============================] - 3s 3s/step - loss: 0.2003
Epoch 462/500
1/1 [==============================] - 3s 3s/step - loss: 0.2002
Epoch 463/500
1/1 [==============================] - 5s 5s/step - loss: 0.2001
Epoch 464/500
```

```
1/1 [==============================] - 5s 5s/step - loss: 0.2001
Epoch 465/500
1/1 [==============================] - 3s 3s/step - loss: 0.2000
Epoch 466/500
1/1 [==============================] - 3s 3s/step - loss: 0.2000
Epoch 467/500
1/1 [==============================] - 4s 4s/step - loss: 0.1999
Epoch 468/500
1/1 [==============================] - 6s 6s/step - loss: 0.1998
Epoch 469/500
1/1 [==============================] - 4s 4s/step - loss: 0.1998
Epoch 470/500
1/1 [==============================] - 3s 3s/step - loss: 0.1997
Epoch 471/500
1/1 [==============================] - 3s 3s/step - loss: 0.1997
Epoch 472/500
1/1 [==============================] - 4s 4s/step - loss: 0.1996
Epoch 473/500
1/1 [==============================] - 6s 6s/step - loss: 0.1996
Epoch 474/500
1/1 [==============================] - 4s 4s/step - loss: 0.1995
Epoch 475/500
1/1 [==============================] - 3s 3s/step - loss: 0.1995
Epoch 476/500
1/1 [==============================] - 3s 3s/step - loss: 0.1994
Epoch 477/500
1/1 [==============================] - 5s 5s/step - loss: 0.1994
Epoch 478/500
1/1 [==============================] - 5s 5s/step - loss: 0.1993
Epoch 479/500
1/1 [==============================] - 3s 3s/step - loss: 0.1993
Epoch 480/500
1/1 [==============================] - 3s 3s/step - loss: 0.1992
Epoch 481/500
1/1 [==============================] - 4s 4s/step - loss: 0.1992
Epoch 482/500
1/1 [==============================] - 6s 6s/step - loss: 0.1991
Epoch 483/500
1/1 [==============================] - 4s 4s/step - loss: 0.1991
Epoch 484/500
1/1 [==============================] - 3s 3s/step - loss: 0.1990
Epoch 485/500
1/1 [==============================] - 3s 3s/step - loss: 0.1990
Epoch 486/500
1/1 [==============================] - 5s 5s/step - loss: 0.1989
Epoch 487/500
1/1 [==============================] - 5s 5s/step - loss: 0.1989
Epoch 488/500
1/1 [==============================] - 3s 3s/step - loss: 0.1988
Epoch 489/500
1/1 [==============================] - 3s 3s/step - loss: 0.1988
Epoch 490/500
1/1 [==============================] - 3s 3s/step - loss: 0.1987
Epoch 491/500
1/1 [==============================] - 6s 6s/step - loss: 0.1987
Epoch 492/500
1/1 [==============================] - 4s 4s/step - loss: 0.1986
Epoch 493/500
1/1 [==============================] - 3s 3s/step - loss: 0.1986
Epoch 494/500
1/1 [==============================] - 3s 3s/step - loss: 0.1986
Epoch 495/500
1/1 [==============================] - 5s 5s/step - loss: 0.1985
Epoch 496/500
1/1 [==============================] - 5s 5s/step - loss: 0.1985
Epoch 497/500
1/1 [==============================] - 3s 3s/step - loss: 0.1984
Epoch 498/500
1/1 [==============================] - 3s 3s/step - loss: 0.1984
Epoch 499/500
1/1 [==============================] - 3s 3s/step - loss: 0.1983
Epoch 500/500
```

```
1/1 [==============================] - 6s 6s/step - loss: 0.1983
```

In [ ]:

```python
plt.plot(H.history['loss'])
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.title("Generator's Loss for Cycle two")
plt.show()
```

```
WARNING:matplotlib.font_manager:findfont: Font family 'Arial' not found.
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WARNING:matplotlib.font_manager:findfont: Font family 'Arial' not found.
WARNING:matplotlib.font_manager:findfont: Font family 'Arial' not found.
```

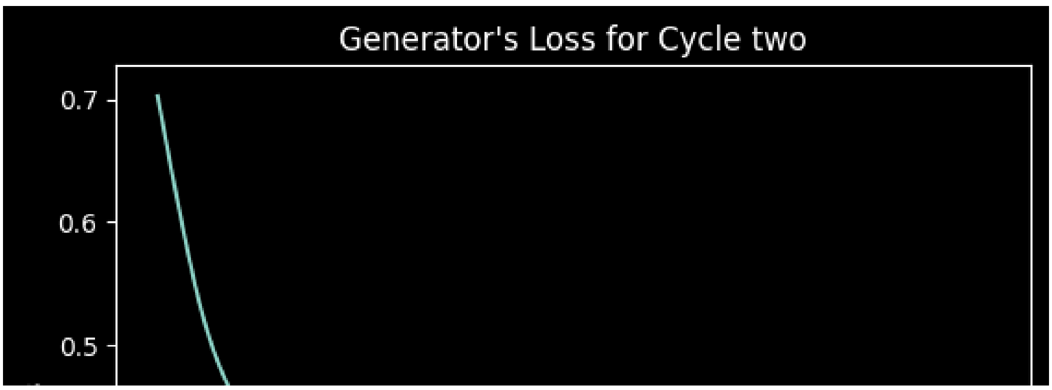

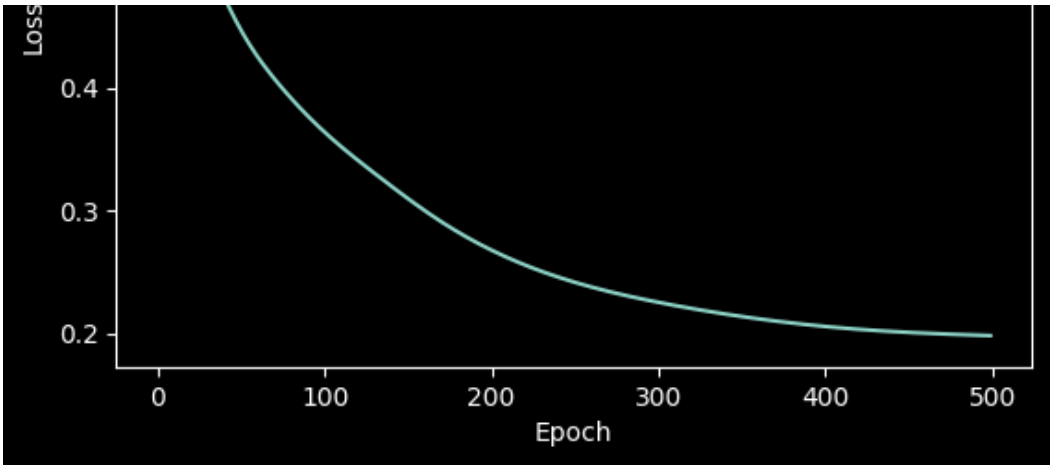

In [ ]:

```
# Generate Real + Fake Data

gen_data_train = tfq.convert_to_tensor(generate_data(x_train, qgan_qubits) + generate_fa
ke_data(x_train, qgan_qubits, qgen_model.get_weights()[0], layer=gen_layer))
gen_data_test = tfq.convert_to_tensor(generate_data(x_test, qgan_qubits) + generate_fake_
data(x_test, qgan_qubits, qgen_model.get_weights()[0], layer=gen_layer))

y_gen_train = np.concatenate((y_train, y_true_fake), axis = 0)
y_gen_test = np.concatenate((y_test, y_true_fake), axis = 0)

print(len(gen_data_train), len(gen_data_test))
print(y_gen_train.shape, y_gen_test.shape)
```

```
200 200
(200, 3) (200, 3)
```

In [ ]:

```
# Fit the Discriminator Model
H = train_qdisc(300, 64, 1)
```

```
Epoch 1/300
4/4 [==============================] - 9s 2s/step - loss: 0.4629 - custom_accuracy: 0.756
9 - val_loss: 0.4142 - val_custom_accuracy: 0.3442
Epoch 2/300
4/4 [==============================] - 6s 2s/step - loss: 0.4602 - custom_accuracy: 0.760
5 - val_loss: 0.4123 - val_custom_accuracy: 0.3442
Epoch 3/300
4/4 [==============================] - 9s 3s/step - loss: 0.4646 - custom_accuracy: 0.696
6 - val_loss: 0.4078 - val_custom_accuracy: 0.3442
Epoch 4/300
4/4 [==============================] - 6s 2s/step - loss: 0.4624 - custom_accuracy: 0.741
9 - val_loss: 0.4014 - val_custom_accuracy: 0.3511
Epoch 5/300
4/4 [==============================] - 7s 2s/step - loss: 0.4498 - custom_accuracy: 0.769
4 - val_loss: 0.3970 - val_custom_accuracy: 0.3511
Epoch 6/300
4/4 [==============================] - 9s 2s/step - loss: 0.4459 - custom_accuracy: 0.814
9 - val_loss: 0.3934 - val_custom_accuracy: 0.3542
Epoch 7/300
4/4 [==============================] - 6s 2s/step - loss: 0.4398 - custom_accuracy: 0.832
2 - val_loss: 0.3918 - val_custom_accuracy: 0.3464
Epoch 8/300
4/4 [==============================] - 9s 3s/step - loss: 0.4546 - custom_accuracy: 0.851
8 - val_loss: 0.3922 - val_custom_accuracy: 0.3503
Epoch 9/300
4/4 [==============================] - 7s 2s/step - loss: 0.4469 - custom_accuracy: 0.829
7 - val_loss: 0.3938 - val_custom_accuracy: 0.3511
Epoch 10/300
4/4 [==============================] - 7s 2s/step - loss: 0.4605 - custom_accuracy: 0.734
2 - val_loss: 0.3956 - val_custom_accuracy: 0.3511
Epoch 11/300
4/4 [==============================] - 9s 2s/step - loss: 0.4400 - custom_accuracy: 0.815
8 - val_loss: 0.3962 - val_custom_accuracy: 0.3511
```

```
Epoch 12/300
4/4 [==============================] - 6s 2s/step - loss: 0.4398 - custom_accuracy: 0.819
3 - val_loss: 0.3977 - val_custom_accuracy: 0.3442
Epoch 13/300
4/4 [==============================] - 10s 3s/step - loss: 0.4452 - custom_accuracy: 0.75
72 - val_loss: 0.3980 - val_custom_accuracy: 0.3442
Epoch 14/300
4/4 [==============================] - 6s 2s/step - loss: 0.4484 - custom_accuracy: 0.759
7 - val_loss: 0.3961 - val_custom_accuracy: 0.3442
Epoch 15/300
4/4 [==============================] - 10s 3s/step - loss: 0.4515 - custom_accuracy: 0.76
16 - val_loss: 0.3938 - val_custom_accuracy: 0.3511
Epoch 16/300
4/4 [==============================] - 7s 2s/step - loss: 0.4491 - custom_accuracy: 0.756
9 - val_loss: 0.3913 - val_custom_accuracy: 0.3511
Epoch 17/300
4/4 [==============================] - 6s 2s/step - loss: 0.4332 - custom_accuracy: 0.773
3 - val_loss: 0.3892 - val_custom_accuracy: 0.3511
Epoch 18/300
4/4 [==============================] - 10s 2s/step - loss: 0.4481 - custom_accuracy: 0.81
40 - val_loss: 0.3899 - val_custom_accuracy: 0.3511
Epoch 19/300
4/4 [==============================] - 6s 2s/step - loss: 0.4369 - custom_accuracy: 0.768
4 - val_loss: 0.3916 - val_custom_accuracy: 0.3442
Epoch 20/300
4/4 [==============================] - 8s 2s/step - loss: 0.4436 - custom_accuracy: 0.812
9 - val_loss: 0.3931 - val_custom_accuracy: 0.3442
Epoch 21/300
4/4 [==============================] - 7s 2s/step - loss: 0.4337 - custom_accuracy: 0.771
6 - val_loss: 0.3955 - val_custom_accuracy: 0.3442
Epoch 22/300
4/4 [==============================] - 6s 2s/step - loss: 0.4444 - custom_accuracy: 0.747
6 - val_loss: 0.3976 - val_custom_accuracy: 0.3442
Epoch 23/300
4/4 [==============================] - 9s 2s/step - loss: 0.4468 - custom_accuracy: 0.716
4 - val_loss: 0.3980 - val_custom_accuracy: 0.3442
Epoch 24/300
4/4 [==============================] - 6s 2s/step - loss: 0.4378 - custom_accuracy: 0.742
5 - val_loss: 0.3985 - val_custom_accuracy: 0.3442
Epoch 25/300
4/4 [==============================] - 9s 2s/step - loss: 0.4401 - custom_accuracy: 0.772
9 - val_loss: 0.4006 - val_custom_accuracy: 0.3442
Epoch 26/300
4/4 [==============================] - 7s 2s/step - loss: 0.4302 - custom_accuracy: 0.817
9 - val_loss: 0.4030 - val_custom_accuracy: 0.3442
Epoch 27/300
4/4 [==============================] - 7s 2s/step - loss: 0.4372 - custom_accuracy: 0.771
4 - val_loss: 0.4047 - val_custom_accuracy: 0.3442
Epoch 28/300
4/4 [==============================] - 9s 2s/step - loss: 0.4326 - custom_accuracy: 0.813
4 - val_loss: 0.4057 - val_custom_accuracy: 0.3442
Epoch 29/300
4/4 [==============================] - 6s 2s/step - loss: 0.4442 - custom_accuracy: 0.756
0 - val_loss: 0.4055 - val_custom_accuracy: 0.3442
Epoch 30/300
4/4 [==============================] - 9s 3s/step - loss: 0.4336 - custom_accuracy: 0.816
8 - val_loss: 0.4032 - val_custom_accuracy: 0.3442
Epoch 31/300
4/4 [==============================] - 6s 2s/step - loss: 0.4359 - custom_accuracy: 0.724
8 - val_loss: 0.4014 - val_custom_accuracy: 0.3442
Epoch 32/300
4/4 [==============================] - 7s 2s/step - loss: 0.4299 - custom_accuracy: 0.819
8 - val_loss: 0.3998 - val_custom_accuracy: 0.3442
Epoch 33/300
4/4 [==============================] - 9s 2s/step - loss: 0.4311 - custom_accuracy: 0.709
1 - val_loss: 0.3973 - val_custom_accuracy: 0.3442
Epoch 34/300
4/4 [==============================] - 6s 2s/step - loss: 0.4293 - custom_accuracy: 0.707
9 - val_loss: 0.3944 - val_custom_accuracy: 0.3442
Epoch 35/300
4/4 [==============================] - 10s 3s/step - loss: 0.4331 - custom_accuracy: 0.70
78 - val_loss: 0.3914 - val_custom_accuracy: 0.3442
```

```
Epoch 36/300
4/4 [==============================] - 6s 2s/step - loss: 0.4337 - custom_accuracy: 0.739
3 - val_loss: 0.3919 - val_custom_accuracy: 0.3442
Epoch 37/300
4/4 [==============================] - 10s 3s/step - loss: 0.4410 - custom_accuracy: 0.76
95 - val_loss: 0.3953 - val_custom_accuracy: 0.3442
Epoch 38/300
4/4 [==============================] - 7s 2s/step - loss: 0.4346 - custom_accuracy: 0.762
1 - val_loss: 0.4000 - val_custom_accuracy: 0.3442
Epoch 39/300
4/4 [==============================] - 7s 2s/step - loss: 0.4362 - custom_accuracy: 0.763
9 - val_loss: 0.4035 - val_custom_accuracy: 0.3442
Epoch 40/300
4/4 [==============================] - 9s 2s/step - loss: 0.4355 - custom_accuracy: 0.736
3 - val_loss: 0.4047 - val_custom_accuracy: 0.3442
Epoch 41/300
4/4 [==============================] - 6s 2s/step - loss: 0.4353 - custom_accuracy: 0.811
8 - val_loss: 0.4036 - val_custom_accuracy: 0.3442
Epoch 42/300
4/4 [==============================] - 9s 3s/step - loss: 0.4285 - custom_accuracy: 0.686
3 - val_loss: 0.4017 - val_custom_accuracy: 0.3442
Epoch 43/300
4/4 [==============================] - 7s 2s/step - loss: 0.4360 - custom_accuracy: 0.699
9 - val_loss: 0.3982 - val_custom_accuracy: 0.3442
Epoch 44/300
4/4 [==============================] - 7s 2s/step - loss: 0.4378 - custom_accuracy: 0.756
7 - val_loss: 0.3941 - val_custom_accuracy: 0.3442
Epoch 45/300
4/4 [==============================] - 9s 2s/step - loss: 0.4344 - custom_accuracy: 0.815
7 - val_loss: 0.3903 - val_custom_accuracy: 0.3442
Epoch 46/300
4/4 [==============================] - 6s 2s/step - loss: 0.4256 - custom_accuracy: 0.707
0 - val_loss: 0.3904 - val_custom_accuracy: 0.3442
Epoch 47/300
4/4 [==============================] - 9s 3s/step - loss: 0.4382 - custom_accuracy: 0.735
8 - val_loss: 0.3906 - val_custom_accuracy: 0.3442
Epoch 48/300
4/4 [==============================] - 7s 2s/step - loss: 0.4323 - custom_accuracy: 0.776
4 - val_loss: 0.3892 - val_custom_accuracy: 0.3442
Epoch 49/300
4/4 [==============================] - 10s 3s/step - loss: 0.4245 - custom_accuracy: 0.81
66 - val_loss: 0.3867 - val_custom_accuracy: 0.3442
Epoch 50/300
4/4 [==============================] - 7s 2s/step - loss: 0.4190 - custom_accuracy: 0.687
6 - val_loss: 0.3838 - val_custom_accuracy: 0.3442
Epoch 51/300
4/4 [==============================] - 7s 2s/step - loss: 0.4311 - custom_accuracy: 0.759
2 - val_loss: 0.3816 - val_custom_accuracy: 0.3511
Epoch 52/300
4/4 [==============================] - 9s 2s/step - loss: 0.4382 - custom_accuracy: 0.810
0 - val_loss: 0.3808 - val_custom_accuracy: 0.3511
Epoch 53/300
4/4 [==============================] - 6s 2s/step - loss: 0.4271 - custom_accuracy: 0.772
4 - val_loss: 0.3800 - val_custom_accuracy: 0.3511
Epoch 54/300
4/4 [==============================] - 9s 2s/step - loss: 0.4324 - custom_accuracy: 0.810
0 - val_loss: 0.3803 - val_custom_accuracy: 0.3511
Epoch 55/300
4/4 [==============================] - 7s 2s/step - loss: 0.4321 - custom_accuracy: 0.808
3 - val_loss: 0.3814 - val_custom_accuracy: 0.3511
Epoch 56/300
4/4 [==============================] - 6s 2s/step - loss: 0.4286 - custom_accuracy: 0.816
8 - val_loss: 0.3835 - val_custom_accuracy: 0.3442
Epoch 57/300
4/4 [==============================] - 9s 2s/step - loss: 0.4288 - custom_accuracy: 0.767
9 - val_loss: 0.3856 - val_custom_accuracy: 0.3442
Epoch 58/300
4/4 [==============================] - 6s 2s/step - loss: 0.4258 - custom_accuracy: 0.814
1 - val_loss: 0.3868 - val_custom_accuracy: 0.3442
Epoch 59/300
4/4 [==============================] - 9s 2s/step - loss: 0.4395 - custom_accuracy: 0.806
8 - val_loss: 0.3883 - val_custom_accuracy: 0.3442
```

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Epoch 60/300
4/4 [==============================] - 7s 2s/step - loss: 0.4386 - custom_accuracy: 0.756
9 - val_loss: 0.3898 - val_custom_accuracy: 0.3442
Epoch 61/300
4/4 [==============================] - 6s 2s/step - loss: 0.4314 - custom_accuracy: 0.808
4 - val_loss: 0.3913 - val_custom_accuracy: 0.3442
Epoch 62/300
4/4 [==============================] - 10s 2s/step - loss: 0.4301 - custom_accuracy: 0.81
57 - val_loss: 0.3934 - val_custom_accuracy: 0.3442
Epoch 63/300
4/4 [==============================] - 6s 2s/step - loss: 0.4246 - custom_accuracy: 0.704
0 - val_loss: 0.3936 - val_custom_accuracy: 0.3442
Epoch 64/300
4/4 [==============================] - 9s 2s/step - loss: 0.4312 - custom_accuracy: 0.736
8 - val_loss: 0.3902 - val_custom_accuracy: 0.3442
Epoch 65/300
4/4 [==============================] - 7s 2s/step - loss: 0.4229 - custom_accuracy: 0.776
2 - val_loss: 0.3867 - val_custom_accuracy: 0.3442
Epoch 66/300
4/4 [==============================] - 6s 2s/step - loss: 0.4317 - custom_accuracy: 0.779
4 - val_loss: 0.3849 - val_custom_accuracy: 0.3442
Epoch 67/300
4/4 [==============================] - 10s 2s/step - loss: 0.4305 - custom_accuracy: 0.81
11 - val_loss: 0.3850 - val_custom_accuracy: 0.3442
Epoch 68/300
4/4 [==============================] - 6s 2s/step - loss: 0.4207 - custom_accuracy: 0.816
2 - val_loss: 0.3860 - val_custom_accuracy: 0.3442
Epoch 69/300
4/4 [==============================] - 9s 2s/step - loss: 0.4250 - custom_accuracy: 0.762
1 - val_loss: 0.3870 - val_custom_accuracy: 0.3442
Epoch 70/300
4/4 [==============================] - 7s 2s/step - loss: 0.4344 - custom_accuracy: 0.812
5 - val_loss: 0.3855 - val_custom_accuracy: 0.3442
Epoch 71/300
4/4 [==============================] - 6s 2s/step - loss: 0.4368 - custom_accuracy: 0.768
4 - val_loss: 0.3848 - val_custom_accuracy: 0.3442
Epoch 72/300
4/4 [==============================] - 10s 2s/step - loss: 0.4273 - custom_accuracy: 0.72
27 - val_loss: 0.3843 - val_custom_accuracy: 0.3442
Epoch 73/300
4/4 [==============================] - 6s 2s/step - loss: 0.4299 - custom_accuracy: 0.816
1 - val_loss: 0.3831 - val_custom_accuracy: 0.3442
Epoch 74/300
4/4 [==============================] - 8s 2s/step - loss: 0.4340 - custom_accuracy: 0.809
0 - val_loss: 0.3815 - val_custom_accuracy: 0.3442
Epoch 75/300
4/4 [==============================] - 8s 2s/step - loss: 0.4286 - custom_accuracy: 0.809
4 - val_loss: 0.3816 - val_custom_accuracy: 0.3442
Epoch 76/300
4/4 [==============================] - 6s 1s/step - loss: 0.4268 - custom_accuracy: 0.768
9 - val_loss: 0.3825 - val_custom_accuracy: 0.3442
Epoch 77/300
4/4 [==============================] - 10s 2s/step - loss: 0.4280 - custom_accuracy: 0.81
02 - val_loss: 0.3826 - val_custom_accuracy: 0.3442
Epoch 78/300
4/4 [==============================] - 6s 2s/step - loss: 0.4178 - custom_accuracy: 0.697
9 - val_loss: 0.3834 - val_custom_accuracy: 0.3442
Epoch 79/300
4/4 [==============================] - 9s 2s/step - loss: 0.4216 - custom_accuracy: 0.741
7 - val_loss: 0.3846 - val_custom_accuracy: 0.3442
Epoch 80/300
4/4 [==============================] - 7s 2s/step - loss: 0.4277 - custom_accuracy: 0.700
5 - val_loss: 0.3849 - val_custom_accuracy: 0.3442
Epoch 81/300
4/4 [==============================] - 6s 2s/step - loss: 0.4234 - custom_accuracy: 0.822
7 - val_loss: 0.3857 - val_custom_accuracy: 0.3442
Epoch 82/300
4/4 [==============================] - 10s 2s/step - loss: 0.4327 - custom_accuracy: 0.75
32 - val_loss: 0.3879 - val_custom_accuracy: 0.3442
Epoch 83/300
4/4 [==============================] - 6s 2s/step - loss: 0.4314 - custom_accuracy: 0.757
7 - val_loss: 0.3917 - val_custom_accuracy: 0.3442
```

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Epoch 84/300
4/4 [==============================] - 8s 2s/step - loss: 0.4324 - custom_accuracy: 0.757
2 - val_loss: 0.3952 - val_custom_accuracy: 0.3442
Epoch 85/300
4/4 [==============================] - 7s 2s/step - loss: 0.4273 - custom_accuracy: 0.815
2 - val_loss: 0.3953 - val_custom_accuracy: 0.3442
Epoch 86/300
4/4 [==============================] - 6s 2s/step - loss: 0.4295 - custom_accuracy: 0.772
3 - val_loss: 0.3944 - val_custom_accuracy: 0.3442
Epoch 87/300
4/4 [==============================] - 10s 2s/step - loss: 0.4361 - custom_accuracy: 0.80
95 - val_loss: 0.3930 - val_custom_accuracy: 0.3442
Epoch 88/300
4/4 [==============================] - 6s 2s/step - loss: 0.4323 - custom_accuracy: 0.814
3 - val_loss: 0.3913 - val_custom_accuracy: 0.3442
Epoch 89/300
4/4 [==============================] - 8s 2s/step - loss: 0.4226 - custom_accuracy: 0.771
9 - val_loss: 0.3898 - val_custom_accuracy: 0.3442
Epoch 90/300
4/4 [==============================] - 8s 2s/step - loss: 0.4236 - custom_accuracy: 0.739
9 - val_loss: 0.3893 - val_custom_accuracy: 0.3442
Epoch 91/300
4/4 [==============================] - 6s 2s/step - loss: 0.4295 - custom_accuracy: 0.702
8 - val_loss: 0.3896 - val_custom_accuracy: 0.3442
Epoch 92/300
4/4 [==============================] - 10s 2s/step - loss: 0.4251 - custom_accuracy: 0.81
72 - val_loss: 0.3916 - val_custom_accuracy: 0.3442
Epoch 93/300
4/4 [==============================] - 6s 2s/step - loss: 0.4267 - custom_accuracy: 0.767
6 - val_loss: 0.3921 - val_custom_accuracy: 0.3442
Epoch 94/300
4/4 [==============================] - 8s 2s/step - loss: 0.4217 - custom_accuracy: 0.668
9 - val_loss: 0.3886 - val_custom_accuracy: 0.3442
Epoch 95/300
4/4 [==============================] - 7s 2s/step - loss: 0.4291 - custom_accuracy: 0.663
6 - val_loss: 0.3819 - val_custom_accuracy: 0.3442
Epoch 96/300
4/4 [==============================] - 6s 2s/step - loss: 0.4219 - custom_accuracy: 0.814
7 - val_loss: 0.3768 - val_custom_accuracy: 0.3442
Epoch 97/300
4/4 [==============================] - 10s 2s/step - loss: 0.4401 - custom_accuracy: 0.70
51 - val_loss: 0.3753 - val_custom_accuracy: 0.3472
Epoch 98/300
4/4 [==============================] - 6s 2s/step - loss: 0.4235 - custom_accuracy: 0.816
1 - val_loss: 0.3751 - val_custom_accuracy: 0.3511
Epoch 99/300
4/4 [==============================] - 8s 2s/step - loss: 0.4276 - custom_accuracy: 0.756
6 - val_loss: 0.3764 - val_custom_accuracy: 0.3511
Epoch 100/300
4/4 [==============================] - 8s 2s/step - loss: 0.4240 - custom_accuracy: 0.816
7 - val_loss: 0.3790 - val_custom_accuracy: 0.3442
Epoch 101/300
4/4 [==============================] - 6s 2s/step - loss: 0.4227 - custom_accuracy: 0.697
4 - val_loss: 0.3808 - val_custom_accuracy: 0.3442
Epoch 102/300
4/4 [==============================] - 10s 2s/step - loss: 0.4273 - custom_accuracy: 0.73
67 - val_loss: 0.3799 - val_custom_accuracy: 0.3442
Epoch 103/300
4/4 [==============================] - 6s 2s/step - loss: 0.4197 - custom_accuracy: 0.811
4 - val_loss: 0.3804 - val_custom_accuracy: 0.3442
Epoch 104/300
4/4 [==============================] - 9s 2s/step - loss: 0.4252 - custom_accuracy: 0.663
4 - val_loss: 0.3805 - val_custom_accuracy: 0.3442
Epoch 105/300
4/4 [==============================] - 7s 2s/step - loss: 0.4301 - custom_accuracy: 0.735
7 - val_loss: 0.3798 - val_custom_accuracy: 0.3511
Epoch 106/300
4/4 [==============================] - 6s 2s/step - loss: 0.4253 - custom_accuracy: 0.812
6 - val_loss: 0.3802 - val_custom_accuracy: 0.3442
Epoch 107/300
4/4 [==============================] - 9s 2s/step - loss: 0.4289 - custom_accuracy: 0.765
5 - val_loss: 0.3811 - val_custom_accuracy: 0.3442
```

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Epoch 108/300
4/4 [==============================] - 6s 2s/step - loss: 0.4289 - custom_accuracy: 0.808
3 - val_loss: 0.3813 - val_custom_accuracy: 0.3442
Epoch 109/300
4/4 [==============================] - 9s 2s/step - loss: 0.4303 - custom_accuracy: 0.751
7 - val_loss: 0.3814 - val_custom_accuracy: 0.3442
Epoch 110/300
4/4 [==============================] - 7s 2s/step - loss: 0.4300 - custom_accuracy: 0.726
1 - val_loss: 0.3806 - val_custom_accuracy: 0.3442
Epoch 111/300
4/4 [==============================] - 6s 2s/step - loss: 0.4214 - custom_accuracy: 0.760
7 - val_loss: 0.3828 - val_custom_accuracy: 0.3442
Epoch 112/300
4/4 [==============================] - 10s 2s/step - loss: 0.4207 - custom_accuracy: 0.66
49 - val_loss: 0.3858 - val_custom_accuracy: 0.3442
Epoch 113/300
4/4 [==============================] - 6s 2s/step - loss: 0.4291 - custom_accuracy: 0.696
7 - val_loss: 0.3859 - val_custom_accuracy: 0.3442
Epoch 114/300
4/4 [==============================] - 8s 2s/step - loss: 0.4216 - custom_accuracy: 0.813
2 - val_loss: 0.3825 - val_custom_accuracy: 0.3442
Epoch 115/300
4/4 [==============================] - 7s 2s/step - loss: 0.4296 - custom_accuracy: 0.745
1 - val_loss: 0.3792 - val_custom_accuracy: 0.3442
Epoch 116/300
4/4 [==============================] - 6s 2s/step - loss: 0.4237 - custom_accuracy: 0.752
6 - val_loss: 0.3760 - val_custom_accuracy: 0.3511
Epoch 117/300
4/4 [==============================] - 10s 2s/step - loss: 0.4223 - custom_accuracy: 0.76
09 - val_loss: 0.3740 - val_custom_accuracy: 0.3511
Epoch 118/300
4/4 [==============================] - 6s 2s/step - loss: 0.4204 - custom_accuracy: 0.697
4 - val_loss: 0.3722 - val_custom_accuracy: 0.3511
Epoch 119/300
4/4 [==============================] - 8s 2s/step - loss: 0.4204 - custom_accuracy: 0.775
9 - val_loss: 0.3703 - val_custom_accuracy: 0.3511
Epoch 120/300
4/4 [==============================] - 8s 2s/step - loss: 0.4206 - custom_accuracy: 0.816
0 - val_loss: 0.3706 - val_custom_accuracy: 0.3511
Epoch 121/300
4/4 [==============================] - 6s 2s/step - loss: 0.4284 - custom_accuracy: 0.758
9 - val_loss: 0.3727 - val_custom_accuracy: 0.3511
Epoch 122/300
4/4 [==============================] - 10s 2s/step - loss: 0.4207 - custom_accuracy: 0.73
84 - val_loss: 0.3744 - val_custom_accuracy: 0.3511
Epoch 123/300
4/4 [==============================] - 6s 2s/step - loss: 0.4237 - custom_accuracy: 0.815
8 - val_loss: 0.3773 - val_custom_accuracy: 0.3442
Epoch 124/300
4/4 [==============================] - 9s 2s/step - loss: 0.4219 - custom_accuracy: 0.813
8 - val_loss: 0.3788 - val_custom_accuracy: 0.3442
Epoch 125/300
4/4 [==============================] - 7s 2s/step - loss: 0.4185 - custom_accuracy: 0.770
8 - val_loss: 0.3802 - val_custom_accuracy: 0.3442
Epoch 126/300
4/4 [==============================] - 7s 2s/step - loss: 0.4253 - custom_accuracy: 0.662
5 - val_loss: 0.3807 - val_custom_accuracy: 0.3442
Epoch 127/300
4/4 [==============================] - 9s 2s/step - loss: 0.4260 - custom_accuracy: 0.815
7 - val_loss: 0.3797 - val_custom_accuracy: 0.3442
Epoch 128/300
4/4 [==============================] - 6s 2s/step - loss: 0.4231 - custom_accuracy: 0.741
7 - val_loss: 0.3789 - val_custom_accuracy: 0.3442
Epoch 129/300
4/4 [==============================] - 9s 2s/step - loss: 0.4164 - custom_accuracy: 0.698
9 - val_loss: 0.3774 - val_custom_accuracy: 0.3442
Epoch 130/300
4/4 [==============================] - 7s 2s/step - loss: 0.4210 - custom_accuracy: 0.703
8 - val_loss: 0.3742 - val_custom_accuracy: 0.3511
Epoch 131/300
4/4 [==============================] - 6s 2s/step - loss: 0.4204 - custom_accuracy: 0.740
0 - val_loss: 0.3727 - val_custom_accuracy: 0.3511
```

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Epoch 132/300
4/4 [==============================] - 10s 2s/step - loss: 0.4264 - custom_accuracy: 0.81
28 - val_loss: 0.3723 - val_custom_accuracy: 0.3472
Epoch 133/300
4/4 [==============================] - 6s 2s/step - loss: 0.4282 - custom_accuracy: 0.811
3 - val_loss: 0.3717 - val_custom_accuracy: 0.3472
Epoch 134/300
4/4 [==============================] - 9s 2s/step - loss: 0.4244 - custom_accuracy: 0.702
8 - val_loss: 0.3711 - val_custom_accuracy: 0.3472
Epoch 135/300
4/4 [==============================] - 7s 2s/step - loss: 0.4182 - custom_accuracy: 0.771
4 - val_loss: 0.3708 - val_custom_accuracy: 0.3472
Epoch 136/300
4/4 [==============================] - 7s 2s/step - loss: 0.4242 - custom_accuracy: 0.817
2 - val_loss: 0.3720 - val_custom_accuracy: 0.3472
Epoch 137/300
4/4 [==============================] - 9s 2s/step - loss: 0.4289 - custom_accuracy: 0.742
0 - val_loss: 0.3762 - val_custom_accuracy: 0.3442
Epoch 138/300
4/4 [==============================] - 6s 2s/step - loss: 0.4257 - custom_accuracy: 0.736
8 - val_loss: 0.3816 - val_custom_accuracy: 0.3442
Epoch 139/300
4/4 [==============================] - 8s 2s/step - loss: 0.4274 - custom_accuracy: 0.774
3 - val_loss: 0.3865 - val_custom_accuracy: 0.3442
Epoch 140/300
4/4 [==============================] - 7s 2s/step - loss: 0.4173 - custom_accuracy: 0.770
5 - val_loss: 0.3892 - val_custom_accuracy: 0.3442
Epoch 141/300
4/4 [==============================] - 7s 2s/step - loss: 0.4237 - custom_accuracy: 0.804
3 - val_loss: 0.3911 - val_custom_accuracy: 0.3442
Epoch 142/300
4/4 [==============================] - 9s 2s/step - loss: 0.4315 - custom_accuracy: 0.581
7 - val_loss: 0.3913 - val_custom_accuracy: 0.3442
Epoch 143/300
4/4 [==============================] - 6s 1s/step - loss: 0.4282 - custom_accuracy: 0.740
2 - val_loss: 0.3884 - val_custom_accuracy: 0.3442
Epoch 144/300
4/4 [==============================] - 8s 2s/step - loss: 0.4197 - custom_accuracy: 0.812
4 - val_loss: 0.3848 - val_custom_accuracy: 0.3442
Epoch 145/300
4/4 [==============================] - 7s 2s/step - loss: 0.4231 - custom_accuracy: 0.699
4 - val_loss: 0.3829 - val_custom_accuracy: 0.3442
Epoch 146/300
4/4 [==============================] - 6s 2s/step - loss: 0.4274 - custom_accuracy: 0.774
9 - val_loss: 0.3807 - val_custom_accuracy: 0.3442
Epoch 147/300
4/4 [==============================] - 10s 2s/step - loss: 0.4233 - custom_accuracy: 0.77
34 - val_loss: 0.3787 - val_custom_accuracy: 0.3442
Epoch 148/300
4/4 [==============================] - 6s 2s/step - loss: 0.4181 - custom_accuracy: 0.767
9 - val_loss: 0.3771 - val_custom_accuracy: 0.3442
Epoch 149/300
4/4 [==============================] - 9s 2s/step - loss: 0.4144 - custom_accuracy: 0.650
6 - val_loss: 0.3755 - val_custom_accuracy: 0.3442
Epoch 150/300
4/4 [==============================] - 7s 2s/step - loss: 0.4291 - custom_accuracy: 0.733
6 - val_loss: 0.3736 - val_custom_accuracy: 0.3511
Epoch 151/300
4/4 [==============================] - 7s 2s/step - loss: 0.4183 - custom_accuracy: 0.664
2 - val_loss: 0.3716 - val_custom_accuracy: 0.3511
Epoch 152/300
4/4 [==============================] - 9s 2s/step - loss: 0.4151 - custom_accuracy: 0.680
8 - val_loss: 0.3702 - val_custom_accuracy: 0.3472
Epoch 153/300
4/4 [==============================] - 6s 2s/step - loss: 0.4272 - custom_accuracy: 0.782
9 - val_loss: 0.3686 - val_custom_accuracy: 0.3472
Epoch 154/300
4/4 [==============================] - 8s 2s/step - loss: 0.4291 - custom_accuracy: 0.811
6 - val_loss: 0.3683 - val_custom_accuracy: 0.3472
Epoch 155/300
4/4 [==============================] - 7s 2s/step - loss: 0.4185 - custom_accuracy: 0.747
2 - val_loss: 0.3693 - val_custom_accuracy: 0.3472
```

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Epoch 156/300
4/4 [==============================] - 6s 2s/step - loss: 0.4222 - custom_accuracy: 0.812
7 - val_loss: 0.3700 - val_custom_accuracy: 0.3472
Epoch 157/300
4/4 [==============================] - 9s 2s/step - loss: 0.4273 - custom_accuracy: 0.731
7 - val_loss: 0.3709 - val_custom_accuracy: 0.3472
Epoch 158/300
4/4 [==============================] - 6s 2s/step - loss: 0.4281 - custom_accuracy: 0.765
4 - val_loss: 0.3710 - val_custom_accuracy: 0.3472
Epoch 159/300
4/4 [==============================] - 8s 2s/step - loss: 0.4199 - custom_accuracy: 0.822
0 - val_loss: 0.3708 - val_custom_accuracy: 0.3472
Epoch 160/300
4/4 [==============================] - 7s 2s/step - loss: 0.4250 - custom_accuracy: 0.697
4 - val_loss: 0.3712 - val_custom_accuracy: 0.3472
Epoch 161/300
4/4 [==============================] - 6s 2s/step - loss: 0.4193 - custom_accuracy: 0.723
5 - val_loss: 0.3706 - val_custom_accuracy: 0.3472
Epoch 162/300
4/4 [==============================] - 10s 2s/step - loss: 0.4297 - custom_accuracy: 0.75
64 - val_loss: 0.3710 - val_custom_accuracy: 0.3472
Epoch 163/300
4/4 [==============================] - 6s 2s/step - loss: 0.4200 - custom_accuracy: 0.811
3 - val_loss: 0.3708 - val_custom_accuracy: 0.3472
Epoch 164/300
4/4 [==============================] - 8s 2s/step - loss: 0.4247 - custom_accuracy: 0.767
8 - val_loss: 0.3718 - val_custom_accuracy: 0.3472
Epoch 165/300
4/4 [==============================] - 8s 2s/step - loss: 0.4194 - custom_accuracy: 0.770
9 - val_loss: 0.3737 - val_custom_accuracy: 0.3442
Epoch 166/300
4/4 [==============================] - 6s 2s/step - loss: 0.4219 - custom_accuracy: 0.740
0 - val_loss: 0.3754 - val_custom_accuracy: 0.3442
Epoch 167/300
4/4 [==============================] - 10s 3s/step - loss: 0.4172 - custom_accuracy: 0.76
93 - val_loss: 0.3753 - val_custom_accuracy: 0.3442
Epoch 168/300
4/4 [==============================] - 6s 2s/step - loss: 0.4187 - custom_accuracy: 0.820
3 - val_loss: 0.3748 - val_custom_accuracy: 0.3442
Epoch 169/300
4/4 [==============================] - 8s 2s/step - loss: 0.4206 - custom_accuracy: 0.771
6 - val_loss: 0.3768 - val_custom_accuracy: 0.3442
Epoch 170/300
4/4 [==============================] - 8s 2s/step - loss: 0.4235 - custom_accuracy: 0.683
5 - val_loss: 0.3773 - val_custom_accuracy: 0.3442
Epoch 171/300
4/4 [==============================] - 6s 2s/step - loss: 0.4233 - custom_accuracy: 0.755
4 - val_loss: 0.3776 - val_custom_accuracy: 0.3442
Epoch 172/300
4/4 [==============================] - 9s 3s/step - loss: 0.4252 - custom_accuracy: 0.811
1 - val_loss: 0.3783 - val_custom_accuracy: 0.3442
Epoch 173/300
4/4 [==============================] - 6s 2s/step - loss: 0.4182 - custom_accuracy: 0.758
5 - val_loss: 0.3788 - val_custom_accuracy: 0.3442
Epoch 174/300
4/4 [==============================] - 7s 2s/step - loss: 0.4079 - custom_accuracy: 0.824
9 - val_loss: 0.3800 - val_custom_accuracy: 0.3442
Epoch 175/300
4/4 [==============================] - 9s 2s/step - loss: 0.4225 - custom_accuracy: 0.811
0 - val_loss: 0.3798 - val_custom_accuracy: 0.3442
Epoch 176/300
4/4 [==============================] - 6s 2s/step - loss: 0.4191 - custom_accuracy: 0.810
9 - val_loss: 0.3800 - val_custom_accuracy: 0.3442
Epoch 177/300
4/4 [==============================] - 9s 3s/step - loss: 0.4191 - custom_accuracy: 0.812
3 - val_loss: 0.3801 - val_custom_accuracy: 0.3442
Epoch 178/300
4/4 [==============================] - 6s 2s/step - loss: 0.4187 - custom_accuracy: 0.761
5 - val_loss: 0.3807 - val_custom_accuracy: 0.3442
Epoch 179/300
4/4 [==============================] - 7s 2s/step - loss: 0.4208 - custom_accuracy: 0.725
9 - val_loss: 0.3811 - val_custom_accuracy: 0.3442
```

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Epoch 180/300
4/4 [==============================] - 9s 2s/step - loss: 0.4152 - custom_accuracy: 0.755
4 - val_loss: 0.3807 - val_custom_accuracy: 0.3442
Epoch 181/300
4/4 [==============================] - 6s 2s/step - loss: 0.4221 - custom_accuracy: 0.808
9 - val_loss: 0.3781 - val_custom_accuracy: 0.3442
Epoch 182/300
4/4 [==============================] - 9s 3s/step - loss: 0.4209 - custom_accuracy: 0.702
6 - val_loss: 0.3762 - val_custom_accuracy: 0.3442
Epoch 183/300
4/4 [==============================] - 7s 2s/step - loss: 0.4200 - custom_accuracy: 0.816
1 - val_loss: 0.3738 - val_custom_accuracy: 0.3442
Epoch 184/300
4/4 [==============================] - 7s 2s/step - loss: 0.4194 - custom_accuracy: 0.768
9 - val_loss: 0.3743 - val_custom_accuracy: 0.3442
Epoch 185/300
4/4 [==============================] - 9s 2s/step - loss: 0.4222 - custom_accuracy: 0.756
4 - val_loss: 0.3741 - val_custom_accuracy: 0.3442
Epoch 186/300
4/4 [==============================] - 6s 2s/step - loss: 0.4165 - custom_accuracy: 0.812
9 - val_loss: 0.3752 - val_custom_accuracy: 0.3442
Epoch 187/300
4/4 [==============================] - 9s 3s/step - loss: 0.4217 - custom_accuracy: 0.741
5 - val_loss: 0.3773 - val_custom_accuracy: 0.3442
Epoch 188/300
4/4 [==============================] - 7s 2s/step - loss: 0.4221 - custom_accuracy: 0.814
7 - val_loss: 0.3800 - val_custom_accuracy: 0.3442
Epoch 189/300
4/4 [==============================] - 7s 2s/step - loss: 0.4218 - custom_accuracy: 0.719
2 - val_loss: 0.3826 - val_custom_accuracy: 0.3442
Epoch 190/300
4/4 [==============================] - 9s 2s/step - loss: 0.4212 - custom_accuracy: 0.694
9 - val_loss: 0.3851 - val_custom_accuracy: 0.3442
Epoch 191/300
4/4 [==============================] - 6s 2s/step - loss: 0.4211 - custom_accuracy: 0.777
7 - val_loss: 0.3884 - val_custom_accuracy: 0.3442
Epoch 192/300
4/4 [==============================] - 9s 2s/step - loss: 0.4211 - custom_accuracy: 0.809
0 - val_loss: 0.3920 - val_custom_accuracy: 0.3442
Epoch 193/300
4/4 [==============================] - 7s 2s/step - loss: 0.4207 - custom_accuracy: 0.757
2 - val_loss: 0.3941 - val_custom_accuracy: 0.3442
Epoch 194/300
4/4 [==============================] - 7s 2s/step - loss: 0.4203 - custom_accuracy: 0.809
7 - val_loss: 0.3949 - val_custom_accuracy: 0.3442
Epoch 195/300
4/4 [==============================] - 9s 2s/step - loss: 0.4252 - custom_accuracy: 0.700
8 - val_loss: 0.3949 - val_custom_accuracy: 0.3442
Epoch 196/300
4/4 [==============================] - 6s 2s/step - loss: 0.4181 - custom_accuracy: 0.813
7 - val_loss: 0.3955 - val_custom_accuracy: 0.3442
Epoch 197/300
4/4 [==============================] - 9s 3s/step - loss: 0.4176 - custom_accuracy: 0.811
0 - val_loss: 0.3953 - val_custom_accuracy: 0.3442
Epoch 198/300
4/4 [==============================] - 7s 2s/step - loss: 0.4243 - custom_accuracy: 0.732
2 - val_loss: 0.3945 - val_custom_accuracy: 0.3442
Epoch 199/300
4/4 [==============================] - 7s 2s/step - loss: 0.4218 - custom_accuracy: 0.708
2 - val_loss: 0.3917 - val_custom_accuracy: 0.3442
Epoch 200/300
4/4 [==============================] - 9s 2s/step - loss: 0.4154 - custom_accuracy: 0.771
3 - val_loss: 0.3873 - val_custom_accuracy: 0.3442
Epoch 201/300
4/4 [==============================] - 6s 2s/step - loss: 0.4216 - custom_accuracy: 0.772
5 - val_loss: 0.3842 - val_custom_accuracy: 0.3442
Epoch 202/300
4/4 [==============================] - 9s 2s/step - loss: 0.4201 - custom_accuracy: 0.752
1 - val_loss: 0.3826 - val_custom_accuracy: 0.3442
Epoch 203/300
4/4 [==============================] - 7s 2s/step - loss: 0.4175 - custom_accuracy: 0.740
8 - val_loss: 0.3821 - val_custom_accuracy: 0.3442
```

```
Epoch 204/300
4/4 [==============================] - 6s 2s/step - loss: 0.4240 - custom_accuracy: 0.702
7 - val_loss: 0.3833 - val_custom_accuracy: 0.3442
Epoch 205/300
4/4 [==============================] - 10s 2s/step - loss: 0.4134 - custom_accuracy: 0.75
99 - val_loss: 0.3864 - val_custom_accuracy: 0.3442
Epoch 206/300
4/4 [==============================] - 6s 2s/step - loss: 0.4229 - custom_accuracy: 0.805
1 - val_loss: 0.3884 - val_custom_accuracy: 0.3442
Epoch 207/300
4/4 [==============================] - 9s 2s/step - loss: 0.4195 - custom_accuracy: 0.808
5 - val_loss: 0.3891 - val_custom_accuracy: 0.3442
Epoch 208/300
4/4 [==============================] - 7s 2s/step - loss: 0.4262 - custom_accuracy: 0.738
2 - val_loss: 0.3893 - val_custom_accuracy: 0.3442
Epoch 209/300
4/4 [==============================] - 6s 2s/step - loss: 0.4172 - custom_accuracy: 0.812
5 - val_loss: 0.3899 - val_custom_accuracy: 0.3442
Epoch 210/300
4/4 [==============================] - 9s 2s/step - loss: 0.4191 - custom_accuracy: 0.725
7 - val_loss: 0.3899 - val_custom_accuracy: 0.3442
Epoch 211/300
4/4 [==============================] - 6s 2s/step - loss: 0.4213 - custom_accuracy: 0.756
9 - val_loss: 0.3879 - val_custom_accuracy: 0.3442
Epoch 212/300
4/4 [==============================] - 9s 2s/step - loss: 0.4225 - custom_accuracy: 0.806
3 - val_loss: 0.3868 - val_custom_accuracy: 0.3442
Epoch 213/300
4/4 [==============================] - 7s 2s/step - loss: 0.4160 - custom_accuracy: 0.741
9 - val_loss: 0.3856 - val_custom_accuracy: 0.3442
Epoch 214/300
4/4 [==============================] - 6s 2s/step - loss: 0.4178 - custom_accuracy: 0.767
1 - val_loss: 0.3838 - val_custom_accuracy: 0.3442
Epoch 215/300
4/4 [==============================] - 9s 2s/step - loss: 0.4139 - custom_accuracy: 0.775
9 - val_loss: 0.3828 - val_custom_accuracy: 0.3442
Epoch 216/300
4/4 [==============================] - 6s 2s/step - loss: 0.4187 - custom_accuracy: 0.764
3 - val_loss: 0.3825 - val_custom_accuracy: 0.3442
Epoch 217/300
4/4 [==============================] - 9s 2s/step - loss: 0.4193 - custom_accuracy: 0.812
9 - val_loss: 0.3805 - val_custom_accuracy: 0.3442
Epoch 218/300
4/4 [==============================] - 7s 1s/step - loss: 0.4234 - custom_accuracy: 0.773
5 - val_loss: 0.3775 - val_custom_accuracy: 0.3442
Epoch 219/300
4/4 [==============================] - 6s 2s/step - loss: 0.4157 - custom_accuracy: 0.723
0 - val_loss: 0.3740 - val_custom_accuracy: 0.3442
Epoch 220/300
4/4 [==============================] - 10s 2s/step - loss: 0.4139 - custom_accuracy: 0.76
79 - val_loss: 0.3711 - val_custom_accuracy: 0.3442
Epoch 221/300
4/4 [==============================] - 6s 2s/step - loss: 0.4105 - custom_accuracy: 0.704
9 - val_loss: 0.3682 - val_custom_accuracy: 0.3511
Epoch 222/300
4/4 [==============================] - 9s 2s/step - loss: 0.4179 - custom_accuracy: 0.738
1 - val_loss: 0.3666 - val_custom_accuracy: 0.3511
Epoch 223/300
4/4 [==============================] - 7s 2s/step - loss: 0.4199 - custom_accuracy: 0.760
3 - val_loss: 0.3668 - val_custom_accuracy: 0.3511
Epoch 224/300
4/4 [==============================] - 7s 2s/step - loss: 0.4159 - custom_accuracy: 0.757
9 - val_loss: 0.3681 - val_custom_accuracy: 0.3511
Epoch 225/300
4/4 [==============================] - 9s 2s/step - loss: 0.4100 - custom_accuracy: 0.705
5 - val_loss: 0.3702 - val_custom_accuracy: 0.3442
Epoch 226/300
4/4 [==============================] - 6s 2s/step - loss: 0.4148 - custom_accuracy: 0.815
9 - val_loss: 0.3716 - val_custom_accuracy: 0.3442
Epoch 227/300
4/4 [==============================] - 9s 2s/step - loss: 0.4239 - custom_accuracy: 0.733
0 - val_loss: 0.3734 - val_custom_accuracy: 0.3442
```

```
Epoch 228/300
4/4 [==============================] - 7s 2s/step - loss: 0.4108 - custom_accuracy: 0.746
2 - val_loss: 0.3749 - val_custom_accuracy: 0.3442
Epoch 229/300
4/4 [==============================] - 7s 2s/step - loss: 0.4191 - custom_accuracy: 0.815
8 - val_loss: 0.3747 - val_custom_accuracy: 0.3442
Epoch 230/300
4/4 [==============================] - 9s 2s/step - loss: 0.4230 - custom_accuracy: 0.756
8 - val_loss: 0.3739 - val_custom_accuracy: 0.3442
Epoch 231/300
4/4 [==============================] - 6s 2s/step - loss: 0.4122 - custom_accuracy: 0.811
6 - val_loss: 0.3741 - val_custom_accuracy: 0.3442
Epoch 232/300
4/4 [==============================] - 9s 2s/step - loss: 0.4223 - custom_accuracy: 0.581
4 - val_loss: 0.3728 - val_custom_accuracy: 0.3442
Epoch 233/300
4/4 [==============================] - 7s 2s/step - loss: 0.4139 - custom_accuracy: 0.812
3 - val_loss: 0.3697 - val_custom_accuracy: 0.3472
Epoch 234/300
4/4 [==============================] - 7s 2s/step - loss: 0.4184 - custom_accuracy: 0.814
9 - val_loss: 0.3693 - val_custom_accuracy: 0.3472
Epoch 235/300
4/4 [==============================] - 9s 2s/step - loss: 0.4163 - custom_accuracy: 0.814
0 - val_loss: 0.3700 - val_custom_accuracy: 0.3472
Epoch 236/300
4/4 [==============================] - 6s 2s/step - loss: 0.4272 - custom_accuracy: 0.803
3 - val_loss: 0.3711 - val_custom_accuracy: 0.3403
Epoch 237/300
4/4 [==============================] - 9s 3s/step - loss: 0.4177 - custom_accuracy: 0.768
4 - val_loss: 0.3726 - val_custom_accuracy: 0.3442
Epoch 238/300
4/4 [==============================] - 7s 2s/step - loss: 0.4102 - custom_accuracy: 0.708
7 - val_loss: 0.3734 - val_custom_accuracy: 0.3442
Epoch 239/300
4/4 [==============================] - 7s 2s/step - loss: 0.4162 - custom_accuracy: 0.814
4 - val_loss: 0.3735 - val_custom_accuracy: 0.3442
Epoch 240/300
4/4 [==============================] - 9s 2s/step - loss: 0.4154 - custom_accuracy: 0.703
5 - val_loss: 0.3737 - val_custom_accuracy: 0.3442
Epoch 241/300
4/4 [==============================] - 6s 2s/step - loss: 0.4244 - custom_accuracy: 0.807
8 - val_loss: 0.3746 - val_custom_accuracy: 0.3442
Epoch 242/300
4/4 [==============================] - 9s 3s/step - loss: 0.4199 - custom_accuracy: 0.736
2 - val_loss: 0.3758 - val_custom_accuracy: 0.3442
Epoch 243/300
4/4 [==============================] - 7s 2s/step - loss: 0.4180 - custom_accuracy: 0.811
5 - val_loss: 0.3766 - val_custom_accuracy: 0.3442
Epoch 244/300
4/4 [==============================] - 7s 2s/step - loss: 0.4191 - custom_accuracy: 0.810
6 - val_loss: 0.3773 - val_custom_accuracy: 0.3442
Epoch 245/300
4/4 [==============================] - 9s 2s/step - loss: 0.4127 - custom_accuracy: 0.729
8 - val_loss: 0.3781 - val_custom_accuracy: 0.3442
Epoch 246/300
4/4 [==============================] - 6s 2s/step - loss: 0.4146 - custom_accuracy: 0.811
9 - val_loss: 0.3799 - val_custom_accuracy: 0.3442
Epoch 247/300
4/4 [==============================] - 9s 3s/step - loss: 0.4175 - custom_accuracy: 0.757
2 - val_loss: 0.3803 - val_custom_accuracy: 0.3442
Epoch 248/300
4/4 [==============================] - 7s 2s/step - loss: 0.4141 - custom_accuracy: 0.702
8 - val_loss: 0.3788 - val_custom_accuracy: 0.3442
Epoch 249/300
4/4 [==============================] - 7s 2s/step - loss: 0.4139 - custom_accuracy: 0.814
1 - val_loss: 0.3783 - val_custom_accuracy: 0.3442
Epoch 250/300
4/4 [==============================] - 9s 2s/step - loss: 0.4164 - custom_accuracy: 0.756
7 - val_loss: 0.3770 - val_custom_accuracy: 0.3442
Epoch 251/300
4/4 [==============================] - 6s 2s/step - loss: 0.4109 - custom_accuracy: 0.818
8 - val_loss: 0.3760 - val_custom_accuracy: 0.3442
```

```
Epoch 252/300
4/4 [==============================] - 9s 3s/step - loss: 0.4125 - custom_accuracy: 0.770
2 - val_loss: 0.3742 - val_custom_accuracy: 0.3442
Epoch 253/300
4/4 [==============================] - 7s 2s/step - loss: 0.4164 - custom_accuracy: 0.809
8 - val_loss: 0.3724 - val_custom_accuracy: 0.3442
Epoch 254/300
4/4 [==============================] - 7s 2s/step - loss: 0.4147 - custom_accuracy: 0.737
9 - val_loss: 0.3718 - val_custom_accuracy: 0.3442
Epoch 255/300
4/4 [==============================] - 9s 2s/step - loss: 0.4133 - custom_accuracy: 0.662
7 - val_loss: 0.3721 - val_custom_accuracy: 0.3442
Epoch 256/300
4/4 [==============================] - 6s 2s/step - loss: 0.4175 - custom_accuracy: 0.740
2 - val_loss: 0.3719 - val_custom_accuracy: 0.3442
Epoch 257/300
4/4 [==============================] - 9s 3s/step - loss: 0.4211 - custom_accuracy: 0.818
2 - val_loss: 0.3738 - val_custom_accuracy: 0.3442
Epoch 258/300
4/4 [==============================] - 7s 2s/step - loss: 0.4103 - custom_accuracy: 0.816
9 - val_loss: 0.3767 - val_custom_accuracy: 0.3442
Epoch 259/300
4/4 [==============================] - 7s 2s/step - loss: 0.4157 - custom_accuracy: 0.700
7 - val_loss: 0.3775 - val_custom_accuracy: 0.3442
Epoch 260/300
4/4 [==============================] - 9s 2s/step - loss: 0.4170 - custom_accuracy: 0.759
0 - val_loss: 0.3755 - val_custom_accuracy: 0.3442
Epoch 261/300
4/4 [==============================] - 6s 2s/step - loss: 0.4182 - custom_accuracy: 0.702
1 - val_loss: 0.3733 - val_custom_accuracy: 0.3442
Epoch 262/300
4/4 [==============================] - 9s 2s/step - loss: 0.4215 - custom_accuracy: 0.813
4 - val_loss: 0.3734 - val_custom_accuracy: 0.3442
Epoch 263/300
4/4 [==============================] - 7s 2s/step - loss: 0.4158 - custom_accuracy: 0.746
2 - val_loss: 0.3732 - val_custom_accuracy: 0.3442
Epoch 264/300
4/4 [==============================] - 7s 2s/step - loss: 0.4232 - custom_accuracy: 0.738
4 - val_loss: 0.3731 - val_custom_accuracy: 0.3442
Epoch 265/300
4/4 [==============================] - 10s 2s/step - loss: 0.4175 - custom_accuracy: 0.72
35 - val_loss: 0.3742 - val_custom_accuracy: 0.3442
Epoch 266/300
4/4 [==============================] - 6s 2s/step - loss: 0.4158 - custom_accuracy: 0.706
4 - val_loss: 0.3745 - val_custom_accuracy: 0.3442
Epoch 267/300
4/4 [==============================] - 9s 2s/step - loss: 0.4110 - custom_accuracy: 0.742
0 - val_loss: 0.3754 - val_custom_accuracy: 0.3442
Epoch 268/300
4/4 [==============================] - 7s 1s/step - loss: 0.4268 - custom_accuracy: 0.762
6 - val_loss: 0.3773 - val_custom_accuracy: 0.3442
Epoch 269/300
4/4 [==============================] - 7s 2s/step - loss: 0.4157 - custom_accuracy: 0.815
0 - val_loss: 0.3793 - val_custom_accuracy: 0.3442
Epoch 270/300
4/4 [==============================] - 9s 2s/step - loss: 0.4154 - custom_accuracy: 0.660
6 - val_loss: 0.3805 - val_custom_accuracy: 0.3442
Epoch 271/300
4/4 [==============================] - 6s 2s/step - loss: 0.4146 - custom_accuracy: 0.648
3 - val_loss: 0.3820 - val_custom_accuracy: 0.3442
Epoch 272/300
4/4 [==============================] - 9s 2s/step - loss: 0.4166 - custom_accuracy: 0.725
9 - val_loss: 0.3811 - val_custom_accuracy: 0.3442
Epoch 273/300
4/4 [==============================] - 7s 2s/step - loss: 0.4147 - custom_accuracy: 0.769
9 - val_loss: 0.3802 - val_custom_accuracy: 0.3442
Epoch 274/300
4/4 [==============================] - 7s 2s/step - loss: 0.4104 - custom_accuracy: 0.821
2 - val_loss: 0.3785 - val_custom_accuracy: 0.3442
Epoch 275/300
4/4 [==============================] - 9s 2s/step - loss: 0.4064 - custom_accuracy: 0.812
3 - val_loss: 0.3780 - val_custom_accuracy: 0.3442
```

```
Epoch 276/300
4/4 [==============================] - 6s 2s/step - loss: 0.4107 - custom_accuracy: 0.814
3 - val_loss: 0.3790 - val_custom_accuracy: 0.3442
Epoch 277/300
4/4 [==============================] - 9s 2s/step - loss: 0.4134 - custom_accuracy: 0.741
8 - val_loss: 0.3798 - val_custom_accuracy: 0.3442
Epoch 278/300
4/4 [==============================] - 7s 2s/step - loss: 0.4135 - custom_accuracy: 0.700
3 - val_loss: 0.3807 - val_custom_accuracy: 0.3442
Epoch 279/300
4/4 [==============================] - 7s 2s/step - loss: 0.4164 - custom_accuracy: 0.764
8 - val_loss: 0.3814 - val_custom_accuracy: 0.3442
Epoch 280/300
4/4 [==============================] - 9s 2s/step - loss: 0.4176 - custom_accuracy: 0.779
2 - val_loss: 0.3806 - val_custom_accuracy: 0.3442
Epoch 281/300
4/4 [==============================] - 6s 2s/step - loss: 0.4214 - custom_accuracy: 0.806
7 - val_loss: 0.3807 - val_custom_accuracy: 0.3442
Epoch 282/300
4/4 [==============================] - 9s 3s/step - loss: 0.4187 - custom_accuracy: 0.767
9 - val_loss: 0.3805 - val_custom_accuracy: 0.3442
Epoch 283/300
4/4 [==============================] - 7s 2s/step - loss: 0.4111 - custom_accuracy: 0.817
8 - val_loss: 0.3799 - val_custom_accuracy: 0.3442
Epoch 284/300
4/4 [==============================] - 7s 2s/step - loss: 0.4152 - custom_accuracy: 0.737
9 - val_loss: 0.3776 - val_custom_accuracy: 0.3442
Epoch 285/300
4/4 [==============================] - 9s 2s/step - loss: 0.4140 - custom_accuracy: 0.814
8 - val_loss: 0.3750 - val_custom_accuracy: 0.3442
Epoch 286/300
4/4 [==============================] - 6s 2s/step - loss: 0.4238 - custom_accuracy: 0.764
1 - val_loss: 0.3746 - val_custom_accuracy: 0.3442
Epoch 287/300
4/4 [==============================] - 9s 3s/step - loss: 0.4129 - custom_accuracy: 0.771
0 - val_loss: 0.3747 - val_custom_accuracy: 0.3442
Epoch 288/300
4/4 [==============================] - 7s 2s/step - loss: 0.4142 - custom_accuracy: 0.727
7 - val_loss: 0.3746 - val_custom_accuracy: 0.3442
Epoch 289/300
4/4 [==============================] - 7s 2s/step - loss: 0.4152 - custom_accuracy: 0.723
0 - val_loss: 0.3722 - val_custom_accuracy: 0.3442
Epoch 290/300
4/4 [==============================] - 9s 2s/step - loss: 0.4159 - custom_accuracy: 0.812
9 - val_loss: 0.3692 - val_custom_accuracy: 0.3511
Epoch 291/300
4/4 [==============================] - 6s 2s/step - loss: 0.4160 - custom_accuracy: 0.702
5 - val_loss: 0.3681 - val_custom_accuracy: 0.3511
Epoch 292/300
4/4 [==============================] - 9s 3s/step - loss: 0.4160 - custom_accuracy: 0.755
8 - val_loss: 0.3674 - val_custom_accuracy: 0.3511
Epoch 293/300
4/4 [==============================] - 7s 2s/step - loss: 0.4125 - custom_accuracy: 0.768
4 - val_loss: 0.3671 - val_custom_accuracy: 0.3511
Epoch 294/300
4/4 [==============================] - 7s 2s/step - loss: 0.4195 - custom_accuracy: 0.767
8 - val_loss: 0.3688 - val_custom_accuracy: 0.3511
Epoch 295/300
4/4 [==============================] - 9s 2s/step - loss: 0.4116 - custom_accuracy: 0.682
2 - val_loss: 0.3699 - val_custom_accuracy: 0.3442
Epoch 296/300
4/4 [==============================] - 6s 2s/step - loss: 0.4164 - custom_accuracy: 0.758
7 - val_loss: 0.3706 - val_custom_accuracy: 0.3442
Epoch 297/300
4/4 [==============================] - 10s 3s/step - loss: 0.4156 - custom_accuracy: 0.81
11 - val_loss: 0.3735 - val_custom_accuracy: 0.3442
Epoch 298/300
4/4 [==============================] - 6s 2s/step - loss: 0.4140 - custom_accuracy: 0.813
0 - val_loss: 0.3766 - val_custom_accuracy: 0.3442
Epoch 299/300
4/4 [==============================] - 8s 2s/step - loss: 0.4067 - custom_accuracy: 0.821
6 - val_loss: 0.3792 - val_custom_accuracy: 0.3442
```

```
Epoch 300/300
4/4 [==============================] - 8s 2s/step - loss: 0.4084 - custom_accuracy: 0.691
1 - val_loss: 0.3829 - val_custom_accuracy: 0.3442
```

In [ ]:

```python
plt.plot(H.history['loss'])
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.title("Discriminator's Loss for cycle two")
plt.show()
```

```
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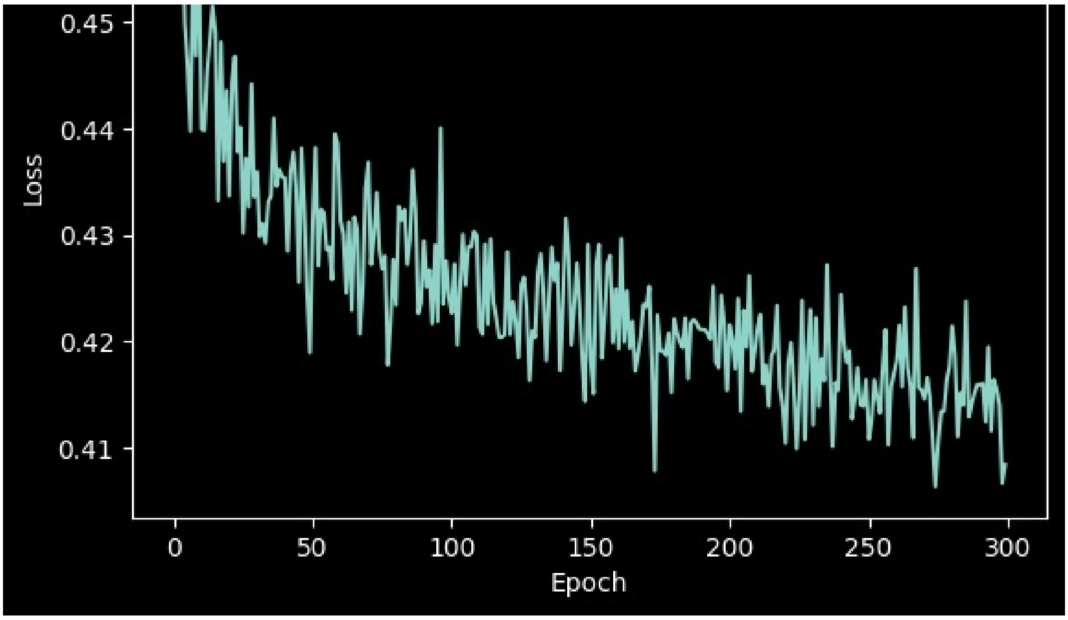
```



In [ ]:

```
plt.plot(H.history['custom_accuracy'])
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.title("Discriminator's Accuracy in Cycle two ")
plt.show()
```

```
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WARNING:matplotlib.font_manager:findfont: Font family 'Arial' not found.
WARNING:matplotlib.font_manager:findfont: Font family 'Arial' not found.
```

```
WARNING:matplotlib.font_manager:findfont: Font family 'Arial' not found.
WARNING:matplotlib.font_manager:findfont: Font family 'Arial' not found.
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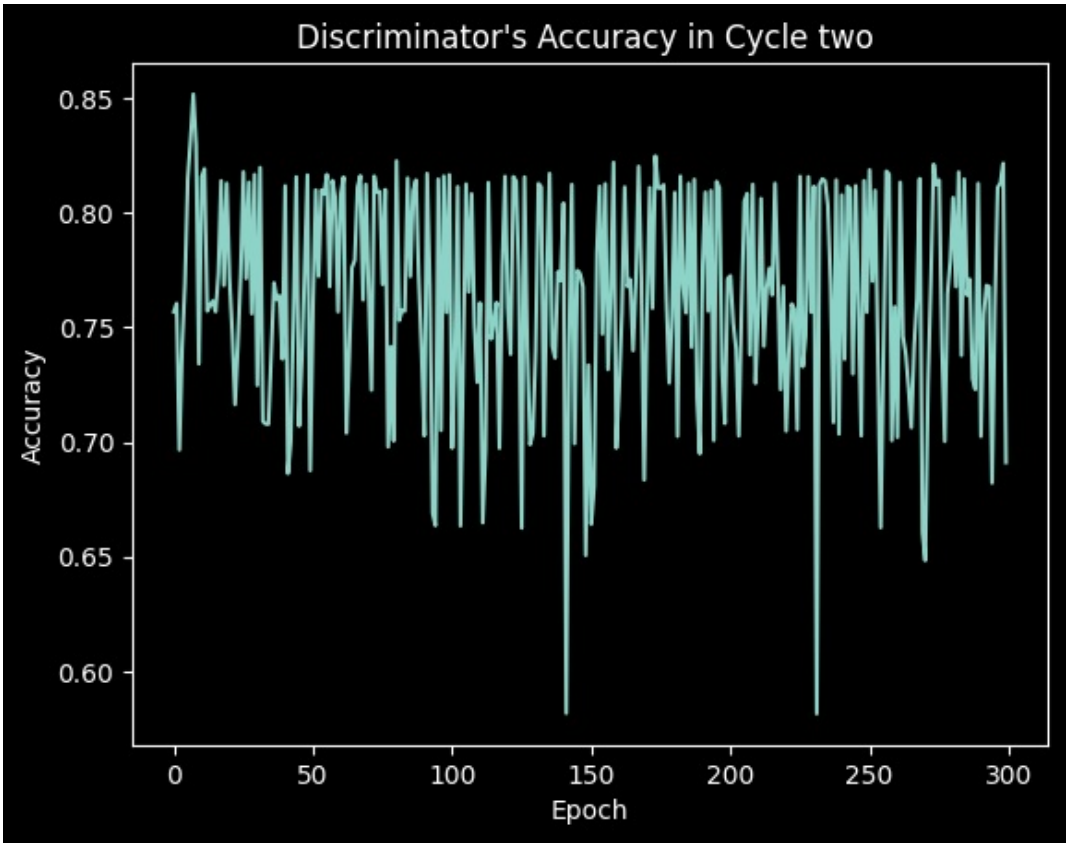
WARNING:matplotlib.font_manager:findfont: Font family 'Arial' not found.
WARNING:matplotlib.font_manager:findfont: Font family 'Arial' not found.
```



In [ ]:

```
custom_accuracy(np.array(y_gen_test, dtype=np.float32), qdisc_model.predict(gen_data_tes
t))
```

Out[ ]:

```
<tf.Tensor: shape=(), dtype=float32, numpy=0.71>
```

In [ ]:

```
# 3rd Cycle
best_qdisc_weights = qdisc_model.get_weights()[0]
best_qgen_weights = qgen_model.get_weights()[0]
qgen_model = generator_model(symbols_gen, qdisc_model.get_weights()[0])

qgen_model.get_layer('qgen_layer').set_weights([best_qgen_weights])
qdisc_model.get_layer('qdisc_layer').set_weights([best_qdisc_weights])
```

In [ ]:

```
gen_model_cp, disc_model_cp = checkpoints(cycle=3)
```

In [ ]:

```
# Generator training
H = train_qgen(300, 100, 1)
```

```
Epoch 1/300
1/1 [==============================] - 6s 6s/step - loss: 0.6963
Epoch 2/300
1/1 [==============================] - 4s 4s/step - loss: 0.6847
Epoch 3/300
1/1 [==============================] - 3s 3s/step - loss: 0.6733
```

```
Epoch 4/300
1/1 [==============================] - 3s 3s/step - loss: 0.6620
Epoch 5/300
1/1 [==============================] - 4s 4s/step - loss: 0.6510
Epoch 6/300
1/1 [==============================] - 6s 6s/step - loss: 0.6402
Epoch 7/300
1/1 [==============================] - 4s 4s/step - loss: 0.6297
Epoch 8/300
1/1 [==============================] - 3s 3s/step - loss: 0.6194
Epoch 9/300
1/1 [==============================] - 3s 3s/step - loss: 0.6093
Epoch 10/300
1/1 [==============================] - 5s 5s/step - loss: 0.5995
Epoch 11/300
1/1 [==============================] - 5s 5s/step - loss: 0.5900
Epoch 12/300
1/1 [==============================] - 3s 3s/step - loss: 0.5807
Epoch 13/300
1/1 [==============================] - 3s 3s/step - loss: 0.5717
Epoch 14/300
1/1 [==============================] - 4s 4s/step - loss: 0.5630
Epoch 15/300
1/1 [==============================] - 6s 6s/step - loss: 0.5545
Epoch 16/300
1/1 [==============================] - 4s 4s/step - loss: 0.5464
Epoch 17/300
1/1 [==============================] - 3s 3s/step - loss: 0.5385
Epoch 18/300
1/1 [==============================] - 3s 3s/step - loss: 0.5309
Epoch 19/300
1/1 [==============================] - 4s 4s/step - loss: 0.5235
Epoch 20/300
1/1 [==============================] - 6s 6s/step - loss: 0.5164
Epoch 21/300
1/1 [==============================] - 3s 3s/step - loss: 0.5095
Epoch 22/300
1/1 [==============================] - 3s 3s/step - loss: 0.5029
Epoch 23/300
1/1 [==============================] - 3s 3s/step - loss: 0.4965
Epoch 24/300
1/1 [==============================] - 5s 5s/step - loss: 0.4904
Epoch 25/300
1/1 [==============================] - 5s 5s/step - loss: 0.4845
Epoch 26/300
1/1 [==============================] - 3s 3s/step - loss: 0.4789
Epoch 27/300
1/1 [==============================] - 3s 3s/step - loss: 0.4734
Epoch 28/300
1/1 [==============================] - 4s 4s/step - loss: 0.4682
Epoch 29/300
1/1 [==============================] - 6s 6s/step - loss: 0.4631
Epoch 30/300
1/1 [==============================] - 4s 4s/step - loss: 0.4583
Epoch 31/300
1/1 [==============================] - 3s 3s/step - loss: 0.4536
Epoch 32/300
1/1 [==============================] - 3s 3s/step - loss: 0.4491
Epoch 33/300
1/1 [==============================] - 5s 5s/step - loss: 0.4448
Epoch 34/300
1/1 [==============================] - 5s 5s/step - loss: 0.4406
Epoch 35/300
1/1 [==============================] - 3s 3s/step - loss: 0.4366
Epoch 36/300
1/1 [==============================] - 3s 3s/step - loss: 0.4327
Epoch 37/300
1/1 [==============================] - 3s 3s/step - loss: 0.4289
Epoch 38/300
1/1 [==============================] - 6s 6s/step - loss: 0.4253
Epoch 39/300
1/1 [==============================] - 4s 4s/step - loss: 0.4218
```

```
Epoch 40/300
1/1 [==============================] - 3s 3s/step - loss: 0.4184
Epoch 41/300
1/1 [==============================] - 3s 3s/step - loss: 0.4151
Epoch 42/300
1/1 [==============================] - 5s 5s/step - loss: 0.4119
Epoch 43/300
1/1 [==============================] - 6s 6s/step - loss: 0.4088
Epoch 44/300
1/1 [==============================] - 3s 3s/step - loss: 0.4058
Epoch 45/300
1/1 [==============================] - 3s 3s/step - loss: 0.4029
Epoch 46/300
1/1 [==============================] - 3s 3s/step - loss: 0.4001
Epoch 47/300
1/1 [==============================] - 6s 6s/step - loss: 0.3973
Epoch 48/300
1/1 [==============================] - 5s 5s/step - loss: 0.3946
Epoch 49/300
1/1 [==============================] - 3s 3s/step - loss: 0.3920
Epoch 50/300
1/1 [==============================] - 3s 3s/step - loss: 0.3894
Epoch 51/300
1/1 [==============================] - 4s 4s/step - loss: 0.3869
Epoch 52/300
1/1 [==============================] - 6s 6s/step - loss: 0.3845
Epoch 53/300
1/1 [==============================] - 4s 4s/step - loss: 0.3821
Epoch 54/300
1/1 [==============================] - 3s 3s/step - loss: 0.3797
Epoch 55/300
1/1 [==============================] - 3s 3s/step - loss: 0.3775
Epoch 56/300
1/1 [==============================] - 5s 5s/step - loss: 0.3752
Epoch 57/300
1/1 [==============================] - 5s 5s/step - loss: 0.3730
Epoch 58/300
1/1 [==============================] - 3s 3s/step - loss: 0.3709
Epoch 59/300
1/1 [==============================] - 3s 3s/step - loss: 0.3688
Epoch 60/300
1/1 [==============================] - 3s 3s/step - loss: 0.3667
Epoch 61/300
1/1 [==============================] - 6s 6s/step - loss: 0.3647
Epoch 62/300
1/1 [==============================] - 4s 4s/step - loss: 0.3628
Epoch 63/300
1/1 [==============================] - 3s 3s/step - loss: 0.3608
Epoch 64/300
1/1 [==============================] - 3s 3s/step - loss: 0.3590
Epoch 65/300
1/1 [==============================] - 4s 4s/step - loss: 0.3571
Epoch 66/300
1/1 [==============================] - 6s 6s/step - loss: 0.3553
Epoch 67/300
1/1 [==============================] - 4s 4s/step - loss: 0.3536
Epoch 68/300
1/1 [==============================] - 3s 3s/step - loss: 0.3519
Epoch 69/300
1/1 [==============================] - 3s 3s/step - loss: 0.3502
Epoch 70/300
1/1 [==============================] - 5s 5s/step - loss: 0.3485
Epoch 71/300
1/1 [==============================] - 5s 5s/step - loss: 0.3469
Epoch 72/300
1/1 [==============================] - 3s 3s/step - loss: 0.3454
Epoch 73/300
1/1 [==============================] - 3s 3s/step - loss: 0.3439
Epoch 74/300
1/1 [==============================] - 3s 3s/step - loss: 0.3424
Epoch 75/300
1/1 [==============================] - 6s 6s/step - loss: 0.3409
```

```
Epoch 76/300
1/1 [==============================] - 4s 4s/step - loss: 0.3395
Epoch 77/300
1/1 [==============================] - 3s 3s/step - loss: 0.3381
Epoch 78/300
1/1 [==============================] - 3s 3s/step - loss: 0.3367
Epoch 79/300
1/1 [==============================] - 5s 5s/step - loss: 0.3353
Epoch 80/300
1/1 [==============================] - 6s 6s/step - loss: 0.3340
Epoch 81/300
1/1 [==============================] - 3s 3s/step - loss: 0.3327
Epoch 82/300
1/1 [==============================] - 3s 3s/step - loss: 0.3314
Epoch 83/300
1/1 [==============================] - 3s 3s/step - loss: 0.3301
Epoch 84/300
1/1 [==============================] - 5s 5s/step - loss: 0.3289
Epoch 85/300
1/1 [==============================] - 5s 5s/step - loss: 0.3276
Epoch 86/300
1/1 [==============================] - 3s 3s/step - loss: 0.3264
Epoch 87/300
1/1 [==============================] - 3s 3s/step - loss: 0.3252
Epoch 88/300
1/1 [==============================] - 4s 4s/step - loss: 0.3240
Epoch 89/300
1/1 [==============================] - 6s 6s/step - loss: 0.3228
Epoch 90/300
1/1 [==============================] - 4s 4s/step - loss: 0.3217
Epoch 91/300
1/1 [==============================] - 3s 3s/step - loss: 0.3205
Epoch 92/300
1/1 [==============================] - 3s 3s/step - loss: 0.3194
Epoch 93/300
1/1 [==============================] - 5s 5s/step - loss: 0.3183
Epoch 94/300
1/1 [==============================] - 5s 5s/step - loss: 0.3172
Epoch 95/300
1/1 [==============================] - 3s 3s/step - loss: 0.3161
Epoch 96/300
1/1 [==============================] - 3s 3s/step - loss: 0.3150
Epoch 97/300
1/1 [==============================] - 3s 3s/step - loss: 0.3139
Epoch 98/300
1/1 [==============================] - 6s 6s/step - loss: 0.3128
Epoch 99/300
1/1 [==============================] - 4s 4s/step - loss: 0.3118
Epoch 100/300
1/1 [==============================] - 3s 3s/step - loss: 0.3107
Epoch 101/300
1/1 [==============================] - 3s 3s/step - loss: 0.3097
Epoch 102/300
1/1 [==============================] - 4s 4s/step - loss: 0.3087
Epoch 103/300
1/1 [==============================] - 6s 6s/step - loss: 0.3076
Epoch 104/300
1/1 [==============================] - 4s 4s/step - loss: 0.3066
Epoch 105/300
1/1 [==============================] - 3s 3s/step - loss: 0.3056
Epoch 106/300
1/1 [==============================] - 3s 3s/step - loss: 0.3046
Epoch 107/300
1/1 [==============================] - 5s 5s/step - loss: 0.3036
Epoch 108/300
1/1 [==============================] - 5s 5s/step - loss: 0.3026
Epoch 109/300
1/1 [==============================] - 3s 3s/step - loss: 0.3016
Epoch 110/300
1/1 [==============================] - 3s 3s/step - loss: 0.3006
Epoch 111/300
1/1 [==============================] - 3s 3s/step - loss: 0.2996
```

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Epoch 112/300
1/1 [==============================] - 6s 6s/step - loss: 0.2987
Epoch 113/300
1/1 [==============================] - 4s 4s/step - loss: 0.2977
Epoch 114/300
1/1 [==============================] - 3s 3s/step - loss: 0.2967
Epoch 115/300
1/1 [==============================] - 3s 3s/step - loss: 0.2957
Epoch 116/300
1/1 [==============================] - 5s 5s/step - loss: 0.2948
Epoch 117/300
1/1 [==============================] - 6s 6s/step - loss: 0.2938
Epoch 118/300
1/1 [==============================] - 3s 3s/step - loss: 0.2929
Epoch 119/300
1/1 [==============================] - 3s 3s/step - loss: 0.2919
Epoch 120/300
1/1 [==============================] - 3s 3s/step - loss: 0.2910
Epoch 121/300
1/1 [==============================] - 6s 6s/step - loss: 0.2900
Epoch 122/300
1/1 [==============================] - 5s 5s/step - loss: 0.2890
Epoch 123/300
1/1 [==============================] - 3s 3s/step - loss: 0.2881
Epoch 124/300
1/1 [==============================] - 3s 3s/step - loss: 0.2871
Epoch 125/300
1/1 [==============================] - 4s 4s/step - loss: 0.2862
Epoch 126/300
1/1 [==============================] - 6s 6s/step - loss: 0.2852
Epoch 127/300
1/1 [==============================] - 4s 4s/step - loss: 0.2843
Epoch 128/300
1/1 [==============================] - 3s 3s/step - loss: 0.2833
Epoch 129/300
1/1 [==============================] - 3s 3s/step - loss: 0.2824
Epoch 130/300
1/1 [==============================] - 5s 5s/step - loss: 0.2814
Epoch 131/300
1/1 [==============================] - 5s 5s/step - loss: 0.2805
Epoch 132/300
1/1 [==============================] - 3s 3s/step - loss: 0.2795
Epoch 133/300
1/1 [==============================] - 3s 3s/step - loss: 0.2786
Epoch 134/300
1/1 [==============================] - 3s 3s/step - loss: 0.2776
Epoch 135/300
1/1 [==============================] - 6s 6s/step - loss: 0.2767
Epoch 136/300
1/1 [==============================] - 4s 4s/step - loss: 0.2757
Epoch 137/300
1/1 [==============================] - 3s 3s/step - loss: 0.2748
Epoch 138/300
1/1 [==============================] - 3s 3s/step - loss: 0.2738
Epoch 139/300
1/1 [==============================] - 5s 5s/step - loss: 0.2729
Epoch 140/300
1/1 [==============================] - 6s 6s/step - loss: 0.2719
Epoch 141/300
1/1 [==============================] - 3s 3s/step - loss: 0.2709
Epoch 142/300
1/1 [==============================] - 3s 3s/step - loss: 0.2700
Epoch 143/300
1/1 [==============================] - 3s 3s/step - loss: 0.2690
Epoch 144/300
1/1 [==============================] - 5s 5s/step - loss: 0.2681
Epoch 145/300
1/1 [==============================] - 5s 5s/step - loss: 0.2671
Epoch 146/300
1/1 [==============================] - 3s 3s/step - loss: 0.2661
Epoch 147/300
1/1 [==============================] - 3s 3s/step - loss: 0.2652
```

```
Epoch 148/300
1/1 [==============================] - 4s 4s/step - loss: 0.2642
Epoch 149/300
1/1 [==============================] - 6s 6s/step - loss: 0.2632
Epoch 150/300
1/1 [==============================] - 4s 4s/step - loss: 0.2623
Epoch 151/300
1/1 [==============================] - 3s 3s/step - loss: 0.2613
Epoch 152/300
1/1 [==============================] - 3s 3s/step - loss: 0.2603
Epoch 153/300
1/1 [==============================] - 5s 5s/step - loss: 0.2594
Epoch 154/300
1/1 [==============================] - 5s 5s/step - loss: 0.2584
Epoch 155/300
1/1 [==============================] - 3s 3s/step - loss: 0.2575
Epoch 156/300
1/1 [==============================] - 3s 3s/step - loss: 0.2565
Epoch 157/300
1/1 [==============================] - 3s 3s/step - loss: 0.2555
Epoch 158/300
1/1 [==============================] - 6s 6s/step - loss: 0.2546
Epoch 159/300
1/1 [==============================] - 4s 4s/step - loss: 0.2536
Epoch 160/300
1/1 [==============================] - 3s 3s/step - loss: 0.2526
Epoch 161/300
1/1 [==============================] - 3s 3s/step - loss: 0.2517
Epoch 162/300
1/1 [==============================] - 4s 4s/step - loss: 0.2507
Epoch 163/300
1/1 [==============================] - 6s 6s/step - loss: 0.2498
Epoch 164/300
1/1 [==============================] - 4s 4s/step - loss: 0.2488
Epoch 165/300
1/1 [==============================] - 3s 3s/step - loss: 0.2479
Epoch 166/300
1/1 [==============================] - 3s 3s/step - loss: 0.2469
Epoch 167/300
1/1 [==============================] - 5s 5s/step - loss: 0.2460
Epoch 168/300
1/1 [==============================] - 5s 5s/step - loss: 0.2450
Epoch 169/300
1/1 [==============================] - 3s 3s/step - loss: 0.2441
Epoch 170/300
1/1 [==============================] - 3s 3s/step - loss: 0.2431
Epoch 171/300
1/1 [==============================] - 3s 3s/step - loss: 0.2422
Epoch 172/300
1/1 [==============================] - 6s 6s/step - loss: 0.2413
Epoch 173/300
1/1 [==============================] - 4s 4s/step - loss: 0.2404
Epoch 174/300
1/1 [==============================] - 3s 3s/step - loss: 0.2394
Epoch 175/300
1/1 [==============================] - 3s 3s/step - loss: 0.2385
Epoch 176/300
1/1 [==============================] - 4s 4s/step - loss: 0.2376
Epoch 177/300
1/1 [==============================] - 6s 6s/step - loss: 0.2367
Epoch 178/300
1/1 [==============================] - 4s 4s/step - loss: 0.2358
Epoch 179/300
1/1 [==============================] - 3s 3s/step - loss: 0.2350
Epoch 180/300
1/1 [==============================] - 3s 3s/step - loss: 0.2341
Epoch 181/300
1/1 [==============================] - 5s 5s/step - loss: 0.2332
Epoch 182/300
1/1 [==============================] - 5s 5s/step - loss: 0.2324
Epoch 183/300
1/1 [==============================] - 3s 3s/step - loss: 0.2315
```

```
Epoch 184/300
1/1 [==============================] - 3s 3s/step - loss: 0.2307
Epoch 185/300
1/1 [==============================] - 3s 3s/step - loss: 0.2299
Epoch 186/300
1/1 [==============================] - 6s 6s/step - loss: 0.2291
Epoch 187/300
1/1 [==============================] - 4s 4s/step - loss: 0.2283
Epoch 188/300
1/1 [==============================] - 3s 3s/step - loss: 0.2275
Epoch 189/300
1/1 [==============================] - 3s 3s/step - loss: 0.2267
Epoch 190/300
1/1 [==============================] - 4s 4s/step - loss: 0.2259
Epoch 191/300
1/1 [==============================] - 6s 6s/step - loss: 0.2252
Epoch 192/300
1/1 [==============================] - 4s 4s/step - loss: 0.2244
Epoch 193/300
1/1 [==============================] - 3s 3s/step - loss: 0.2237
Epoch 194/300
1/1 [==============================] - 3s 3s/step - loss: 0.2230
Epoch 195/300
1/1 [==============================] - 5s 5s/step - loss: 0.2223
Epoch 196/300
1/1 [==============================] - 5s 5s/step - loss: 0.2216
Epoch 197/300
1/1 [==============================] - 3s 3s/step - loss: 0.2209
Epoch 198/300
1/1 [==============================] - 3s 3s/step - loss: 0.2203
Epoch 199/300
1/1 [==============================] - 3s 3s/step - loss: 0.2196
Epoch 200/300
1/1 [==============================] - 6s 6s/step - loss: 0.2190
Epoch 201/300
1/1 [==============================] - 5s 5s/step - loss: 0.2183
Epoch 202/300
1/1 [==============================] - 3s 3s/step - loss: 0.2177
Epoch 203/300
1/1 [==============================] - 3s 3s/step - loss: 0.2171
Epoch 204/300
1/1 [==============================] - 4s 4s/step - loss: 0.2165
Epoch 205/300
1/1 [==============================] - 6s 6s/step - loss: 0.2159
Epoch 206/300
1/1 [==============================] - 4s 4s/step - loss: 0.2154
Epoch 207/300
1/1 [==============================] - 3s 3s/step - loss: 0.2148
Epoch 208/300
1/1 [==============================] - 3s 3s/step - loss: 0.2142
Epoch 209/300
1/1 [==============================] - 5s 5s/step - loss: 0.2137
Epoch 210/300
1/1 [==============================] - 5s 5s/step - loss: 0.2131
Epoch 211/300
1/1 [==============================] - 3s 3s/step - loss: 0.2126
Epoch 212/300
1/1 [==============================] - 3s 3s/step - loss: 0.2121
Epoch 213/300
1/1 [==============================] - 3s 3s/step - loss: 0.2116
Epoch 214/300
1/1 [==============================] - 6s 6s/step - loss: 0.2111
Epoch 215/300
1/1 [==============================] - 5s 5s/step - loss: 0.2106
Epoch 216/300
1/1 [==============================] - 3s 3s/step - loss: 0.2101
Epoch 217/300
1/1 [==============================] - 3s 3s/step - loss: 0.2096
Epoch 218/300
1/1 [==============================] - 4s 4s/step - loss: 0.2091
Epoch 219/300
1/1 [==============================] - 6s 6s/step - loss: 0.2086
```

```
Epoch 220/300
1/1 [==============================] - 4s 4s/step - loss: 0.2081
Epoch 221/300
1/1 [==============================] - 3s 3s/step - loss: 0.2076
Epoch 222/300
1/1 [==============================] - 3s 3s/step - loss: 0.2072
Epoch 223/300
1/1 [==============================] - 6s 6s/step - loss: 0.2067
Epoch 224/300
1/1 [==============================] - 5s 5s/step - loss: 0.2062
Epoch 225/300
1/1 [==============================] - 3s 3s/step - loss: 0.2058
Epoch 226/300
1/1 [==============================] - 3s 3s/step - loss: 0.2053
Epoch 227/300
1/1 [==============================] - 4s 4s/step - loss: 0.2049
Epoch 228/300
1/1 [==============================] - 6s 6s/step - loss: 0.2044
Epoch 229/300
1/1 [==============================] - 4s 4s/step - loss: 0.2040
Epoch 230/300
1/1 [==============================] - 3s 3s/step - loss: 0.2035
Epoch 231/300
1/1 [==============================] - 3s 3s/step - loss: 0.2031
Epoch 232/300
1/1 [==============================] - 5s 5s/step - loss: 0.2026
Epoch 233/300
1/1 [==============================] - 5s 5s/step - loss: 0.2022
Epoch 234/300
1/1 [==============================] - 3s 3s/step - loss: 0.2017
Epoch 235/300
1/1 [==============================] - 3s 3s/step - loss: 0.2013
Epoch 236/300
1/1 [==============================] - 3s 3s/step - loss: 0.2009
Epoch 237/300
1/1 [==============================] - 6s 6s/step - loss: 0.2004
Epoch 238/300
1/1 [==============================] - 4s 4s/step - loss: 0.2000
Epoch 239/300
1/1 [==============================] - 3s 3s/step - loss: 0.1996
Epoch 240/300
1/1 [==============================] - 3s 3s/step - loss: 0.1991
Epoch 241/300
1/1 [==============================] - 4s 4s/step - loss: 0.1987
Epoch 242/300
1/1 [==============================] - 6s 6s/step - loss: 0.1983
Epoch 243/300
1/1 [==============================] - 4s 4s/step - loss: 0.1978
Epoch 244/300
1/1 [==============================] - 3s 3s/step - loss: 0.1974
Epoch 245/300
1/1 [==============================] - 3s 3s/step - loss: 0.1970
Epoch 246/300
1/1 [==============================] - 6s 6s/step - loss: 0.1966
Epoch 247/300
1/1 [==============================] - 5s 5s/step - loss: 0.1962
Epoch 248/300
1/1 [==============================] - 3s 3s/step - loss: 0.1957
Epoch 249/300
1/1 [==============================] - 3s 3s/step - loss: 0.1953
Epoch 250/300
1/1 [==============================] - 4s 4s/step - loss: 0.1949
Epoch 251/300
1/1 [==============================] - 6s 6s/step - loss: 0.1945
Epoch 252/300
1/1 [==============================] - 4s 4s/step - loss: 0.1941
Epoch 253/300
1/1 [==============================] - 3s 3s/step - loss: 0.1937
Epoch 254/300
1/1 [==============================] - 3s 3s/step - loss: 0.1933
Epoch 255/300
1/1 [==============================] - 5s 5s/step - loss: 0.1929
```

```
Epoch 256/300
1/1 [==============================] - 5s 5s/step - loss: 0.1925
Epoch 257/300
1/1 [==============================] - 3s 3s/step - loss: 0.1921
Epoch 258/300
1/1 [==============================] - 3s 3s/step - loss: 0.1917
Epoch 259/300
1/1 [==============================] - 3s 3s/step - loss: 0.1913
Epoch 260/300
1/1 [==============================] - 6s 6s/step - loss: 0.1909
Epoch 261/300
1/1 [==============================] - 4s 4s/step - loss: 0.1905
Epoch 262/300
1/1 [==============================] - 3s 3s/step - loss: 0.1901
Epoch 263/300
1/1 [==============================] - 3s 3s/step - loss: 0.1897
Epoch 264/300
1/1 [==============================] - 5s 5s/step - loss: 0.1893
Epoch 265/300
1/1 [==============================] - 6s 6s/step - loss: 0.1890
Epoch 266/300
1/1 [==============================] - 4s 4s/step - loss: 0.1886
Epoch 267/300
1/1 [==============================] - 3s 3s/step - loss: 0.1882
Epoch 268/300
1/1 [==============================] - 3s 3s/step - loss: 0.1879
Epoch 269/300
1/1 [==============================] - 5s 5s/step - loss: 0.1875
Epoch 270/300
1/1 [==============================] - 5s 5s/step - loss: 0.1871
Epoch 271/300
1/1 [==============================] - 3s 3s/step - loss: 0.1868
Epoch 272/300
1/1 [==============================] - 3s 3s/step - loss: 0.1864
Epoch 273/300
1/1 [==============================] - 4s 4s/step - loss: 0.1861
Epoch 274/300
1/1 [==============================] - 6s 6s/step - loss: 0.1857
Epoch 275/300
1/1 [==============================] - 4s 4s/step - loss: 0.1854
Epoch 276/300
1/1 [==============================] - 3s 3s/step - loss: 0.1851
Epoch 277/300
1/1 [==============================] - 3s 3s/step - loss: 0.1847
Epoch 278/300
1/1 [==============================] - 5s 5s/step - loss: 0.1844
Epoch 279/300
1/1 [==============================] - 5s 5s/step - loss: 0.1841
Epoch 280/300
1/1 [==============================] - 3s 3s/step - loss: 0.1837
Epoch 281/300
1/1 [==============================] - 3s 3s/step - loss: 0.1834
Epoch 282/300
1/1 [==============================] - 3s 3s/step - loss: 0.1831
Epoch 283/300
1/1 [==============================] - 6s 6s/step - loss: 0.1828
Epoch 284/300
1/1 [==============================] - 5s 5s/step - loss: 0.1825
Epoch 285/300
1/1 [==============================] - 3s 3s/step - loss: 0.1822
Epoch 286/300
1/1 [==============================] - 3s 3s/step - loss: 0.1819
Epoch 287/300
1/1 [==============================] - 4s 4s/step - loss: 0.1816
Epoch 288/300
1/1 [==============================] - 6s 6s/step - loss: 0.1813
Epoch 289/300
1/1 [==============================] - 4s 4s/step - loss: 0.1810
Epoch 290/300
1/1 [==============================] - 3s 3s/step - loss: 0.1807
Epoch 291/300
1/1 [==============================] - 3s 3s/step - loss: 0.1805
```

```
Epoch 292/300
1/1 [==============================] - 5s 5s/step - loss: 0.1802
Epoch 293/300
1/1 [==============================] - 5s 5s/step - loss: 0.1799
Epoch 294/300
1/1 [==============================] - 3s 3s/step - loss: 0.1796
Epoch 295/300
1/1 [==============================] - 3s 3s/step - loss: 0.1794
Epoch 296/300
1/1 [==============================] - 3s 3s/step - loss: 0.1791
Epoch 297/300
1/1 [==============================] - 6s 6s/step - loss: 0.1789
Epoch 298/300
1/1 [==============================] - 4s 4s/step - loss: 0.1786
Epoch 299/300
1/1 [==============================] - 3s 3s/step - loss: 0.1784
Epoch 300/300
1/1 [==============================] - 3s 3s/step - loss: 0.1781
```

In [ ]:

```
plt.plot(H.history['loss'])
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.title("Generator's Loss in Cycle three")
plt.show()
```

```
WARNING:matplotlib.font_manager:findfont: Font family 'Arial' not found.
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```

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WARNING:matplotlib.font_manager:findfont: Font family 'Arial' not found.
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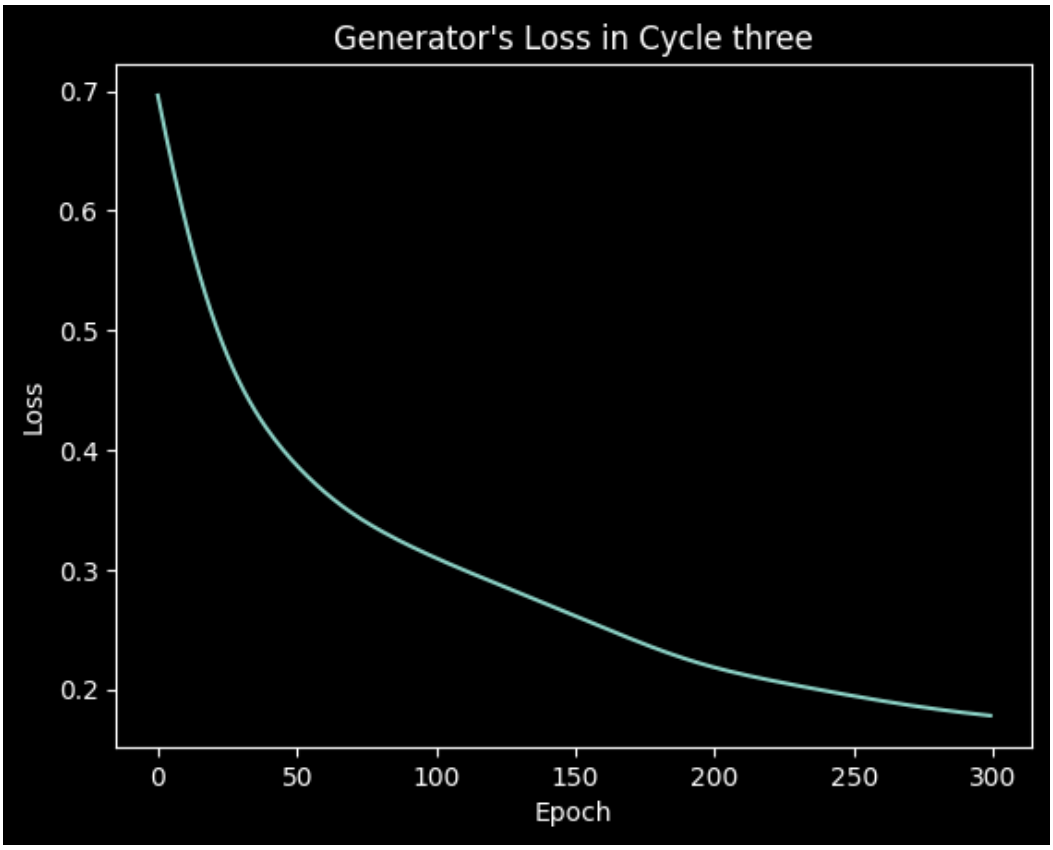
WARNING:matplotlib.font_manager:findfont: Font family 'Arial' not found.
WARNING:matplotlib.font_manager:findfont: Font family 'Arial' not found.
```



In [ ]:

```
gen_data_train = tfq.convert_to_tensor(generate_data(x_train, qgan_qubits) + generate_fa
ke_data(x_train, qgan_qubits, qgen_model.get_weights()[0], layer=gen_layer))
gen_data_test = tfq.convert_to_tensor(generate_data(x_test, qgan_qubits) + generate_fake_
data(x_test, qgan_qubits, qgen_model.get_weights()[0], layer=gen_layer))

y_gen_train = np.concatenate((y_train, y_true_fake), axis = 0)
y_gen_test = np.concatenate((y_test, y_true_fake), axis = 0)

print(y_gen_train.shape, y_gen_test.shape)
```

```
(200, 3) (200, 3)
```

In [ ]:

```
# Change the C_weight
C_weight = 0.70
```

In [ ]:

```
# Fit the Discriminator Model
H = train_qdisc(400, 64, 1)
```

```
Epoch 1/400
4/4 [==============================] - 8s 2s/step - loss: 0.4484 - custom_accuracy: 0.661
1 - val_loss: 0.4062 - val_custom_accuracy: 0.3442
Epoch 2/400
4/4 [==============================] - 6s 2s/step - loss: 0.4440 - custom_accuracy: 0.758
9 - val_loss: 0.4061 - val_custom_accuracy: 0.3442
Epoch 3/400
4/4 [==============================] - 10s 2s/step - loss: 0.4502 - custom_accuracy: 0.69
77 - val_loss: 0.4066 - val_custom_accuracy: 0.3442
Epoch 4/400
4/4 [==============================] - 6s 2s/step - loss: 0.4436 - custom_accuracy: 0.723
5 - val_loss: 0.4065 - val_custom_accuracy: 0.3442
```

```
Epoch 5/400
4/4 [==============================] - 8s 2s/step - loss: 0.4428 - custom_accuracy: 0.814
2 - val_loss: 0.4062 - val_custom_accuracy: 0.3442
Epoch 6/400
4/4 [==============================] - 8s 2s/step - loss: 0.4428 - custom_accuracy: 0.812
9 - val_loss: 0.4060 - val_custom_accuracy: 0.3442
Epoch 7/400
4/4 [==============================] - 6s 2s/step - loss: 0.4486 - custom_accuracy: 0.706
0 - val_loss: 0.4034 - val_custom_accuracy: 0.3442
Epoch 8/400
4/4 [==============================] - 10s 2s/step - loss: 0.4451 - custom_accuracy: 0.74
17 - val_loss: 0.4002 - val_custom_accuracy: 0.3442
Epoch 9/400
4/4 [==============================] - 6s 2s/step - loss: 0.4392 - custom_accuracy: 0.812
6 - val_loss: 0.3978 - val_custom_accuracy: 0.3442
Epoch 10/400
4/4 [==============================] - 8s 2s/step - loss: 0.4358 - custom_accuracy: 0.762
9 - val_loss: 0.3957 - val_custom_accuracy: 0.3442
Epoch 11/400
4/4 [==============================] - 8s 2s/step - loss: 0.4353 - custom_accuracy: 0.770
5 - val_loss: 0.3939 - val_custom_accuracy: 0.3442
Epoch 12/400
4/4 [==============================] - 6s 2s/step - loss: 0.4421 - custom_accuracy: 0.813
7 - val_loss: 0.3933 - val_custom_accuracy: 0.3442
Epoch 13/400
4/4 [==============================] - 10s 3s/step - loss: 0.4344 - custom_accuracy: 0.73
91 - val_loss: 0.3938 - val_custom_accuracy: 0.3442
Epoch 14/400
4/4 [==============================] - 6s 2s/step - loss: 0.4393 - custom_accuracy: 0.742
2 - val_loss: 0.3916 - val_custom_accuracy: 0.3442
Epoch 15/400
4/4 [==============================] - 8s 2s/step - loss: 0.4398 - custom_accuracy: 0.812
5 - val_loss: 0.3877 - val_custom_accuracy: 0.3442
Epoch 16/400
4/4 [==============================] - 8s 2s/step - loss: 0.4313 - custom_accuracy: 0.819
9 - val_loss: 0.3846 - val_custom_accuracy: 0.3442
Epoch 17/400
4/4 [==============================] - 6s 2s/step - loss: 0.4328 - custom_accuracy: 0.741
4 - val_loss: 0.3822 - val_custom_accuracy: 0.3442
Epoch 18/400
4/4 [==============================] - 10s 3s/step - loss: 0.4356 - custom_accuracy: 0.76
00 - val_loss: 0.3807 - val_custom_accuracy: 0.3511
Epoch 19/400
4/4 [==============================] - 6s 2s/step - loss: 0.4401 - custom_accuracy: 0.753
9 - val_loss: 0.3803 - val_custom_accuracy: 0.3511
Epoch 20/400
4/4 [==============================] - 8s 2s/step - loss: 0.4350 - custom_accuracy: 0.812
9 - val_loss: 0.3808 - val_custom_accuracy: 0.3442
Epoch 21/400
4/4 [==============================] - 8s 2s/step - loss: 0.4277 - custom_accuracy: 0.816
6 - val_loss: 0.3813 - val_custom_accuracy: 0.3442
Epoch 22/400
4/4 [==============================] - 6s 2s/step - loss: 0.4227 - custom_accuracy: 0.821
9 - val_loss: 0.3807 - val_custom_accuracy: 0.3442
Epoch 23/400
4/4 [==============================] - 10s 3s/step - loss: 0.4343 - custom_accuracy: 0.70
20 - val_loss: 0.3805 - val_custom_accuracy: 0.3442
Epoch 24/400
4/4 [==============================] - 6s 2s/step - loss: 0.4310 - custom_accuracy: 0.726
4 - val_loss: 0.3799 - val_custom_accuracy: 0.3511
Epoch 25/400
4/4 [==============================] - 8s 2s/step - loss: 0.4308 - custom_accuracy: 0.700
4 - val_loss: 0.3786 - val_custom_accuracy: 0.3511
Epoch 26/400
4/4 [==============================] - 8s 2s/step - loss: 0.4360 - custom_accuracy: 0.813
6 - val_loss: 0.3758 - val_custom_accuracy: 0.3511
Epoch 27/400
4/4 [==============================] - 6s 2s/step - loss: 0.4301 - custom_accuracy: 0.809
3 - val_loss: 0.3745 - val_custom_accuracy: 0.3511
Epoch 28/400
4/4 [==============================] - 10s 3s/step - loss: 0.4291 - custom_accuracy: 0.73
81 - val_loss: 0.3743 - val_custom_accuracy: 0.3511
```

```
Epoch 29/400
4/4 [==============================] - 6s 2s/step - loss: 0.4395 - custom_accuracy: 0.802
8 - val_loss: 0.3740 - val_custom_accuracy: 0.3511
Epoch 30/400
4/4 [==============================] - 8s 2s/step - loss: 0.4240 - custom_accuracy: 0.730
6 - val_loss: 0.3750 - val_custom_accuracy: 0.3511
Epoch 31/400
4/4 [==============================] - 8s 2s/step - loss: 0.4321 - custom_accuracy: 0.735
8 - val_loss: 0.3766 - val_custom_accuracy: 0.3511
Epoch 32/400
4/4 [==============================] - 6s 2s/step - loss: 0.4231 - custom_accuracy: 0.816
3 - val_loss: 0.3784 - val_custom_accuracy: 0.3511
Epoch 33/400
4/4 [==============================] - 10s 2s/step - loss: 0.4254 - custom_accuracy: 0.70
46 - val_loss: 0.3806 - val_custom_accuracy: 0.3442
Epoch 34/400
4/4 [==============================] - 6s 2s/step - loss: 0.4313 - custom_accuracy: 0.755
2 - val_loss: 0.3816 - val_custom_accuracy: 0.3442
Epoch 35/400
4/4 [==============================] - 8s 2s/step - loss: 0.4311 - custom_accuracy: 0.812
5 - val_loss: 0.3819 - val_custom_accuracy: 0.3442
Epoch 36/400
4/4 [==============================] - 8s 2s/step - loss: 0.4250 - custom_accuracy: 0.812
0 - val_loss: 0.3820 - val_custom_accuracy: 0.3442
Epoch 37/400
4/4 [==============================] - 6s 2s/step - loss: 0.4316 - custom_accuracy: 0.733
3 - val_loss: 0.3823 - val_custom_accuracy: 0.3442
Epoch 38/400
4/4 [==============================] - 10s 2s/step - loss: 0.4341 - custom_accuracy: 0.81
19 - val_loss: 0.3838 - val_custom_accuracy: 0.3442
Epoch 39/400
4/4 [==============================] - 6s 2s/step - loss: 0.4311 - custom_accuracy: 0.812
5 - val_loss: 0.3865 - val_custom_accuracy: 0.3442
Epoch 40/400
4/4 [==============================] - 8s 2s/step - loss: 0.4385 - custom_accuracy: 0.697
0 - val_loss: 0.3878 - val_custom_accuracy: 0.3442
Epoch 41/400
4/4 [==============================] - 8s 2s/step - loss: 0.4352 - custom_accuracy: 0.694
3 - val_loss: 0.3857 - val_custom_accuracy: 0.3442
Epoch 42/400
4/4 [==============================] - 6s 2s/step - loss: 0.4350 - custom_accuracy: 0.734
7 - val_loss: 0.3822 - val_custom_accuracy: 0.3442
Epoch 43/400
4/4 [==============================] - 10s 3s/step - loss: 0.4270 - custom_accuracy: 0.64
81 - val_loss: 0.3786 - val_custom_accuracy: 0.3511
Epoch 44/400
4/4 [==============================] - 6s 2s/step - loss: 0.4333 - custom_accuracy: 0.804
8 - val_loss: 0.3764 - val_custom_accuracy: 0.3511
Epoch 45/400
4/4 [==============================] - 8s 2s/step - loss: 0.4300 - custom_accuracy: 0.758
4 - val_loss: 0.3755 - val_custom_accuracy: 0.3511
Epoch 46/400
4/4 [==============================] - 8s 2s/step - loss: 0.4288 - custom_accuracy: 0.757
4 - val_loss: 0.3753 - val_custom_accuracy: 0.3511
Epoch 47/400
4/4 [==============================] - 6s 2s/step - loss: 0.4306 - custom_accuracy: 0.758
2 - val_loss: 0.3761 - val_custom_accuracy: 0.3511
Epoch 48/400
4/4 [==============================] - 10s 3s/step - loss: 0.4296 - custom_accuracy: 0.81
22 - val_loss: 0.3772 - val_custom_accuracy: 0.3511
Epoch 49/400
4/4 [==============================] - 6s 2s/step - loss: 0.4295 - custom_accuracy: 0.734
9 - val_loss: 0.3795 - val_custom_accuracy: 0.3442
Epoch 50/400
4/4 [==============================] - 8s 2s/step - loss: 0.4256 - custom_accuracy: 0.819
2 - val_loss: 0.3822 - val_custom_accuracy: 0.3442
Epoch 51/400
4/4 [==============================] - 8s 2s/step - loss: 0.4311 - custom_accuracy: 0.766
7 - val_loss: 0.3861 - val_custom_accuracy: 0.3442
Epoch 52/400
4/4 [==============================] - 6s 2s/step - loss: 0.4297 - custom_accuracy: 0.702
8 - val_loss: 0.3885 - val_custom_accuracy: 0.3442
```

```
Epoch 53/400
4/4 [==============================] - 10s 3s/step - loss: 0.4244 - custom_accuracy: 0.81
74 - val_loss: 0.3868 - val_custom_accuracy: 0.3442
Epoch 54/400
4/4 [==============================] - 6s 2s/step - loss: 0.4295 - custom_accuracy: 0.703
0 - val_loss: 0.3834 - val_custom_accuracy: 0.3442
Epoch 55/400
4/4 [==============================] - 8s 2s/step - loss: 0.4212 - custom_accuracy: 0.816
1 - val_loss: 0.3797 - val_custom_accuracy: 0.3442
Epoch 56/400
4/4 [==============================] - 8s 2s/step - loss: 0.4250 - custom_accuracy: 0.812
1 - val_loss: 0.3786 - val_custom_accuracy: 0.3442
Epoch 57/400
4/4 [==============================] - 6s 2s/step - loss: 0.4208 - custom_accuracy: 0.684
1 - val_loss: 0.3778 - val_custom_accuracy: 0.3442
Epoch 58/400
4/4 [==============================] - 10s 3s/step - loss: 0.4157 - custom_accuracy: 0.57
00 - val_loss: 0.3774 - val_custom_accuracy: 0.3442
Epoch 59/400
4/4 [==============================] - 6s 2s/step - loss: 0.4184 - custom_accuracy: 0.815
2 - val_loss: 0.3769 - val_custom_accuracy: 0.3442
Epoch 60/400
4/4 [==============================] - 8s 2s/step - loss: 0.4252 - custom_accuracy: 0.760
7 - val_loss: 0.3763 - val_custom_accuracy: 0.3442
Epoch 61/400
4/4 [==============================] - 8s 2s/step - loss: 0.4255 - custom_accuracy: 0.738
5 - val_loss: 0.3757 - val_custom_accuracy: 0.3511
Epoch 62/400
4/4 [==============================] - 6s 2s/step - loss: 0.4272 - custom_accuracy: 0.811
0 - val_loss: 0.3750 - val_custom_accuracy: 0.3511
Epoch 63/400
4/4 [==============================] - 10s 3s/step - loss: 0.4231 - custom_accuracy: 0.80
79 - val_loss: 0.3754 - val_custom_accuracy: 0.3442
Epoch 64/400
4/4 [==============================] - 6s 2s/step - loss: 0.4192 - custom_accuracy: 0.775
9 - val_loss: 0.3754 - val_custom_accuracy: 0.3442
Epoch 65/400
4/4 [==============================] - 8s 2s/step - loss: 0.4294 - custom_accuracy: 0.768
8 - val_loss: 0.3753 - val_custom_accuracy: 0.3442
Epoch 66/400
4/4 [==============================] - 8s 2s/step - loss: 0.4264 - custom_accuracy: 0.775
1 - val_loss: 0.3759 - val_custom_accuracy: 0.3442
Epoch 67/400
4/4 [==============================] - 6s 2s/step - loss: 0.4299 - custom_accuracy: 0.741
2 - val_loss: 0.3779 - val_custom_accuracy: 0.3442
Epoch 68/400
4/4 [==============================] - 10s 3s/step - loss: 0.4251 - custom_accuracy: 0.75
90 - val_loss: 0.3808 - val_custom_accuracy: 0.3442
Epoch 69/400
4/4 [==============================] - 6s 2s/step - loss: 0.4299 - custom_accuracy: 0.764
1 - val_loss: 0.3844 - val_custom_accuracy: 0.3442
Epoch 70/400
4/4 [==============================] - 8s 2s/step - loss: 0.4232 - custom_accuracy: 0.757
8 - val_loss: 0.3869 - val_custom_accuracy: 0.3442
Epoch 71/400
4/4 [==============================] - 8s 2s/step - loss: 0.4264 - custom_accuracy: 0.755
4 - val_loss: 0.3863 - val_custom_accuracy: 0.3442
Epoch 72/400
4/4 [==============================] - 6s 2s/step - loss: 0.4246 - custom_accuracy: 0.809
3 - val_loss: 0.3869 - val_custom_accuracy: 0.3442
Epoch 73/400
4/4 [==============================] - 10s 3s/step - loss: 0.4261 - custom_accuracy: 0.69
89 - val_loss: 0.3880 - val_custom_accuracy: 0.3442
Epoch 74/400
4/4 [==============================] - 6s 2s/step - loss: 0.4275 - custom_accuracy: 0.812
8 - val_loss: 0.3891 - val_custom_accuracy: 0.3442
Epoch 75/400
4/4 [==============================] - 7s 2s/step - loss: 0.4286 - custom_accuracy: 0.808
8 - val_loss: 0.3882 - val_custom_accuracy: 0.3442
Epoch 76/400
4/4 [==============================] - 8s 2s/step - loss: 0.4217 - custom_accuracy: 0.814
2 - val_loss: 0.3877 - val_custom_accuracy: 0.3442
```

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Epoch 77/400
4/4 [==============================] - 6s 2s/step - loss: 0.4093 - custom_accuracy: 0.827
6 - val_loss: 0.3888 - val_custom_accuracy: 0.3442
Epoch 78/400
4/4 [==============================] - 10s 3s/step - loss: 0.4224 - custom_accuracy: 0.70
41 - val_loss: 0.3889 - val_custom_accuracy: 0.3442
Epoch 79/400
4/4 [==============================] - 6s 2s/step - loss: 0.4192 - custom_accuracy: 0.762
5 - val_loss: 0.3876 - val_custom_accuracy: 0.3442
Epoch 80/400
4/4 [==============================] - 8s 2s/step - loss: 0.4168 - custom_accuracy: 0.739
1 - val_loss: 0.3866 - val_custom_accuracy: 0.3442
Epoch 81/400
4/4 [==============================] - 8s 2s/step - loss: 0.4218 - custom_accuracy: 0.768
4 - val_loss: 0.3839 - val_custom_accuracy: 0.3442
Epoch 82/400
4/4 [==============================] - 6s 2s/step - loss: 0.4161 - custom_accuracy: 0.711
3 - val_loss: 0.3802 - val_custom_accuracy: 0.3442
Epoch 83/400
4/4 [==============================] - 10s 3s/step - loss: 0.4224 - custom_accuracy: 0.81
10 - val_loss: 0.3774 - val_custom_accuracy: 0.3442
Epoch 84/400
4/4 [==============================] - 6s 2s/step - loss: 0.4189 - custom_accuracy: 0.763
8 - val_loss: 0.3764 - val_custom_accuracy: 0.3442
Epoch 85/400
4/4 [==============================] - 10s 3s/step - loss: 0.4250 - custom_accuracy: 0.77
11 - val_loss: 0.3757 - val_custom_accuracy: 0.3442
Epoch 86/400
4/4 [==============================] - 7s 2s/step - loss: 0.4230 - custom_accuracy: 0.740
1 - val_loss: 0.3741 - val_custom_accuracy: 0.3442
Epoch 87/400
4/4 [==============================] - 7s 2s/step - loss: 0.4219 - custom_accuracy: 0.812
5 - val_loss: 0.3738 - val_custom_accuracy: 0.3442
Epoch 88/400
4/4 [==============================] - 9s 2s/step - loss: 0.4256 - custom_accuracy: 0.695
1 - val_loss: 0.3742 - val_custom_accuracy: 0.3442
Epoch 89/400
4/4 [==============================] - 6s 2s/step - loss: 0.4245 - custom_accuracy: 0.810
3 - val_loss: 0.3736 - val_custom_accuracy: 0.3442
Epoch 90/400
4/4 [==============================] - 9s 2s/step - loss: 0.4203 - custom_accuracy: 0.818
1 - val_loss: 0.3730 - val_custom_accuracy: 0.3442
Epoch 91/400
4/4 [==============================] - 7s 2s/step - loss: 0.4205 - custom_accuracy: 0.811
6 - val_loss: 0.3741 - val_custom_accuracy: 0.3442
Epoch 92/400
4/4 [==============================] - 7s 2s/step - loss: 0.4188 - custom_accuracy: 0.700
5 - val_loss: 0.3753 - val_custom_accuracy: 0.3442
Epoch 93/400
4/4 [==============================] - 9s 2s/step - loss: 0.4227 - custom_accuracy: 0.811
2 - val_loss: 0.3741 - val_custom_accuracy: 0.3442
Epoch 94/400
4/4 [==============================] - 6s 2s/step - loss: 0.4210 - custom_accuracy: 0.741
7 - val_loss: 0.3734 - val_custom_accuracy: 0.3442
Epoch 95/400
4/4 [==============================] - 9s 3s/step - loss: 0.4177 - custom_accuracy: 0.759
8 - val_loss: 0.3724 - val_custom_accuracy: 0.3442
Epoch 96/400
4/4 [==============================] - 7s 2s/step - loss: 0.4270 - custom_accuracy: 0.808
4 - val_loss: 0.3708 - val_custom_accuracy: 0.3442
Epoch 97/400
4/4 [==============================] - 7s 2s/step - loss: 0.4238 - custom_accuracy: 0.663
4 - val_loss: 0.3698 - val_custom_accuracy: 0.3511
Epoch 98/400
4/4 [==============================] - 9s 2s/step - loss: 0.4172 - custom_accuracy: 0.735
4 - val_loss: 0.3688 - val_custom_accuracy: 0.3511
Epoch 99/400
4/4 [==============================] - 6s 2s/step - loss: 0.4194 - custom_accuracy: 0.770
4 - val_loss: 0.3680 - val_custom_accuracy: 0.3511
Epoch 100/400
4/4 [==============================] - 9s 3s/step - loss: 0.4172 - custom_accuracy: 0.815
2 - val_loss: 0.3674 - val_custom_accuracy: 0.3511
```

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Epoch 101/400
4/4 [==============================] - 7s 1s/step - loss: 0.4268 - custom_accuracy: 0.665
5 - val_loss: 0.3663 - val_custom_accuracy: 0.3511
Epoch 102/400
4/4 [==============================] - 7s 2s/step - loss: 0.4220 - custom_accuracy: 0.815
8 - val_loss: 0.3652 - val_custom_accuracy: 0.3511
Epoch 103/400
4/4 [==============================] - 9s 2s/step - loss: 0.4206 - custom_accuracy: 0.759
8 - val_loss: 0.3665 - val_custom_accuracy: 0.3511
Epoch 104/400
4/4 [==============================] - 6s 2s/step - loss: 0.4122 - custom_accuracy: 0.709
8 - val_loss: 0.3676 - val_custom_accuracy: 0.3511
Epoch 105/400
4/4 [==============================] - 9s 3s/step - loss: 0.4161 - custom_accuracy: 0.702
3 - val_loss: 0.3669 - val_custom_accuracy: 0.3511
Epoch 106/400
4/4 [==============================] - 7s 2s/step - loss: 0.4177 - custom_accuracy: 0.823
4 - val_loss: 0.3662 - val_custom_accuracy: 0.3511
Epoch 107/400
4/4 [==============================] - 7s 2s/step - loss: 0.4186 - custom_accuracy: 0.746
7 - val_loss: 0.3661 - val_custom_accuracy: 0.3511
Epoch 108/400
4/4 [==============================] - 9s 2s/step - loss: 0.4197 - custom_accuracy: 0.738
9 - val_loss: 0.3676 - val_custom_accuracy: 0.3511
Epoch 109/400
4/4 [==============================] - 6s 2s/step - loss: 0.4232 - custom_accuracy: 0.726
7 - val_loss: 0.3695 - val_custom_accuracy: 0.3511
Epoch 110/400
4/4 [==============================] - 9s 2s/step - loss: 0.4233 - custom_accuracy: 0.809
9 - val_loss: 0.3713 - val_custom_accuracy: 0.3442
Epoch 111/400
4/4 [==============================] - 7s 2s/step - loss: 0.4203 - custom_accuracy: 0.766
1 - val_loss: 0.3738 - val_custom_accuracy: 0.3442
Epoch 112/400
4/4 [==============================] - 7s 2s/step - loss: 0.4166 - custom_accuracy: 0.815
0 - val_loss: 0.3772 - val_custom_accuracy: 0.3442
Epoch 113/400
4/4 [==============================] - 9s 2s/step - loss: 0.4205 - custom_accuracy: 0.767
5 - val_loss: 0.3788 - val_custom_accuracy: 0.3442
Epoch 114/400
4/4 [==============================] - 6s 2s/step - loss: 0.4164 - custom_accuracy: 0.759
1 - val_loss: 0.3789 - val_custom_accuracy: 0.3442
Epoch 115/400
4/4 [==============================] - 9s 3s/step - loss: 0.4132 - custom_accuracy: 0.766
6 - val_loss: 0.3788 - val_custom_accuracy: 0.3442
Epoch 116/400
4/4 [==============================] - 7s 2s/step - loss: 0.4252 - custom_accuracy: 0.755
2 - val_loss: 0.3786 - val_custom_accuracy: 0.3442
Epoch 117/400
4/4 [==============================] - 7s 2s/step - loss: 0.4144 - custom_accuracy: 0.733
7 - val_loss: 0.3776 - val_custom_accuracy: 0.3442
Epoch 118/400
4/4 [==============================] - 9s 2s/step - loss: 0.4202 - custom_accuracy: 0.738
8 - val_loss: 0.3748 - val_custom_accuracy: 0.3442
Epoch 119/400
4/4 [==============================] - 6s 2s/step - loss: 0.4239 - custom_accuracy: 0.758
4 - val_loss: 0.3728 - val_custom_accuracy: 0.3442
Epoch 120/400
4/4 [==============================] - 9s 2s/step - loss: 0.4169 - custom_accuracy: 0.811
9 - val_loss: 0.3730 - val_custom_accuracy: 0.3442
Epoch 121/400
4/4 [==============================] - 7s 2s/step - loss: 0.4241 - custom_accuracy: 0.722
9 - val_loss: 0.3738 - val_custom_accuracy: 0.3442
Epoch 122/400
4/4 [==============================] - 7s 2s/step - loss: 0.4190 - custom_accuracy: 0.816
5 - val_loss: 0.3745 - val_custom_accuracy: 0.3442
Epoch 123/400
4/4 [==============================] - 9s 2s/step - loss: 0.4174 - custom_accuracy: 0.757
9 - val_loss: 0.3752 - val_custom_accuracy: 0.3442
Epoch 124/400
4/4 [==============================] - 6s 2s/step - loss: 0.4182 - custom_accuracy: 0.684
2 - val_loss: 0.3748 - val_custom_accuracy: 0.3442
```

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Epoch 125/400
4/4 [==============================] - 9s 3s/step - loss: 0.4117 - custom_accuracy: 0.748
0 - val_loss: 0.3741 - val_custom_accuracy: 0.3442
Epoch 126/400
4/4 [==============================] - 7s 2s/step - loss: 0.4219 - custom_accuracy: 0.769
2 - val_loss: 0.3739 - val_custom_accuracy: 0.3442
Epoch 127/400
4/4 [==============================] - 7s 2s/step - loss: 0.4202 - custom_accuracy: 0.758
4 - val_loss: 0.3743 - val_custom_accuracy: 0.3442
Epoch 128/400
4/4 [==============================] - 9s 2s/step - loss: 0.4206 - custom_accuracy: 0.814
4 - val_loss: 0.3740 - val_custom_accuracy: 0.3442
Epoch 129/400
4/4 [==============================] - 6s 2s/step - loss: 0.4141 - custom_accuracy: 0.758
9 - val_loss: 0.3741 - val_custom_accuracy: 0.3442
Epoch 130/400
4/4 [==============================] - 9s 2s/step - loss: 0.4240 - custom_accuracy: 0.760
9 - val_loss: 0.3758 - val_custom_accuracy: 0.3442
Epoch 131/400
4/4 [==============================] - 7s 2s/step - loss: 0.4182 - custom_accuracy: 0.757
1 - val_loss: 0.3763 - val_custom_accuracy: 0.3442
Epoch 132/400
4/4 [==============================] - 7s 2s/step - loss: 0.4236 - custom_accuracy: 0.700
0 - val_loss: 0.3767 - val_custom_accuracy: 0.3442
Epoch 133/400
4/4 [==============================] - 9s 2s/step - loss: 0.4223 - custom_accuracy: 0.772
4 - val_loss: 0.3788 - val_custom_accuracy: 0.3442
Epoch 134/400
4/4 [==============================] - 6s 2s/step - loss: 0.4147 - custom_accuracy: 0.742
8 - val_loss: 0.3801 - val_custom_accuracy: 0.3442
Epoch 135/400
4/4 [==============================] - 9s 3s/step - loss: 0.4236 - custom_accuracy: 0.731
8 - val_loss: 0.3781 - val_custom_accuracy: 0.3442
Epoch 136/400
4/4 [==============================] - 7s 2s/step - loss: 0.4161 - custom_accuracy: 0.758
7 - val_loss: 0.3743 - val_custom_accuracy: 0.3442
Epoch 137/400
4/4 [==============================] - 7s 2s/step - loss: 0.4233 - custom_accuracy: 0.697
4 - val_loss: 0.3734 - val_custom_accuracy: 0.3442
Epoch 138/400
4/4 [==============================] - 9s 2s/step - loss: 0.4164 - custom_accuracy: 0.770
3 - val_loss: 0.3729 - val_custom_accuracy: 0.3442
Epoch 139/400
4/4 [==============================] - 6s 2s/step - loss: 0.4179 - custom_accuracy: 0.727
1 - val_loss: 0.3718 - val_custom_accuracy: 0.3442
Epoch 140/400
4/4 [==============================] - 9s 3s/step - loss: 0.4163 - custom_accuracy: 0.685
5 - val_loss: 0.3715 - val_custom_accuracy: 0.3442
Epoch 141/400
4/4 [==============================] - 7s 2s/step - loss: 0.4165 - custom_accuracy: 0.703
7 - val_loss: 0.3716 - val_custom_accuracy: 0.3442
Epoch 142/400
4/4 [==============================] - 7s 2s/step - loss: 0.4192 - custom_accuracy: 0.815
3 - val_loss: 0.3728 - val_custom_accuracy: 0.3442
Epoch 143/400
4/4 [==============================] - 9s 2s/step - loss: 0.4193 - custom_accuracy: 0.590
9 - val_loss: 0.3737 - val_custom_accuracy: 0.3442
Epoch 144/400
4/4 [==============================] - 6s 2s/step - loss: 0.4126 - custom_accuracy: 0.822
4 - val_loss: 0.3710 - val_custom_accuracy: 0.3442
Epoch 145/400
4/4 [==============================] - 9s 3s/step - loss: 0.4195 - custom_accuracy: 0.755
3 - val_loss: 0.3688 - val_custom_accuracy: 0.3511
Epoch 146/400
4/4 [==============================] - 6s 2s/step - loss: 0.4194 - custom_accuracy: 0.756
6 - val_loss: 0.3677 - val_custom_accuracy: 0.3511
Epoch 147/400
4/4 [==============================] - 8s 2s/step - loss: 0.4249 - custom_accuracy: 0.582
5 - val_loss: 0.3664 - val_custom_accuracy: 0.3511
Epoch 148/400
4/4 [==============================] - 8s 2s/step - loss: 0.4114 - custom_accuracy: 0.763
1 - val_loss: 0.3651 - val_custom_accuracy: 0.3511
```

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Epoch 149/400
4/4 [==============================] - 6s 2s/step - loss: 0.4177 - custom_accuracy: 0.767
0 - val_loss: 0.3640 - val_custom_accuracy: 0.3511
Epoch 150/400
4/4 [==============================] - 10s 3s/step - loss: 0.4154 - custom_accuracy: 0.70
01 - val_loss: 0.3630 - val_custom_accuracy: 0.3472
Epoch 151/400
4/4 [==============================] - 6s 2s/step - loss: 0.4201 - custom_accuracy: 0.738
0 - val_loss: 0.3622 - val_custom_accuracy: 0.3472
Epoch 152/400
4/4 [==============================] - 8s 2s/step - loss: 0.4249 - custom_accuracy: 0.811
1 - val_loss: 0.3612 - val_custom_accuracy: 0.3472
Epoch 153/400
4/4 [==============================] - 8s 2s/step - loss: 0.4193 - custom_accuracy: 0.814
9 - val_loss: 0.3605 - val_custom_accuracy: 0.3472
Epoch 154/400
4/4 [==============================] - 6s 2s/step - loss: 0.4198 - custom_accuracy: 0.811
4 - val_loss: 0.3601 - val_custom_accuracy: 0.3511
Epoch 155/400
4/4 [==============================] - 10s 2s/step - loss: 0.4265 - custom_accuracy: 0.81
14 - val_loss: 0.3611 - val_custom_accuracy: 0.3511
Epoch 156/400
4/4 [==============================] - 6s 2s/step - loss: 0.4206 - custom_accuracy: 0.726
9 - val_loss: 0.3639 - val_custom_accuracy: 0.3511
Epoch 157/400
4/4 [==============================] - 8s 2s/step - loss: 0.4224 - custom_accuracy: 0.808
7 - val_loss: 0.3658 - val_custom_accuracy: 0.3511
Epoch 158/400
4/4 [==============================] - 8s 2s/step - loss: 0.4174 - custom_accuracy: 0.813
4 - val_loss: 0.3674 - val_custom_accuracy: 0.3442
Epoch 159/400
4/4 [==============================] - 6s 2s/step - loss: 0.4218 - custom_accuracy: 0.696
4 - val_loss: 0.3700 - val_custom_accuracy: 0.3442
Epoch 160/400
4/4 [==============================] - 10s 2s/step - loss: 0.4165 - custom_accuracy: 0.68
41 - val_loss: 0.3728 - val_custom_accuracy: 0.3442
Epoch 161/400
4/4 [==============================] - 6s 2s/step - loss: 0.4235 - custom_accuracy: 0.811
0 - val_loss: 0.3736 - val_custom_accuracy: 0.3442
Epoch 162/400
4/4 [==============================] - 8s 2s/step - loss: 0.4155 - custom_accuracy: 0.725
0 - val_loss: 0.3736 - val_custom_accuracy: 0.3442
Epoch 163/400
4/4 [==============================] - 7s 2s/step - loss: 0.4167 - custom_accuracy: 0.745
0 - val_loss: 0.3731 - val_custom_accuracy: 0.3442
Epoch 164/400
4/4 [==============================] - 6s 2s/step - loss: 0.4164 - custom_accuracy: 0.816
2 - val_loss: 0.3730 - val_custom_accuracy: 0.3442
Epoch 165/400
4/4 [==============================] - 10s 2s/step - loss: 0.4232 - custom_accuracy: 0.73
67 - val_loss: 0.3720 - val_custom_accuracy: 0.3442
Epoch 166/400
4/4 [==============================] - 6s 2s/step - loss: 0.4189 - custom_accuracy: 0.738
4 - val_loss: 0.3698 - val_custom_accuracy: 0.3442
Epoch 167/400
4/4 [==============================] - 8s 2s/step - loss: 0.4199 - custom_accuracy: 0.647
6 - val_loss: 0.3673 - val_custom_accuracy: 0.3442
Epoch 168/400
4/4 [==============================] - 8s 2s/step - loss: 0.4165 - custom_accuracy: 0.741
7 - val_loss: 0.3637 - val_custom_accuracy: 0.3511
Epoch 169/400
4/4 [==============================] - 6s 2s/step - loss: 0.4228 - custom_accuracy: 0.735
3 - val_loss: 0.3614 - val_custom_accuracy: 0.3511
Epoch 170/400
4/4 [==============================] - 10s 2s/step - loss: 0.4219 - custom_accuracy: 0.80
92 - val_loss: 0.3604 - val_custom_accuracy: 0.3511
Epoch 171/400
4/4 [==============================] - 6s 1s/step - loss: 0.4225 - custom_accuracy: 0.739
3 - val_loss: 0.3599 - val_custom_accuracy: 0.3511
Epoch 172/400
4/4 [==============================] - 8s 2s/step - loss: 0.4215 - custom_accuracy: 0.772
1 - val_loss: 0.3594 - val_custom_accuracy: 0.3511
```

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Epoch 173/400
4/4 [==============================] - 8s 2s/step - loss: 0.4168 - custom_accuracy: 0.813
8 - val_loss: 0.3590 - val_custom_accuracy: 0.3511
Epoch 174/400
4/4 [==============================] - 6s 2s/step - loss: 0.4200 - custom_accuracy: 0.755
9 - val_loss: 0.3589 - val_custom_accuracy: 0.3511
Epoch 175/400
4/4 [==============================] - 10s 2s/step - loss: 0.4175 - custom_accuracy: 0.76
17 - val_loss: 0.3589 - val_custom_accuracy: 0.3511
Epoch 176/400
4/4 [==============================] - 6s 2s/step - loss: 0.4190 - custom_accuracy: 0.814
7 - val_loss: 0.3601 - val_custom_accuracy: 0.3511
Epoch 177/400
4/4 [==============================] - 8s 2s/step - loss: 0.4114 - custom_accuracy: 0.706
0 - val_loss: 0.3623 - val_custom_accuracy: 0.3511
Epoch 178/400
4/4 [==============================] - 8s 2s/step - loss: 0.4227 - custom_accuracy: 0.665
6 - val_loss: 0.3652 - val_custom_accuracy: 0.3442
Epoch 179/400
4/4 [==============================] - 7s 2s/step - loss: 0.4149 - custom_accuracy: 0.769
5 - val_loss: 0.3685 - val_custom_accuracy: 0.3442
Epoch 180/400
4/4 [==============================] - 9s 2s/step - loss: 0.4158 - custom_accuracy: 0.813
4 - val_loss: 0.3692 - val_custom_accuracy: 0.3442
Epoch 181/400
4/4 [==============================] - 6s 2s/step - loss: 0.4184 - custom_accuracy: 0.810
7 - val_loss: 0.3701 - val_custom_accuracy: 0.3442
Epoch 182/400
4/4 [==============================] - 9s 3s/step - loss: 0.4167 - custom_accuracy: 0.758
9 - val_loss: 0.3706 - val_custom_accuracy: 0.3442
Epoch 183/400
4/4 [==============================] - 7s 2s/step - loss: 0.4188 - custom_accuracy: 0.767
8 - val_loss: 0.3693 - val_custom_accuracy: 0.3442
Epoch 184/400
4/4 [==============================] - 7s 2s/step - loss: 0.4097 - custom_accuracy: 0.761
1 - val_loss: 0.3686 - val_custom_accuracy: 0.3442
Epoch 185/400
4/4 [==============================] - 9s 2s/step - loss: 0.4113 - custom_accuracy: 0.743
1 - val_loss: 0.3680 - val_custom_accuracy: 0.3442
Epoch 186/400
4/4 [==============================] - 6s 2s/step - loss: 0.4183 - custom_accuracy: 0.700
4 - val_loss: 0.3677 - val_custom_accuracy: 0.3442
Epoch 187/400
4/4 [==============================] - 10s 3s/step - loss: 0.4169 - custom_accuracy: 0.81
25 - val_loss: 0.3683 - val_custom_accuracy: 0.3442
Epoch 188/400
4/4 [==============================] - 6s 2s/step - loss: 0.4127 - custom_accuracy: 0.738
8 - val_loss: 0.3681 - val_custom_accuracy: 0.3442
Epoch 189/400
4/4 [==============================] - 8s 2s/step - loss: 0.4166 - custom_accuracy: 0.759
1 - val_loss: 0.3679 - val_custom_accuracy: 0.3442
Epoch 190/400
4/4 [==============================] - 8s 2s/step - loss: 0.4232 - custom_accuracy: 0.695
4 - val_loss: 0.3684 - val_custom_accuracy: 0.3442
Epoch 191/400
4/4 [==============================] - 6s 2s/step - loss: 0.4138 - custom_accuracy: 0.775
0 - val_loss: 0.3695 - val_custom_accuracy: 0.3442
Epoch 192/400
4/4 [==============================] - 10s 3s/step - loss: 0.4182 - custom_accuracy: 0.80
94 - val_loss: 0.3707 - val_custom_accuracy: 0.3442
Epoch 193/400
4/4 [==============================] - 6s 2s/step - loss: 0.4171 - custom_accuracy: 0.698
1 - val_loss: 0.3708 - val_custom_accuracy: 0.3442
Epoch 194/400
4/4 [==============================] - 8s 2s/step - loss: 0.4111 - custom_accuracy: 0.731
9 - val_loss: 0.3711 - val_custom_accuracy: 0.3442
Epoch 195/400
4/4 [==============================] - 8s 2s/step - loss: 0.4095 - custom_accuracy: 0.818
2 - val_loss: 0.3712 - val_custom_accuracy: 0.3442
Epoch 196/400
4/4 [==============================] - 6s 2s/step - loss: 0.4148 - custom_accuracy: 0.813
0 - val_loss: 0.3726 - val_custom_accuracy: 0.3442
```

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Epoch 197/400
4/4 [==============================] - 10s 2s/step - loss: 0.4214 - custom_accuracy: 0.75
56 - val_loss: 0.3733 - val_custom_accuracy: 0.3442
Epoch 198/400
4/4 [==============================] - 6s 1s/step - loss: 0.4229 - custom_accuracy: 0.801
7 - val_loss: 0.3724 - val_custom_accuracy: 0.3442
Epoch 199/400
4/4 [==============================] - 8s 2s/step - loss: 0.4131 - custom_accuracy: 0.668
0 - val_loss: 0.3724 - val_custom_accuracy: 0.3442
Epoch 200/400
4/4 [==============================] - 8s 2s/step - loss: 0.4149 - custom_accuracy: 0.710
5 - val_loss: 0.3721 - val_custom_accuracy: 0.3442
Epoch 201/400
4/4 [==============================] - 6s 2s/step - loss: 0.4105 - custom_accuracy: 0.818
2 - val_loss: 0.3717 - val_custom_accuracy: 0.3442
Epoch 202/400
4/4 [==============================] - 10s 2s/step - loss: 0.4175 - custom_accuracy: 0.77
08 - val_loss: 0.3712 - val_custom_accuracy: 0.3442
Epoch 203/400
4/4 [==============================] - 6s 2s/step - loss: 0.4143 - custom_accuracy: 0.809
2 - val_loss: 0.3708 - val_custom_accuracy: 0.3442
Epoch 204/400
4/4 [==============================] - 8s 2s/step - loss: 0.4100 - custom_accuracy: 0.694
6 - val_loss: 0.3705 - val_custom_accuracy: 0.3442
Epoch 205/400
4/4 [==============================] - 8s 2s/step - loss: 0.4107 - custom_accuracy: 0.708
1 - val_loss: 0.3692 - val_custom_accuracy: 0.3442
Epoch 206/400
4/4 [==============================] - 6s 2s/step - loss: 0.4138 - custom_accuracy: 0.812
1 - val_loss: 0.3675 - val_custom_accuracy: 0.3442
Epoch 207/400
4/4 [==============================] - 10s 2s/step - loss: 0.4149 - custom_accuracy: 0.70
92 - val_loss: 0.3667 - val_custom_accuracy: 0.3442
Epoch 208/400
4/4 [==============================] - 6s 2s/step - loss: 0.4151 - custom_accuracy: 0.810
5 - val_loss: 0.3648 - val_custom_accuracy: 0.3442
Epoch 209/400
4/4 [==============================] - 8s 2s/step - loss: 0.4118 - custom_accuracy: 0.697
9 - val_loss: 0.3633 - val_custom_accuracy: 0.3442
Epoch 210/400
4/4 [==============================] - 8s 2s/step - loss: 0.4123 - custom_accuracy: 0.818
0 - val_loss: 0.3615 - val_custom_accuracy: 0.3442
Epoch 211/400
4/4 [==============================] - 6s 2s/step - loss: 0.4128 - custom_accuracy: 0.814
9 - val_loss: 0.3611 - val_custom_accuracy: 0.3442
Epoch 212/400
4/4 [==============================] - 10s 2s/step - loss: 0.4125 - custom_accuracy: 0.77
43 - val_loss: 0.3611 - val_custom_accuracy: 0.3442
Epoch 213/400
4/4 [==============================] - 6s 2s/step - loss: 0.4196 - custom_accuracy: 0.817
5 - val_loss: 0.3608 - val_custom_accuracy: 0.3442
Epoch 214/400
4/4 [==============================] - 8s 2s/step - loss: 0.4207 - custom_accuracy: 0.703
3 - val_loss: 0.3603 - val_custom_accuracy: 0.3442
Epoch 215/400
4/4 [==============================] - 7s 2s/step - loss: 0.4216 - custom_accuracy: 0.699
2 - val_loss: 0.3596 - val_custom_accuracy: 0.3511
Epoch 216/400
4/4 [==============================] - 6s 2s/step - loss: 0.4148 - custom_accuracy: 0.813
9 - val_loss: 0.3583 - val_custom_accuracy: 0.3511
Epoch 217/400
4/4 [==============================] - 10s 2s/step - loss: 0.4159 - custom_accuracy: 0.71
91 - val_loss: 0.3578 - val_custom_accuracy: 0.3511
Epoch 218/400
4/4 [==============================] - 6s 2s/step - loss: 0.4234 - custom_accuracy: 0.682
1 - val_loss: 0.3571 - val_custom_accuracy: 0.3472
Epoch 219/400
4/4 [==============================] - 8s 2s/step - loss: 0.4232 - custom_accuracy: 0.771
4 - val_loss: 0.3575 - val_custom_accuracy: 0.3511
Epoch 220/400
4/4 [==============================] - 7s 2s/step - loss: 0.4176 - custom_accuracy: 0.813
0 - val_loss: 0.3583 - val_custom_accuracy: 0.3511
```

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Epoch 221/400
4/4 [==============================] - 6s 2s/step - loss: 0.4145 - custom_accuracy: 0.815
2 - val_loss: 0.3599 - val_custom_accuracy: 0.3442
Epoch 222/400
4/4 [==============================] - 10s 2s/step - loss: 0.4240 - custom_accuracy: 0.69
78 - val_loss: 0.3619 - val_custom_accuracy: 0.3442
Epoch 223/400
4/4 [==============================] - 6s 2s/step - loss: 0.4139 - custom_accuracy: 0.811
8 - val_loss: 0.3657 - val_custom_accuracy: 0.3442
Epoch 224/400
4/4 [==============================] - 9s 2s/step - loss: 0.4144 - custom_accuracy: 0.816
2 - val_loss: 0.3700 - val_custom_accuracy: 0.3442
Epoch 225/400
4/4 [==============================] - 7s 2s/step - loss: 0.4135 - custom_accuracy: 0.814
2 - val_loss: 0.3740 - val_custom_accuracy: 0.3442
Epoch 226/400
4/4 [==============================] - 6s 2s/step - loss: 0.4144 - custom_accuracy: 0.725
2 - val_loss: 0.3765 - val_custom_accuracy: 0.3442
Epoch 227/400
4/4 [==============================] - 10s 2s/step - loss: 0.4118 - custom_accuracy: 0.75
46 - val_loss: 0.3762 - val_custom_accuracy: 0.3442
Epoch 228/400
4/4 [==============================] - 6s 2s/step - loss: 0.4249 - custom_accuracy: 0.763
1 - val_loss: 0.3764 - val_custom_accuracy: 0.3442
Epoch 229/400
4/4 [==============================] - 9s 2s/step - loss: 0.4116 - custom_accuracy: 0.819
4 - val_loss: 0.3761 - val_custom_accuracy: 0.3442
Epoch 230/400
4/4 [==============================] - 7s 2s/step - loss: 0.4145 - custom_accuracy: 0.703
7 - val_loss: 0.3768 - val_custom_accuracy: 0.3442
Epoch 231/400
4/4 [==============================] - 7s 2s/step - loss: 0.4078 - custom_accuracy: 0.814
7 - val_loss: 0.3771 - val_custom_accuracy: 0.3442
Epoch 232/400
4/4 [==============================] - 9s 2s/step - loss: 0.4093 - custom_accuracy: 0.819
1 - val_loss: 0.3782 - val_custom_accuracy: 0.3442
Epoch 233/400
4/4 [==============================] - 6s 2s/step - loss: 0.4129 - custom_accuracy: 0.724
4 - val_loss: 0.3790 - val_custom_accuracy: 0.3442
Epoch 234/400
4/4 [==============================] - 9s 3s/step - loss: 0.4220 - custom_accuracy: 0.749
5 - val_loss: 0.3790 - val_custom_accuracy: 0.3442
Epoch 235/400
4/4 [==============================] - 7s 2s/step - loss: 0.4105 - custom_accuracy: 0.742
5 - val_loss: 0.3780 - val_custom_accuracy: 0.3442
Epoch 236/400
4/4 [==============================] - 7s 2s/step - loss: 0.4118 - custom_accuracy: 0.709
0 - val_loss: 0.3744 - val_custom_accuracy: 0.3442
Epoch 237/400
4/4 [==============================] - 9s 2s/step - loss: 0.4192 - custom_accuracy: 0.808
1 - val_loss: 0.3705 - val_custom_accuracy: 0.3442
Epoch 238/400
4/4 [==============================] - 6s 2s/step - loss: 0.4135 - custom_accuracy: 0.738
3 - val_loss: 0.3679 - val_custom_accuracy: 0.3442
Epoch 239/400
4/4 [==============================] - 9s 3s/step - loss: 0.4113 - custom_accuracy: 0.812
9 - val_loss: 0.3659 - val_custom_accuracy: 0.3442
Epoch 240/400
4/4 [==============================] - 7s 2s/step - loss: 0.4170 - custom_accuracy: 0.754
1 - val_loss: 0.3648 - val_custom_accuracy: 0.3442
Epoch 241/400
4/4 [==============================] - 7s 2s/step - loss: 0.4127 - custom_accuracy: 0.742
2 - val_loss: 0.3635 - val_custom_accuracy: 0.3442
Epoch 242/400
4/4 [==============================] - 9s 2s/step - loss: 0.4220 - custom_accuracy: 0.653
5 - val_loss: 0.3621 - val_custom_accuracy: 0.3442
Epoch 243/400
4/4 [==============================] - 6s 2s/step - loss: 0.4229 - custom_accuracy: 0.728
3 - val_loss: 0.3619 - val_custom_accuracy: 0.3442
Epoch 244/400
4/4 [==============================] - 9s 3s/step - loss: 0.4171 - custom_accuracy: 0.775
8 - val_loss: 0.3625 - val_custom_accuracy: 0.3442
```

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Epoch 245/400
4/4 [==============================] - 7s 2s/step - loss: 0.4171 - custom_accuracy: 0.778
9 - val_loss: 0.3630 - val_custom_accuracy: 0.3442
Epoch 246/400
4/4 [==============================] - 7s 2s/step - loss: 0.4123 - custom_accuracy: 0.765
7 - val_loss: 0.3640 - val_custom_accuracy: 0.3442
Epoch 247/400
4/4 [==============================] - 9s 2s/step - loss: 0.4111 - custom_accuracy: 0.724
9 - val_loss: 0.3640 - val_custom_accuracy: 0.3442
Epoch 248/400
4/4 [==============================] - 6s 2s/step - loss: 0.4146 - custom_accuracy: 0.770
7 - val_loss: 0.3626 - val_custom_accuracy: 0.3442
Epoch 249/400
4/4 [==============================] - 10s 3s/step - loss: 0.4139 - custom_accuracy: 0.81
05 - val_loss: 0.3613 - val_custom_accuracy: 0.3442
Epoch 250/400
4/4 [==============================] - 6s 2s/step - loss: 0.4145 - custom_accuracy: 0.812
0 - val_loss: 0.3610 - val_custom_accuracy: 0.3442
Epoch 251/400
4/4 [==============================] - 7s 2s/step - loss: 0.4200 - custom_accuracy: 0.814
7 - val_loss: 0.3616 - val_custom_accuracy: 0.3442
Epoch 252/400
4/4 [==============================] - 8s 2s/step - loss: 0.4123 - custom_accuracy: 0.815
6 - val_loss: 0.3642 - val_custom_accuracy: 0.3442
Epoch 253/400
4/4 [==============================] - 6s 2s/step - loss: 0.4128 - custom_accuracy: 0.811
9 - val_loss: 0.3672 - val_custom_accuracy: 0.3442
Epoch 254/400
4/4 [==============================] - 9s 3s/step - loss: 0.4134 - custom_accuracy: 0.738
7 - val_loss: 0.3706 - val_custom_accuracy: 0.3442
Epoch 255/400
4/4 [==============================] - 6s 2s/step - loss: 0.4193 - custom_accuracy: 0.704
5 - val_loss: 0.3758 - val_custom_accuracy: 0.3442
Epoch 256/400
4/4 [==============================] - 7s 2s/step - loss: 0.4137 - custom_accuracy: 0.757
7 - val_loss: 0.3802 - val_custom_accuracy: 0.3442
Epoch 257/400
4/4 [==============================] - 9s 2s/step - loss: 0.4086 - custom_accuracy: 0.817
0 - val_loss: 0.3808 - val_custom_accuracy: 0.3442
Epoch 258/400
4/4 [==============================] - 6s 2s/step - loss: 0.4121 - custom_accuracy: 0.725
1 - val_loss: 0.3819 - val_custom_accuracy: 0.3442
Epoch 259/400
4/4 [==============================] - 10s 3s/step - loss: 0.4215 - custom_accuracy: 0.73
58 - val_loss: 0.3837 - val_custom_accuracy: 0.3442
Epoch 260/400
4/4 [==============================] - 6s 2s/step - loss: 0.4180 - custom_accuracy: 0.587
6 - val_loss: 0.3832 - val_custom_accuracy: 0.3442
Epoch 261/400
4/4 [==============================] - 8s 2s/step - loss: 0.4126 - custom_accuracy: 0.810
6 - val_loss: 0.3824 - val_custom_accuracy: 0.3442
Epoch 262/400
4/4 [==============================] - 8s 2s/step - loss: 0.4190 - custom_accuracy: 0.810
4 - val_loss: 0.3811 - val_custom_accuracy: 0.3442
Epoch 263/400
4/4 [==============================] - 6s 2s/step - loss: 0.4060 - custom_accuracy: 0.777
5 - val_loss: 0.3797 - val_custom_accuracy: 0.3442
Epoch 264/400
4/4 [==============================] - 10s 3s/step - loss: 0.4203 - custom_accuracy: 0.75
49 - val_loss: 0.3781 - val_custom_accuracy: 0.3442
Epoch 265/400
4/4 [==============================] - 6s 2s/step - loss: 0.4221 - custom_accuracy: 0.809
7 - val_loss: 0.3761 - val_custom_accuracy: 0.3442
Epoch 266/400
4/4 [==============================] - 7s 2s/step - loss: 0.4099 - custom_accuracy: 0.737
9 - val_loss: 0.3750 - val_custom_accuracy: 0.3442
Epoch 267/400
4/4 [==============================] - 9s 2s/step - loss: 0.4133 - custom_accuracy: 0.768
2 - val_loss: 0.3742 - val_custom_accuracy: 0.3442
Epoch 268/400
4/4 [==============================] - 6s 2s/step - loss: 0.4117 - custom_accuracy: 0.757
7 - val_loss: 0.3738 - val_custom_accuracy: 0.3442
```

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Epoch 269/400
4/4 [==============================] - 10s 3s/step - loss: 0.4129 - custom_accuracy: 0.73
49 - val_loss: 0.3712 - val_custom_accuracy: 0.3442
Epoch 270/400
4/4 [==============================] - 6s 2s/step - loss: 0.4110 - custom_accuracy: 0.674
5 - val_loss: 0.3689 - val_custom_accuracy: 0.3442
Epoch 271/400
4/4 [==============================] - 8s 2s/step - loss: 0.4153 - custom_accuracy: 0.757
6 - val_loss: 0.3686 - val_custom_accuracy: 0.3442
Epoch 272/400
4/4 [==============================] - 8s 2s/step - loss: 0.4094 - custom_accuracy: 0.701
0 - val_loss: 0.3702 - val_custom_accuracy: 0.3442
Epoch 273/400
4/4 [==============================] - 6s 2s/step - loss: 0.4113 - custom_accuracy: 0.814
3 - val_loss: 0.3717 - val_custom_accuracy: 0.3442
Epoch 274/400
4/4 [==============================] - 10s 3s/step - loss: 0.4142 - custom_accuracy: 0.76
84 - val_loss: 0.3729 - val_custom_accuracy: 0.3442
Epoch 275/400
4/4 [==============================] - 6s 2s/step - loss: 0.4147 - custom_accuracy: 0.740
4 - val_loss: 0.3735 - val_custom_accuracy: 0.3442
Epoch 276/400
4/4 [==============================] - 8s 2s/step - loss: 0.4109 - custom_accuracy: 0.735
9 - val_loss: 0.3755 - val_custom_accuracy: 0.3442
Epoch 277/400
4/4 [==============================] - 8s 2s/step - loss: 0.4083 - custom_accuracy: 0.811
4 - val_loss: 0.3777 - val_custom_accuracy: 0.3442
Epoch 278/400
4/4 [==============================] - 6s 1s/step - loss: 0.4159 - custom_accuracy: 0.745
3 - val_loss: 0.3796 - val_custom_accuracy: 0.3442
Epoch 279/400
4/4 [==============================] - 10s 3s/step - loss: 0.4129 - custom_accuracy: 0.68
77 - val_loss: 0.3795 - val_custom_accuracy: 0.3442
Epoch 280/400
4/4 [==============================] - 6s 2s/step - loss: 0.4138 - custom_accuracy: 0.812
9 - val_loss: 0.3773 - val_custom_accuracy: 0.3442
Epoch 281/400
4/4 [==============================] - 8s 2s/step - loss: 0.4114 - custom_accuracy: 0.759
5 - val_loss: 0.3756 - val_custom_accuracy: 0.3442
Epoch 282/400
4/4 [==============================] - 8s 2s/step - loss: 0.4133 - custom_accuracy: 0.815
3 - val_loss: 0.3749 - val_custom_accuracy: 0.3442
Epoch 283/400
4/4 [==============================] - 6s 2s/step - loss: 0.4106 - custom_accuracy: 0.815
8 - val_loss: 0.3761 - val_custom_accuracy: 0.3442
Epoch 284/400
4/4 [==============================] - 10s 2s/step - loss: 0.4159 - custom_accuracy: 0.81
04 - val_loss: 0.3768 - val_custom_accuracy: 0.3442
Epoch 285/400
4/4 [==============================] - 6s 2s/step - loss: 0.4142 - custom_accuracy: 0.662
6 - val_loss: 0.3784 - val_custom_accuracy: 0.3442
Epoch 286/400
4/4 [==============================] - 8s 2s/step - loss: 0.4116 - custom_accuracy: 0.813
4 - val_loss: 0.3808 - val_custom_accuracy: 0.3442
Epoch 287/400
4/4 [==============================] - 8s 2s/step - loss: 0.4153 - custom_accuracy: 0.811
0 - val_loss: 0.3808 - val_custom_accuracy: 0.3442
Epoch 288/400
4/4 [==============================] - 6s 2s/step - loss: 0.4197 - custom_accuracy: 0.733
8 - val_loss: 0.3795 - val_custom_accuracy: 0.3442
Epoch 289/400
4/4 [==============================] - 10s 2s/step - loss: 0.4111 - custom_accuracy: 0.74
05 - val_loss: 0.3767 - val_custom_accuracy: 0.3442
Epoch 290/400
4/4 [==============================] - 6s 2s/step - loss: 0.4059 - custom_accuracy: 0.816
1 - val_loss: 0.3742 - val_custom_accuracy: 0.3442
Epoch 291/400
4/4 [==============================] - 9s 2s/step - loss: 0.4135 - custom_accuracy: 0.806
1 - val_loss: 0.3728 - val_custom_accuracy: 0.3442
Epoch 292/400
4/4 [==============================] - 7s 2s/step - loss: 0.4221 - custom_accuracy: 0.694
3 - val_loss: 0.3727 - val_custom_accuracy: 0.3442
```

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Epoch 293/400
4/4 [==============================] - 6s 2s/step - loss: 0.4155 - custom_accuracy: 0.772
1 - val_loss: 0.3730 - val_custom_accuracy: 0.3442
Epoch 294/400
4/4 [==============================] - 10s 2s/step - loss: 0.4126 - custom_accuracy: 0.81
48 - val_loss: 0.3721 - val_custom_accuracy: 0.3442
Epoch 295/400
4/4 [==============================] - 6s 2s/step - loss: 0.4129 - custom_accuracy: 0.810
2 - val_loss: 0.3716 - val_custom_accuracy: 0.3442
Epoch 296/400
4/4 [==============================] - 9s 2s/step - loss: 0.4164 - custom_accuracy: 0.751
5 - val_loss: 0.3720 - val_custom_accuracy: 0.3442
Epoch 297/400
4/4 [==============================] - 7s 1s/step - loss: 0.4100 - custom_accuracy: 0.704
9 - val_loss: 0.3717 - val_custom_accuracy: 0.3442
Epoch 298/400
4/4 [==============================] - 7s 2s/step - loss: 0.4070 - custom_accuracy: 0.811
4 - val_loss: 0.3699 - val_custom_accuracy: 0.3442
Epoch 299/400
4/4 [==============================] - 9s 2s/step - loss: 0.4134 - custom_accuracy: 0.737
6 - val_loss: 0.3673 - val_custom_accuracy: 0.3442
Epoch 300/400
4/4 [==============================] - 6s 2s/step - loss: 0.4033 - custom_accuracy: 0.773
4 - val_loss: 0.3642 - val_custom_accuracy: 0.3442
Epoch 301/400
4/4 [==============================] - 9s 3s/step - loss: 0.4122 - custom_accuracy: 0.564
7 - val_loss: 0.3640 - val_custom_accuracy: 0.3442
Epoch 302/400
4/4 [==============================] - 7s 2s/step - loss: 0.4105 - custom_accuracy: 0.740
1 - val_loss: 0.3639 - val_custom_accuracy: 0.3442
Epoch 303/400
4/4 [==============================] - 10s 3s/step - loss: 0.4083 - custom_accuracy: 0.77
31 - val_loss: 0.3636 - val_custom_accuracy: 0.3442
Epoch 304/400
4/4 [==============================] - 8s 2s/step - loss: 0.4043 - custom_accuracy: 0.746
0 - val_loss: 0.3623 - val_custom_accuracy: 0.3442
Epoch 305/400
4/4 [==============================] - 6s 2s/step - loss: 0.4125 - custom_accuracy: 0.760
2 - val_loss: 0.3617 - val_custom_accuracy: 0.3442
Epoch 306/400
4/4 [==============================] - 10s 2s/step - loss: 0.4111 - custom_accuracy: 0.81
35 - val_loss: 0.3613 - val_custom_accuracy: 0.3442
Epoch 307/400
4/4 [==============================] - 6s 2s/step - loss: 0.4083 - custom_accuracy: 0.741
8 - val_loss: 0.3612 - val_custom_accuracy: 0.3442
Epoch 308/400
4/4 [==============================] - 9s 3s/step - loss: 0.4060 - custom_accuracy: 0.821
5 - val_loss: 0.3609 - val_custom_accuracy: 0.3442
Epoch 309/400
4/4 [==============================] - 7s 2s/step - loss: 0.4199 - custom_accuracy: 0.731
4 - val_loss: 0.3616 - val_custom_accuracy: 0.3442
Epoch 310/400
4/4 [==============================] - 7s 2s/step - loss: 0.4147 - custom_accuracy: 0.582
2 - val_loss: 0.3607 - val_custom_accuracy: 0.3442
Epoch 311/400
4/4 [==============================] - 9s 2s/step - loss: 0.4117 - custom_accuracy: 0.810
3 - val_loss: 0.3599 - val_custom_accuracy: 0.3403
Epoch 312/400
4/4 [==============================] - 6s 2s/step - loss: 0.4076 - custom_accuracy: 0.815
3 - val_loss: 0.3607 - val_custom_accuracy: 0.3403
Epoch 313/400
4/4 [==============================] - 10s 3s/step - loss: 0.4205 - custom_accuracy: 0.81
13 - val_loss: 0.3626 - val_custom_accuracy: 0.3403
Epoch 314/400
4/4 [==============================] - 6s 2s/step - loss: 0.4134 - custom_accuracy: 0.685
9 - val_loss: 0.3638 - val_custom_accuracy: 0.3442
Epoch 315/400
4/4 [==============================] - 8s 2s/step - loss: 0.4151 - custom_accuracy: 0.737
1 - val_loss: 0.3623 - val_custom_accuracy: 0.3403
Epoch 316/400
4/4 [==============================] - 8s 2s/step - loss: 0.4142 - custom_accuracy: 0.768
3 - val_loss: 0.3616 - val_custom_accuracy: 0.3403
```

```
Epoch 317/400
4/4 [==============================] - 6s 2s/step - loss: 0.4120 - custom_accuracy: 0.738
4 - val_loss: 0.3598 - val_custom_accuracy: 0.3403
Epoch 318/400
4/4 [==============================] - 10s 3s/step - loss: 0.4133 - custom_accuracy: 0.80
90 - val_loss: 0.3576 - val_custom_accuracy: 0.3472
Epoch 319/400
4/4 [==============================] - 6s 2s/step - loss: 0.4188 - custom_accuracy: 0.665
5 - val_loss: 0.3557 - val_custom_accuracy: 0.3472
Epoch 320/400
4/4 [==============================] - 7s 2s/step - loss: 0.4126 - custom_accuracy: 0.707
2 - val_loss: 0.3536 - val_custom_accuracy: 0.3472
Epoch 321/400
4/4 [==============================] - 8s 2s/step - loss: 0.4046 - custom_accuracy: 0.676
7 - val_loss: 0.3523 - val_custom_accuracy: 0.3472
Epoch 322/400
4/4 [==============================] - 6s 2s/step - loss: 0.4134 - custom_accuracy: 0.699
5 - val_loss: 0.3518 - val_custom_accuracy: 0.3472
Epoch 323/400
4/4 [==============================] - 10s 3s/step - loss: 0.4051 - custom_accuracy: 0.73
13 - val_loss: 0.3518 - val_custom_accuracy: 0.3472
Epoch 324/400
4/4 [==============================] - 6s 2s/step - loss: 0.4195 - custom_accuracy: 0.761
7 - val_loss: 0.3522 - val_custom_accuracy: 0.3464
Epoch 325/400
4/4 [==============================] - 8s 2s/step - loss: 0.4325 - custom_accuracy: 0.768
9 - val_loss: 0.3518 - val_custom_accuracy: 0.3542
Epoch 326/400
4/4 [==============================] - 8s 2s/step - loss: 0.4237 - custom_accuracy: 0.642
0 - val_loss: 0.3510 - val_custom_accuracy: 0.3472
Epoch 327/400
4/4 [==============================] - 6s 2s/step - loss: 0.4140 - custom_accuracy: 0.822
1 - val_loss: 0.3510 - val_custom_accuracy: 0.3472
Epoch 328/400
4/4 [==============================] - 10s 2s/step - loss: 0.4169 - custom_accuracy: 0.76
62 - val_loss: 0.3512 - val_custom_accuracy: 0.3472
Epoch 329/400
4/4 [==============================] - 6s 2s/step - loss: 0.4177 - custom_accuracy: 0.823
0 - val_loss: 0.3518 - val_custom_accuracy: 0.3472
Epoch 330/400
4/4 [==============================] - 9s 2s/step - loss: 0.4121 - custom_accuracy: 0.807
4 - val_loss: 0.3536 - val_custom_accuracy: 0.3511
Epoch 331/400
4/4 [==============================] - 7s 2s/step - loss: 0.4221 - custom_accuracy: 0.812
9 - val_loss: 0.3564 - val_custom_accuracy: 0.3511
Epoch 332/400
4/4 [==============================] - 6s 2s/step - loss: 0.4151 - custom_accuracy: 0.650
7 - val_loss: 0.3584 - val_custom_accuracy: 0.3442
Epoch 333/400
4/4 [==============================] - 10s 2s/step - loss: 0.4082 - custom_accuracy: 0.80
43 - val_loss: 0.3582 - val_custom_accuracy: 0.3442
Epoch 334/400
4/4 [==============================] - 6s 2s/step - loss: 0.4077 - custom_accuracy: 0.740
3 - val_loss: 0.3584 - val_custom_accuracy: 0.3442
Epoch 335/400
4/4 [==============================] - 9s 2s/step - loss: 0.4145 - custom_accuracy: 0.804
7 - val_loss: 0.3601 - val_custom_accuracy: 0.3442
Epoch 336/400
4/4 [==============================] - 7s 2s/step - loss: 0.4173 - custom_accuracy: 0.733
1 - val_loss: 0.3615 - val_custom_accuracy: 0.3442
Epoch 337/400
4/4 [==============================] - 7s 2s/step - loss: 0.4143 - custom_accuracy: 0.754
9 - val_loss: 0.3619 - val_custom_accuracy: 0.3442
Epoch 338/400
4/4 [==============================] - 9s 2s/step - loss: 0.4100 - custom_accuracy: 0.727
1 - val_loss: 0.3612 - val_custom_accuracy: 0.3442
Epoch 339/400
4/4 [==============================] - 6s 2s/step - loss: 0.4144 - custom_accuracy: 0.773
7 - val_loss: 0.3618 - val_custom_accuracy: 0.3442
Epoch 340/400
4/4 [==============================] - 9s 3s/step - loss: 0.4213 - custom_accuracy: 0.768
6 - val_loss: 0.3632 - val_custom_accuracy: 0.3442
```

```
Epoch 341/400
4/4 [==============================] - 7s 2s/step - loss: 0.4166 - custom_accuracy: 0.806
8 - val_loss: 0.3652 - val_custom_accuracy: 0.3442
Epoch 342/400
4/4 [==============================] - 7s 2s/step - loss: 0.4140 - custom_accuracy: 0.702
6 - val_loss: 0.3658 - val_custom_accuracy: 0.3442
Epoch 343/400
4/4 [==============================] - 9s 2s/step - loss: 0.4056 - custom_accuracy: 0.726
9 - val_loss: 0.3643 - val_custom_accuracy: 0.3442
Epoch 344/400
4/4 [==============================] - 6s 1s/step - loss: 0.4176 - custom_accuracy: 0.815
8 - val_loss: 0.3633 - val_custom_accuracy: 0.3442
Epoch 345/400
4/4 [==============================] - 9s 3s/step - loss: 0.4137 - custom_accuracy: 0.809
3 - val_loss: 0.3627 - val_custom_accuracy: 0.3442
Epoch 346/400
4/4 [==============================] - 7s 2s/step - loss: 0.4083 - custom_accuracy: 0.703
1 - val_loss: 0.3617 - val_custom_accuracy: 0.3442
Epoch 347/400
4/4 [==============================] - 10s 3s/step - loss: 0.4119 - custom_accuracy: 0.66
43 - val_loss: 0.3603 - val_custom_accuracy: 0.3442
Epoch 348/400
4/4 [==============================] - 7s 2s/step - loss: 0.4143 - custom_accuracy: 0.776
9 - val_loss: 0.3589 - val_custom_accuracy: 0.3511
Epoch 349/400
4/4 [==============================] - 7s 2s/step - loss: 0.4092 - custom_accuracy: 0.819
8 - val_loss: 0.3583 - val_custom_accuracy: 0.3511
Epoch 350/400
4/4 [==============================] - 9s 2s/step - loss: 0.4096 - custom_accuracy: 0.766
5 - val_loss: 0.3579 - val_custom_accuracy: 0.3511
Epoch 351/400
4/4 [==============================] - 6s 2s/step - loss: 0.4155 - custom_accuracy: 0.756
9 - val_loss: 0.3575 - val_custom_accuracy: 0.3511
Epoch 352/400
4/4 [==============================] - 9s 2s/step - loss: 0.4172 - custom_accuracy: 0.739
0 - val_loss: 0.3579 - val_custom_accuracy: 0.3511
Epoch 353/400
4/4 [==============================] - 7s 2s/step - loss: 0.4169 - custom_accuracy: 0.736
9 - val_loss: 0.3575 - val_custom_accuracy: 0.3511
Epoch 354/400
4/4 [==============================] - 7s 2s/step - loss: 0.4153 - custom_accuracy: 0.773
1 - val_loss: 0.3575 - val_custom_accuracy: 0.3511
Epoch 355/400
4/4 [==============================] - 9s 2s/step - loss: 0.4101 - custom_accuracy: 0.648
4 - val_loss: 0.3576 - val_custom_accuracy: 0.3511
Epoch 356/400
4/4 [==============================] - 6s 2s/step - loss: 0.4143 - custom_accuracy: 0.764
7 - val_loss: 0.3576 - val_custom_accuracy: 0.3511
Epoch 357/400
4/4 [==============================] - 9s 2s/step - loss: 0.4141 - custom_accuracy: 0.697
8 - val_loss: 0.3581 - val_custom_accuracy: 0.3511
Epoch 358/400
4/4 [==============================] - 7s 2s/step - loss: 0.4181 - custom_accuracy: 0.643
7 - val_loss: 0.3567 - val_custom_accuracy: 0.3472
Epoch 359/400
4/4 [==============================] - 7s 2s/step - loss: 0.4187 - custom_accuracy: 0.806
0 - val_loss: 0.3556 - val_custom_accuracy: 0.3472
Epoch 360/400
4/4 [==============================] - 9s 2s/step - loss: 0.4197 - custom_accuracy: 0.701
1 - val_loss: 0.3549 - val_custom_accuracy: 0.3472
Epoch 361/400
4/4 [==============================] - 6s 2s/step - loss: 0.4114 - custom_accuracy: 0.818
0 - val_loss: 0.3550 - val_custom_accuracy: 0.3472
Epoch 362/400
4/4 [==============================] - 8s 2s/step - loss: 0.4073 - custom_accuracy: 0.741
5 - val_loss: 0.3556 - val_custom_accuracy: 0.3472
Epoch 363/400
4/4 [==============================] - 7s 2s/step - loss: 0.4098 - custom_accuracy: 0.816
5 - val_loss: 0.3553 - val_custom_accuracy: 0.3472
Epoch 364/400
4/4 [==============================] - 6s 2s/step - loss: 0.4161 - custom_accuracy: 0.784
0 - val_loss: 0.3553 - val_custom_accuracy: 0.3472
```

```
Epoch 365/400
4/4 [==============================] - 10s 2s/step - loss: 0.4156 - custom_accuracy: 0.76
62 - val_loss: 0.3563 - val_custom_accuracy: 0.3511
Epoch 366/400
4/4 [==============================] - 6s 2s/step - loss: 0.4075 - custom_accuracy: 0.704
3 - val_loss: 0.3567 - val_custom_accuracy: 0.3511
Epoch 367/400
4/4 [==============================] - 9s 2s/step - loss: 0.4145 - custom_accuracy: 0.698
4 - val_loss: 0.3556 - val_custom_accuracy: 0.3511
Epoch 368/400
4/4 [==============================] - 7s 2s/step - loss: 0.4100 - custom_accuracy: 0.735
0 - val_loss: 0.3538 - val_custom_accuracy: 0.3472
Epoch 369/400
4/4 [==============================] - 7s 2s/step - loss: 0.4185 - custom_accuracy: 0.738
6 - val_loss: 0.3530 - val_custom_accuracy: 0.3472
Epoch 370/400
4/4 [==============================] - 9s 2s/step - loss: 0.4181 - custom_accuracy: 0.741
1 - val_loss: 0.3530 - val_custom_accuracy: 0.3472
Epoch 371/400
4/4 [==============================] - 6s 2s/step - loss: 0.4028 - custom_accuracy: 0.663
6 - val_loss: 0.3524 - val_custom_accuracy: 0.3472
Epoch 372/400
4/4 [==============================] - 9s 2s/step - loss: 0.4178 - custom_accuracy: 0.807
3 - val_loss: 0.3512 - val_custom_accuracy: 0.3472
Epoch 373/400
4/4 [==============================] - 7s 2s/step - loss: 0.4158 - custom_accuracy: 0.810
4 - val_loss: 0.3509 - val_custom_accuracy: 0.3472
Epoch 374/400
4/4 [==============================] - 6s 2s/step - loss: 0.4169 - custom_accuracy: 0.770
1 - val_loss: 0.3510 - val_custom_accuracy: 0.3472
Epoch 375/400
4/4 [==============================] - 9s 2s/step - loss: 0.4057 - custom_accuracy: 0.830
6 - val_loss: 0.3516 - val_custom_accuracy: 0.3511
Epoch 376/400
4/4 [==============================] - 6s 2s/step - loss: 0.4215 - custom_accuracy: 0.695
7 - val_loss: 0.3524 - val_custom_accuracy: 0.3511
Epoch 377/400
4/4 [==============================] - 8s 2s/step - loss: 0.4217 - custom_accuracy: 0.809
8 - val_loss: 0.3540 - val_custom_accuracy: 0.3511
Epoch 378/400
4/4 [==============================] - 7s 2s/step - loss: 0.4080 - custom_accuracy: 0.813
2 - val_loss: 0.3558 - val_custom_accuracy: 0.3511
Epoch 379/400
4/4 [==============================] - 6s 2s/step - loss: 0.4143 - custom_accuracy: 0.810
9 - val_loss: 0.3580 - val_custom_accuracy: 0.3511
Epoch 380/400
4/4 [==============================] - 10s 2s/step - loss: 0.4175 - custom_accuracy: 0.69
72 - val_loss: 0.3599 - val_custom_accuracy: 0.3511
Epoch 381/400
4/4 [==============================] - 6s 2s/step - loss: 0.4029 - custom_accuracy: 0.818
3 - val_loss: 0.3605 - val_custom_accuracy: 0.3511
Epoch 382/400
4/4 [==============================] - 8s 2s/step - loss: 0.4108 - custom_accuracy: 0.745
5 - val_loss: 0.3599 - val_custom_accuracy: 0.3511
Epoch 383/400
4/4 [==============================] - 7s 2s/step - loss: 0.4185 - custom_accuracy: 0.757
7 - val_loss: 0.3586 - val_custom_accuracy: 0.3511
Epoch 384/400
4/4 [==============================] - 7s 2s/step - loss: 0.4142 - custom_accuracy: 0.698
1 - val_loss: 0.3585 - val_custom_accuracy: 0.3511
Epoch 385/400
4/4 [==============================] - 9s 2s/step - loss: 0.4175 - custom_accuracy: 0.815
2 - val_loss: 0.3601 - val_custom_accuracy: 0.3442
Epoch 386/400
4/4 [==============================] - 6s 2s/step - loss: 0.4082 - custom_accuracy: 0.778
7 - val_loss: 0.3609 - val_custom_accuracy: 0.3442
Epoch 387/400
4/4 [==============================] - 8s 2s/step - loss: 0.4088 - custom_accuracy: 0.684
3 - val_loss: 0.3606 - val_custom_accuracy: 0.3442
Epoch 388/400
4/4 [==============================] - 7s 2s/step - loss: 0.4259 - custom_accuracy: 0.582
8 - val_loss: 0.3593 - val_custom_accuracy: 0.3511
```

```
Epoch 389/400
4/4 [==============================] - 6s 2s/step - loss: 0.4122 - custom_accuracy: 0.753
5 - val_loss: 0.3607 - val_custom_accuracy: 0.3511
Epoch 390/400
4/4 [==============================] - 10s 2s/step - loss: 0.4121 - custom_accuracy: 0.81
71 - val_loss: 0.3611 - val_custom_accuracy: 0.3511
Epoch 391/400
4/4 [==============================] - 6s 2s/step - loss: 0.4113 - custom_accuracy: 0.729
5 - val_loss: 0.3613 - val_custom_accuracy: 0.3511
Epoch 392/400
4/4 [==============================] - 9s 2s/step - loss: 0.4095 - custom_accuracy: 0.738
4 - val_loss: 0.3604 - val_custom_accuracy: 0.3511
Epoch 393/400
4/4 [==============================] - 7s 2s/step - loss: 0.4137 - custom_accuracy: 0.768
3 - val_loss: 0.3588 - val_custom_accuracy: 0.3472
Epoch 394/400
4/4 [==============================] - 7s 2s/step - loss: 0.4009 - custom_accuracy: 0.701
8 - val_loss: 0.3568 - val_custom_accuracy: 0.3472
Epoch 395/400
4/4 [==============================] - 9s 2s/step - loss: 0.4004 - custom_accuracy: 0.685
1 - val_loss: 0.3537 - val_custom_accuracy: 0.3472
Epoch 396/400
4/4 [==============================] - 6s 2s/step - loss: 0.4188 - custom_accuracy: 0.667
8 - val_loss: 0.3515 - val_custom_accuracy: 0.3472
Epoch 397/400
4/4 [==============================] - 9s 2s/step - loss: 0.3993 - custom_accuracy: 0.760
7 - val_loss: 0.3508 - val_custom_accuracy: 0.3472
Epoch 398/400
4/4 [==============================] - 7s 2s/step - loss: 0.4322 - custom_accuracy: 0.802
1 - val_loss: 0.3506 - val_custom_accuracy: 0.3472
Epoch 399/400
4/4 [==============================] - 7s 2s/step - loss: 0.4145 - custom_accuracy: 0.756
9 - val_loss: 0.3504 - val_custom_accuracy: 0.3472
Epoch 400/400
4/4 [==============================] - 10s 2s/step - loss: 0.4208 - custom_accuracy: 0.69
82 - val_loss: 0.3503 - val_custom_accuracy: 0.3472
```

In [ ]:

```
plt.plot(H.history['loss'])
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.title("Discriminator's Loss in Cycle three")
plt.show()
```

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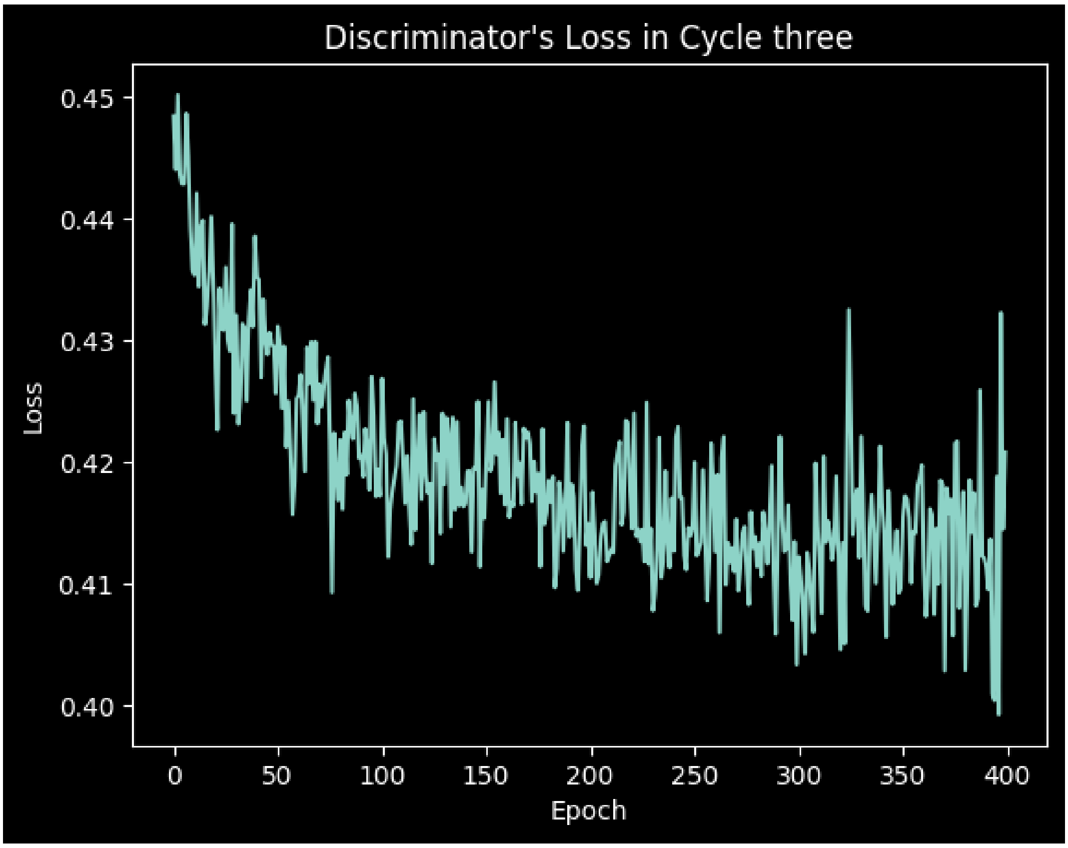
```



In [ ]:

```
plt.plot(H.history['custom_accuracy'])
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.title("Discriminator's Accuracy in Cycle Three")
plt.show()
```

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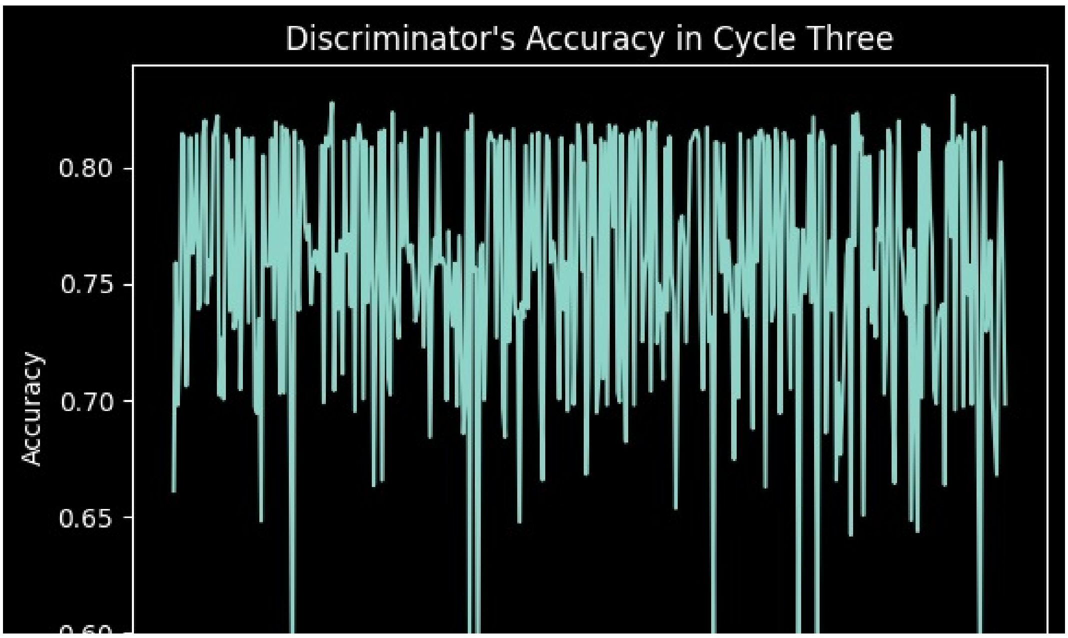
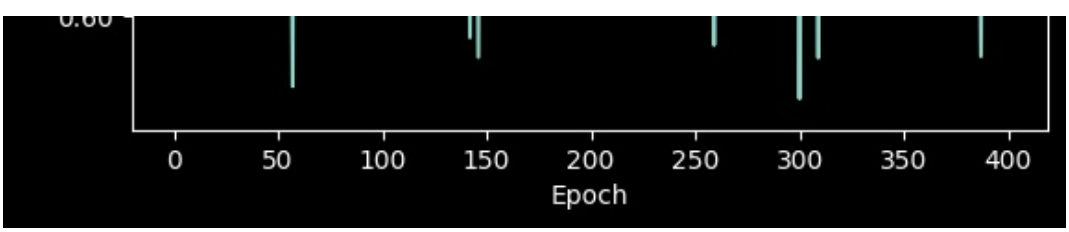
WARNING:matplotlib.font_manager:findfont: Font family 'Arial' not found.
WARNING:matplotlib.font_manager:findfont: Font family 'Arial' not found.
```





In [ ]:

```
# Forth cycle
best_qdisc_weights = qdisc_model.get_weights()[0]
best_qgen_weights = qgen_model.get_weights()[0]
qgen_model = generator_model(symbols_gen, qdisc_model.get_weights()[0])

qgen_model.get_layer('qgen_layer').set_weights([best_qgen_weights])
qdisc_model.get_layer('qdisc_layer').set_weights([best_qdisc_weights])
```

In [ ]:

```
gen_model_cp, disc_model_cp = checkpoints(cycle=4)
```

In [ ]:

```
# Fit the Generator Model
H = train_qgen(200, 100, 1)
```

```
Epoch 1/200
1/1 [==============================] - 4s 4s/step - loss: 0.5887
Epoch 2/200
1/1 [==============================] - 4s 4s/step - loss: 0.5801
Epoch 3/200
1/1 [==============================] - 6s 6s/step - loss: 0.5718
Epoch 4/200
1/1 [==============================] - 4s 4s/step - loss: 0.5637
Epoch 5/200
1/1 [==============================] - 3s 3s/step - loss: 0.5558
Epoch 6/200
1/1 [==============================] - 3s 3s/step - loss: 0.5481
Epoch 7/200
1/1 [==============================] - 5s 5s/step - loss: 0.5406
Epoch 8/200
1/1 [==============================] - 6s 6s/step - loss: 0.5333
Epoch 9/200
1/1 [==============================] - 3s 3s/step - loss: 0.5262
Epoch 10/200
1/1 [==============================] - 3s 3s/step - loss: 0.5193
Epoch 11/200
1/1 [==============================] - 3s 3s/step - loss: 0.5125
Epoch 12/200
1/1 [==============================] - 5s 5s/step - loss: 0.5059
Epoch 13/200
1/1 [==============================] - 5s 5s/step - loss: 0.4994
Epoch 14/200
1/1 [==============================] - 3s 3s/step - loss: 0.4930
Epoch 15/200
1/1 [==============================] - 3s 3s/step - loss: 0.4868
Epoch 16/200
1/1 [==============================] - 4s 4s/step - loss: 0.4808
Epoch 17/200
1/1 [==============================] - 6s 6s/step - loss: 0.4748
Epoch 18/200
1/1 [==============================] - 4s 4s/step - loss: 0.4690
Epoch 19/200
1/1 [==============================] - 3s 3s/step - loss: 0.4632
Epoch 20/200
1/1 [==============================] - 3s 3s/step - loss: 0.4576
Epoch 21/200
1/1 [==============================] - 5s 5s/step - loss: 0.4521
Epoch 22/200
1/1 [==============================] - 5s 5s/step - loss: 0.4467
Epoch 23/200
```

```
1/1 [==============================] - 3s 3s/step - loss: 0.4413
Epoch 24/200
1/1 [==============================] - 3s 3s/step - loss: 0.4361
Epoch 25/200
1/1 [==============================] - 3s 3s/step - loss: 0.4309
Epoch 26/200
1/1 [==============================] - 6s 6s/step - loss: 0.4258
Epoch 27/200
1/1 [==============================] - 5s 5s/step - loss: 0.4207
Epoch 28/200
1/1 [==============================] - 3s 3s/step - loss: 0.4157
Epoch 29/200
1/1 [==============================] - 3s 3s/step - loss: 0.4108
Epoch 30/200
1/1 [==============================] - 4s 4s/step - loss: 0.4060
Epoch 31/200
1/1 [==============================] - 6s 6s/step - loss: 0.4012
Epoch 32/200
1/1 [==============================] - 4s 4s/step - loss: 0.3965
Epoch 33/200
1/1 [==============================] - 3s 3s/step - loss: 0.3918
Epoch 34/200
1/1 [==============================] - 3s 3s/step - loss: 0.3873
Epoch 35/200
1/1 [==============================] - 5s 5s/step - loss: 0.3828
Epoch 36/200
1/1 [==============================] - 5s 5s/step - loss: 0.3784
Epoch 37/200
1/1 [==============================] - 3s 3s/step - loss: 0.3741
Epoch 38/200
1/1 [==============================] - 3s 3s/step - loss: 0.3698
Epoch 39/200
1/1 [==============================] - 3s 3s/step - loss: 0.3657
Epoch 40/200
1/1 [==============================] - 6s 6s/step - loss: 0.3616
Epoch 41/200
1/1 [==============================] - 4s 4s/step - loss: 0.3576
Epoch 42/200
1/1 [==============================] - 3s 3s/step - loss: 0.3537
Epoch 43/200
1/1 [==============================] - 3s 3s/step - loss: 0.3499
Epoch 44/200
1/1 [==============================] - 4s 4s/step - loss: 0.3461
Epoch 45/200
1/1 [==============================] - 6s 6s/step - loss: 0.3425
Epoch 46/200
1/1 [==============================] - 4s 4s/step - loss: 0.3389
Epoch 47/200
1/1 [==============================] - 3s 3s/step - loss: 0.3354
Epoch 48/200
1/1 [==============================] - 3s 3s/step - loss: 0.3320
Epoch 49/200
1/1 [==============================] - 5s 5s/step - loss: 0.3288
Epoch 50/200
1/1 [==============================] - 5s 5s/step - loss: 0.3256
Epoch 51/200
1/1 [==============================] - 3s 3s/step - loss: 0.3225
Epoch 52/200
1/1 [==============================] - 3s 3s/step - loss: 0.3194
Epoch 53/200
1/1 [==============================] - 3s 3s/step - loss: 0.3165
Epoch 54/200
1/1 [==============================] - 6s 6s/step - loss: 0.3137
Epoch 55/200
1/1 [==============================] - 4s 4s/step - loss: 0.3109
Epoch 56/200
1/1 [==============================] - 3s 3s/step - loss: 0.3082
Epoch 57/200
1/1 [==============================] - 3s 3s/step - loss: 0.3056
Epoch 58/200
1/1 [==============================] - 4s 4s/step - loss: 0.3031
Epoch 59/200
```

```
1/1 [==============================] - 6s 6s/step - loss: 0.3006
Epoch 60/200
1/1 [==============================] - 4s 4s/step - loss: 0.2982
Epoch 61/200
1/1 [==============================] - 3s 3s/step - loss: 0.2958
Epoch 62/200
1/1 [==============================] - 3s 3s/step - loss: 0.2936
Epoch 63/200
1/1 [==============================] - 5s 5s/step - loss: 0.2913
Epoch 64/200
1/1 [==============================] - 5s 5s/step - loss: 0.2892
Epoch 65/200
1/1 [==============================] - 3s 3s/step - loss: 0.2870
Epoch 66/200
1/1 [==============================] - 3s 3s/step - loss: 0.2850
Epoch 67/200
1/1 [==============================] - 4s 4s/step - loss: 0.2829
Epoch 68/200
1/1 [==============================] - 6s 6s/step - loss: 0.2810
Epoch 69/200
1/1 [==============================] - 4s 4s/step - loss: 0.2790
Epoch 70/200
1/1 [==============================] - 3s 3s/step - loss: 0.2771
Epoch 71/200
1/1 [==============================] - 3s 3s/step - loss: 0.2753
Epoch 72/200
1/1 [==============================] - 5s 5s/step - loss: 0.2734
Epoch 73/200
1/1 [==============================] - 6s 6s/step - loss: 0.2716
Epoch 74/200
1/1 [==============================] - 3s 3s/step - loss: 0.2699
Epoch 75/200
1/1 [==============================] - 3s 3s/step - loss: 0.2681
Epoch 76/200
1/1 [==============================] - 3s 3s/step - loss: 0.2664
Epoch 77/200
1/1 [==============================] - 6s 6s/step - loss: 0.2648
Epoch 78/200
1/1 [==============================] - 5s 5s/step - loss: 0.2631
Epoch 79/200
1/1 [==============================] - 3s 3s/step - loss: 0.2615
Epoch 80/200
1/1 [==============================] - 3s 3s/step - loss: 0.2599
Epoch 81/200
1/1 [==============================] - 4s 4s/step - loss: 0.2583
Epoch 82/200
1/1 [==============================] - 6s 6s/step - loss: 0.2568
Epoch 83/200
1/1 [==============================] - 4s 4s/step - loss: 0.2552
Epoch 84/200
1/1 [==============================] - 3s 3s/step - loss: 0.2537
Epoch 85/200
1/1 [==============================] - 3s 3s/step - loss: 0.2522
Epoch 86/200
1/1 [==============================] - 5s 5s/step - loss: 0.2508
Epoch 87/200
1/1 [==============================] - 6s 6s/step - loss: 0.2493
Epoch 88/200
1/1 [==============================] - 3s 3s/step - loss: 0.2479
Epoch 89/200
1/1 [==============================] - 3s 3s/step - loss: 0.2465
Epoch 90/200
1/1 [==============================] - 3s 3s/step - loss: 0.2451
Epoch 91/200
1/1 [==============================] - 6s 6s/step - loss: 0.2437
Epoch 92/200
1/1 [==============================] - 4s 4s/step - loss: 0.2424
Epoch 93/200
1/1 [==============================] - 3s 3s/step - loss: 0.2411
Epoch 94/200
1/1 [==============================] - 3s 3s/step - loss: 0.2397
Epoch 95/200
```

```
1/1 [==============================] - 4s 4s/step - loss: 0.2385
Epoch 96/200
1/1 [==============================] - 6s 6s/step - loss: 0.2372
Epoch 97/200
1/1 [==============================] - 4s 4s/step - loss: 0.2359
Epoch 98/200
1/1 [==============================] - 3s 3s/step - loss: 0.2347
Epoch 99/200
1/1 [==============================] - 3s 3s/step - loss: 0.2335
Epoch 100/200
1/1 [==============================] - 5s 5s/step - loss: 0.2322
Epoch 101/200
1/1 [==============================] - 5s 5s/step - loss: 0.2311
Epoch 102/200
1/1 [==============================] - 3s 3s/step - loss: 0.2299
Epoch 103/200
1/1 [==============================] - 3s 3s/step - loss: 0.2287
Epoch 104/200
1/1 [==============================] - 4s 4s/step - loss: 0.2276
Epoch 105/200
1/1 [==============================] - 6s 6s/step - loss: 0.2265
Epoch 106/200
1/1 [==============================] - 4s 4s/step - loss: 0.2254
Epoch 107/200
1/1 [==============================] - 3s 3s/step - loss: 0.2243
Epoch 108/200
1/1 [==============================] - 3s 3s/step - loss: 0.2232
Epoch 109/200
1/1 [==============================] - 5s 5s/step - loss: 0.2221
Epoch 110/200
1/1 [==============================] - 6s 6s/step - loss: 0.2211
Epoch 111/200
1/1 [==============================] - 4s 4s/step - loss: 0.2201
Epoch 112/200
1/1 [==============================] - 3s 3s/step - loss: 0.2191
Epoch 113/200
1/1 [==============================] - 3s 3s/step - loss: 0.2181
Epoch 114/200
1/1 [==============================] - 5s 5s/step - loss: 0.2171
Epoch 115/200
1/1 [==============================] - 5s 5s/step - loss: 0.2161
Epoch 116/200
1/1 [==============================] - 3s 3s/step - loss: 0.2151
Epoch 117/200
1/1 [==============================] - 3s 3s/step - loss: 0.2142
Epoch 118/200
1/1 [==============================] - 4s 4s/step - loss: 0.2133
Epoch 119/200
1/1 [==============================] - 6s 6s/step - loss: 0.2124
Epoch 120/200
1/1 [==============================] - 4s 4s/step - loss: 0.2115
Epoch 121/200
1/1 [==============================] - 3s 3s/step - loss: 0.2106
Epoch 122/200
1/1 [==============================] - 3s 3s/step - loss: 0.2097
Epoch 123/200
1/1 [==============================] - 5s 5s/step - loss: 0.2088
Epoch 124/200
1/1 [==============================] - 6s 6s/step - loss: 0.2080
Epoch 125/200
1/1 [==============================] - 3s 3s/step - loss: 0.2071
Epoch 126/200
1/1 [==============================] - 3s 3s/step - loss: 0.2063
Epoch 127/200
1/1 [==============================] - 3s 3s/step - loss: 0.2055
Epoch 128/200
1/1 [==============================] - 5s 5s/step - loss: 0.2047
Epoch 129/200
1/1 [==============================] - 5s 5s/step - loss: 0.2039
Epoch 130/200
1/1 [==============================] - 3s 3s/step - loss: 0.2031
Epoch 131/200
```

```
1/1 [==============================] - 3s 3s/step - loss: 0.2023
Epoch 132/200
1/1 [==============================] - 4s 4s/step - loss: 0.2016
Epoch 133/200
1/1 [==============================] - 6s 6s/step - loss: 0.2008
Epoch 134/200
1/1 [==============================] - 4s 4s/step - loss: 0.2001
Epoch 135/200
1/1 [==============================] - 3s 3s/step - loss: 0.1994
Epoch 136/200
1/1 [==============================] - 3s 3s/step - loss: 0.1987
Epoch 137/200
1/1 [==============================] - 5s 5s/step - loss: 0.1980
Epoch 138/200
1/1 [==============================] - 6s 6s/step - loss: 0.1973
Epoch 139/200
1/1 [==============================] - 3s 3s/step - loss: 0.1966
Epoch 140/200
1/1 [==============================] - 3s 3s/step - loss: 0.1959
Epoch 141/200
1/1 [==============================] - 3s 3s/step - loss: 0.1952
Epoch 142/200
1/1 [==============================] - 6s 6s/step - loss: 0.1946
Epoch 143/200
1/1 [==============================] - 4s 4s/step - loss: 0.1940
Epoch 144/200
1/1 [==============================] - 3s 3s/step - loss: 0.1933
Epoch 145/200
1/1 [==============================] - 3s 3s/step - loss: 0.1927
Epoch 146/200
1/1 [==============================] - 4s 4s/step - loss: 0.1921
Epoch 147/200
1/1 [==============================] - 6s 6s/step - loss: 0.1915
Epoch 148/200
1/1 [==============================] - 4s 4s/step - loss: 0.1909
Epoch 149/200
1/1 [==============================] - 3s 3s/step - loss: 0.1903
Epoch 150/200
1/1 [==============================] - 3s 3s/step - loss: 0.1897
Epoch 151/200
1/1 [==============================] - 5s 5s/step - loss: 0.1892
Epoch 152/200
1/1 [==============================] - 5s 5s/step - loss: 0.1886
Epoch 153/200
1/1 [==============================] - 3s 3s/step - loss: 0.1881
Epoch 154/200
1/1 [==============================] - 3s 3s/step - loss: 0.1875
Epoch 155/200
1/1 [==============================] - 3s 3s/step - loss: 0.1870
Epoch 156/200
1/1 [==============================] - 6s 6s/step - loss: 0.1865
Epoch 157/200
1/1 [==============================] - 5s 5s/step - loss: 0.1859
Epoch 158/200
1/1 [==============================] - 3s 3s/step - loss: 0.1854
Epoch 159/200
1/1 [==============================] - 3s 3s/step - loss: 0.1849
Epoch 160/200
1/1 [==============================] - 4s 4s/step - loss: 0.1844
Epoch 161/200
1/1 [==============================] - 6s 6s/step - loss: 0.1840
Epoch 162/200
1/1 [==============================] - 4s 4s/step - loss: 0.1835
Epoch 163/200
1/1 [==============================] - 3s 3s/step - loss: 0.1830
Epoch 164/200
1/1 [==============================] - 3s 3s/step - loss: 0.1825
Epoch 165/200
1/1 [==============================] - 5s 5s/step - loss: 0.1821
Epoch 166/200
1/1 [==============================] - 5s 5s/step - loss: 0.1816
Epoch 167/200
```

```
1/1 [==============================] - 3s 3s/step - loss: 0.1812
Epoch 168/200
1/1 [==============================] - 3s 3s/step - loss: 0.1808
Epoch 169/200
1/1 [==============================] - 3s 3s/step - loss: 0.1803
Epoch 170/200
1/1 [==============================] - 6s 6s/step - loss: 0.1799
Epoch 171/200
1/1 [==============================] - 4s 4s/step - loss: 0.1795
Epoch 172/200
1/1 [==============================] - 3s 3s/step - loss: 0.1791
Epoch 173/200
1/1 [==============================] - 3s 3s/step - loss: 0.1787
Epoch 174/200
1/1 [==============================] - 4s 4s/step - loss: 0.1783
Epoch 175/200
1/1 [==============================] - 6s 6s/step - loss: 0.1779
Epoch 176/200
1/1 [==============================] - 4s 4s/step - loss: 0.1775
Epoch 177/200
1/1 [==============================] - 3s 3s/step - loss: 0.1771
Epoch 178/200
1/1 [==============================] - 3s 3s/step - loss: 0.1767
Epoch 179/200
1/1 [==============================] - 5s 5s/step - loss: 0.1763
Epoch 180/200
1/1 [==============================] - 5s 5s/step - loss: 0.1760
Epoch 181/200
1/1 [==============================] - 3s 3s/step - loss: 0.1756
Epoch 182/200
1/1 [==============================] - 3s 3s/step - loss: 0.1752
Epoch 183/200
1/1 [==============================] - 3s 3s/step - loss: 0.1749
Epoch 184/200
1/1 [==============================] - 6s 6s/step - loss: 0.1745
Epoch 185/200
1/1 [==============================] - 4s 4s/step - loss: 0.1742
Epoch 186/200
1/1 [==============================] - 3s 3s/step - loss: 0.1738
Epoch 187/200
1/1 [==============================] - 3s 3s/step - loss: 0.1735
Epoch 188/200
1/1 [==============================] - 4s 4s/step - loss: 0.1731
Epoch 189/200
1/1 [==============================] - 6s 6s/step - loss: 0.1728
Epoch 190/200
1/1 [==============================] - 4s 4s/step - loss: 0.1725
Epoch 191/200
1/1 [==============================] - 3s 3s/step - loss: 0.1721
Epoch 192/200
1/1 [==============================] - 3s 3s/step - loss: 0.1718
Epoch 193/200
1/1 [==============================] - 5s 5s/step - loss: 0.1715
Epoch 194/200
1/1 [==============================] - 5s 5s/step - loss: 0.1712
Epoch 195/200
1/1 [==============================] - 3s 3s/step - loss: 0.1708
Epoch 196/200
1/1 [==============================] - 3s 3s/step - loss: 0.1705
Epoch 197/200
1/1 [==============================] - 3s 3s/step - loss: 0.1702
Epoch 198/200
1/1 [==============================] - 6s 6s/step - loss: 0.1699
Epoch 199/200
1/1 [==============================] - 4s 4s/step - loss: 0.1696
Epoch 200/200
1/1 [==============================] - 3s 3s/step - loss: 0.1693
```

In [ ]:

```
plt.plot(H.history['loss'])
```

```
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.title("Generator's Loss for the cycle 4 ")
plt.show()
```

```
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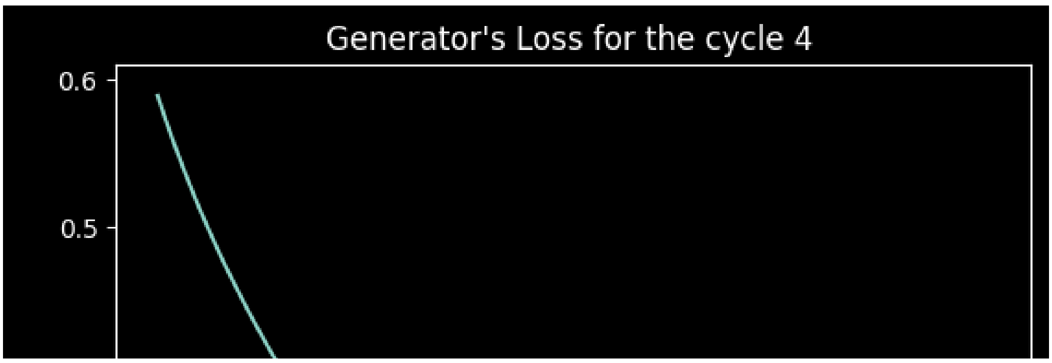
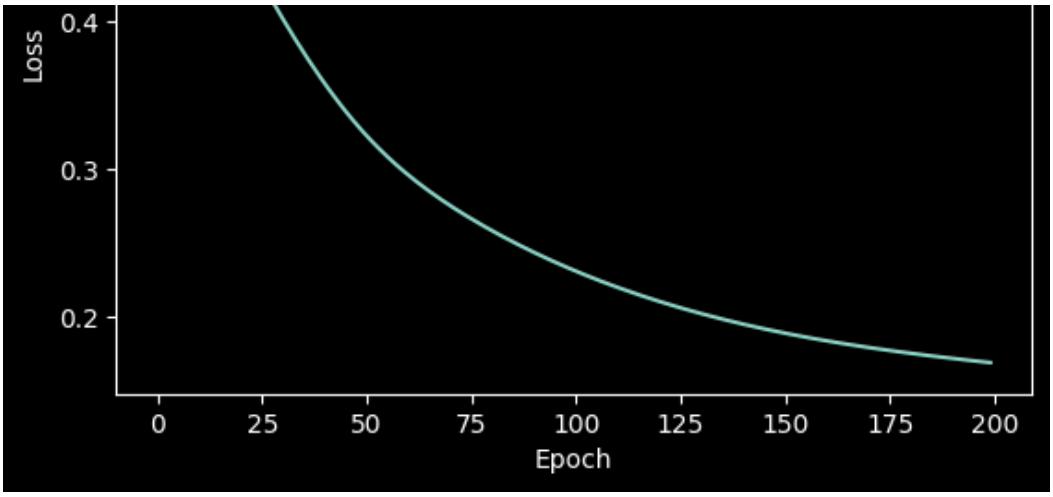
```





In [ ]:

```
# Combine Real + Fake Data

gen_data_train = tfq.convert_to_tensor(generate_data(x_train, qgan_qubits) + generate_fa
ke_data(x_train, qgan_qubits, qgen_model.get_weights()[0], layer=gen_layer))
gen_data_test = tfq.convert_to_tensor(generate_data(x_test, qgan_qubits) + generate_fake_
data(x_test, qgan_qubits, qgen_model.get_weights()[0], layer=gen_layer))

y_gen_train = np.concatenate((y_train, y_true_fake), axis = 0)
y_gen_test = np.concatenate((y_test, y_true_fake), axis = 0)

print(y_gen_train.shape, y_gen_test.shape)
```

```
(200, 3) (200, 3)
```

For cycle 4 weight C_{weight} is increased from $0.70 \rightarrow 0.95$

In [ ]:

```
# Change the C_weight
C_weight = 0.95
```

In [ ]:

```
# Fit the Discriminator Model
H = train_qdisc(300, 64, 1)
```

```
Epoch 1/300
4/4 [==============================] - 6s 2s/step - loss: 0.4453 - custom_accuracy: 0.675
7 - val_loss: 0.3755 - val_custom_accuracy: 0.3472
Epoch 2/300
4/4 [==============================] - 8s 2s/step - loss: 0.4473 - custom_accuracy: 0.813
1 - val_loss: 0.3755 - val_custom_accuracy: 0.3472
Epoch 3/300
4/4 [==============================] - 8s 2s/step - loss: 0.4511 - custom_accuracy: 0.808
8 - val_loss: 0.3760 - val_custom_accuracy: 0.3472
Epoch 4/300
4/4 [==============================] - 6s 2s/step - loss: 0.4296 - custom_accuracy: 0.778
5 - val_loss: 0.3765 - val_custom_accuracy: 0.3472
Epoch 5/300
4/4 [==============================] - 10s 3s/step - loss: 0.4363 - custom_accuracy: 0.76
63 - val_loss: 0.3772 - val_custom_accuracy: 0.3472
Epoch 6/300
4/4 [==============================] - 6s 2s/step - loss: 0.4386 - custom_accuracy: 0.744
3 - val_loss: 0.3773 - val_custom_accuracy: 0.3472
Epoch 7/300
4/4 [==============================] - 8s 2s/step - loss: 0.4381 - custom_accuracy: 0.806
5 - val_loss: 0.3762 - val_custom_accuracy: 0.3511
Epoch 8/300
4/4 [==============================] - 8s 2s/step - loss: 0.4361 - custom_accuracy: 0.817
4 - val_loss: 0.3763 - val_custom_accuracy: 0.3511
Epoch 9/300
4/4 [==============================] - 6s 2s/step - loss: 0.4288 - custom_accuracy: 0.817
```

```
8 - val_loss: 0.3773 - val_custom_accuracy: 0.3511
Epoch 10/300
4/4 [==============================] - 10s 3s/step - loss: 0.4290 - custom_accuracy: 0.76
12 - val_loss: 0.3786 - val_custom_accuracy: 0.3442
Epoch 11/300
4/4 [==============================] - 6s 2s/step - loss: 0.4348 - custom_accuracy: 0.814
0 - val_loss: 0.3792 - val_custom_accuracy: 0.3442
Epoch 12/300
4/4 [==============================] - 8s 2s/step - loss: 0.4347 - custom_accuracy: 0.811
0 - val_loss: 0.3793 - val_custom_accuracy: 0.3442
Epoch 13/300
4/4 [==============================] - 8s 2s/step - loss: 0.4363 - custom_accuracy: 0.694
9 - val_loss: 0.3793 - val_custom_accuracy: 0.3442
Epoch 14/300
4/4 [==============================] - 6s 2s/step - loss: 0.4274 - custom_accuracy: 0.727
6 - val_loss: 0.3786 - val_custom_accuracy: 0.3442
Epoch 15/300
4/4 [==============================] - 10s 2s/step - loss: 0.4340 - custom_accuracy: 0.75
70 - val_loss: 0.3799 - val_custom_accuracy: 0.3442
Epoch 16/300
4/4 [==============================] - 6s 2s/step - loss: 0.4306 - custom_accuracy: 0.766
3 - val_loss: 0.3820 - val_custom_accuracy: 0.3442
Epoch 17/300
4/4 [==============================] - 8s 2s/step - loss: 0.4299 - custom_accuracy: 0.760
8 - val_loss: 0.3829 - val_custom_accuracy: 0.3442
Epoch 18/300
4/4 [==============================] - 8s 2s/step - loss: 0.4265 - custom_accuracy: 0.821
7 - val_loss: 0.3835 - val_custom_accuracy: 0.3442
Epoch 19/300
4/4 [==============================] - 6s 2s/step - loss: 0.4276 - custom_accuracy: 0.700
4 - val_loss: 0.3828 - val_custom_accuracy: 0.3442
Epoch 20/300
4/4 [==============================] - 10s 3s/step - loss: 0.4371 - custom_accuracy: 0.76
56 - val_loss: 0.3817 - val_custom_accuracy: 0.3442
Epoch 21/300
4/4 [==============================] - 6s 2s/step - loss: 0.4362 - custom_accuracy: 0.755
9 - val_loss: 0.3806 - val_custom_accuracy: 0.3442
Epoch 22/300
4/4 [==============================] - 8s 2s/step - loss: 0.4313 - custom_accuracy: 0.813
7 - val_loss: 0.3807 - val_custom_accuracy: 0.3442
Epoch 23/300
4/4 [==============================] - 8s 2s/step - loss: 0.4321 - custom_accuracy: 0.758
2 - val_loss: 0.3808 - val_custom_accuracy: 0.3442
Epoch 24/300
4/4 [==============================] - 6s 2s/step - loss: 0.4315 - custom_accuracy: 0.758
1 - val_loss: 0.3820 - val_custom_accuracy: 0.3442
Epoch 25/300
4/4 [==============================] - 10s 2s/step - loss: 0.4251 - custom_accuracy: 0.81
77 - val_loss: 0.3842 - val_custom_accuracy: 0.3442
Epoch 26/300
4/4 [==============================] - 6s 1s/step - loss: 0.4412 - custom_accuracy: 0.702
3 - val_loss: 0.3861 - val_custom_accuracy: 0.3442
Epoch 27/300
4/4 [==============================] - 8s 2s/step - loss: 0.4319 - custom_accuracy: 0.736
6 - val_loss: 0.3849 - val_custom_accuracy: 0.3442
Epoch 28/300
4/4 [==============================] - 8s 2s/step - loss: 0.4304 - custom_accuracy: 0.764
3 - val_loss: 0.3835 - val_custom_accuracy: 0.3442
Epoch 29/300
4/4 [==============================] - 6s 2s/step - loss: 0.4356 - custom_accuracy: 0.755
7 - val_loss: 0.3829 - val_custom_accuracy: 0.3442
Epoch 30/300
4/4 [==============================] - 10s 2s/step - loss: 0.4225 - custom_accuracy: 0.81
89 - val_loss: 0.3828 - val_custom_accuracy: 0.3442
Epoch 31/300
4/4 [==============================] - 6s 2s/step - loss: 0.4265 - custom_accuracy: 0.815
0 - val_loss: 0.3826 - val_custom_accuracy: 0.3442
Epoch 32/300
4/4 [==============================] - 8s 2s/step - loss: 0.4287 - custom_accuracy: 0.759
0 - val_loss: 0.3828 - val_custom_accuracy: 0.3442
Epoch 33/300
4/4 [==============================] - 7s 2s/step - loss: 0.4281 - custom_accuracy: 0.811
```

```
4 - val_loss: 0.3837 - val_custom_accuracy: 0.3442
Epoch 34/300
4/4 [==============================] - 6s 2s/step - loss: 0.4351 - custom_accuracy: 0.740
6 - val_loss: 0.3850 - val_custom_accuracy: 0.3442
Epoch 35/300
4/4 [==============================] - 10s 2s/step - loss: 0.4342 - custom_accuracy: 0.81
26 - val_loss: 0.3867 - val_custom_accuracy: 0.3442
Epoch 36/300
4/4 [==============================] - 6s 2s/step - loss: 0.4303 - custom_accuracy: 0.775
5 - val_loss: 0.3894 - val_custom_accuracy: 0.3442
Epoch 37/300
4/4 [==============================] - 9s 2s/step - loss: 0.4294 - custom_accuracy: 0.739
9 - val_loss: 0.3922 - val_custom_accuracy: 0.3442
Epoch 38/300
4/4 [==============================] - 7s 2s/step - loss: 0.4306 - custom_accuracy: 0.647
6 - val_loss: 0.3930 - val_custom_accuracy: 0.3442
Epoch 39/300
4/4 [==============================] - 7s 2s/step - loss: 0.4248 - custom_accuracy: 0.741
3 - val_loss: 0.3904 - val_custom_accuracy: 0.3442
Epoch 40/300
4/4 [==============================] - 9s 2s/step - loss: 0.4346 - custom_accuracy: 0.808
8 - val_loss: 0.3880 - val_custom_accuracy: 0.3442
Epoch 41/300
4/4 [==============================] - 6s 2s/step - loss: 0.4324 - custom_accuracy: 0.767
9 - val_loss: 0.3860 - val_custom_accuracy: 0.3442
Epoch 42/300
4/4 [==============================] - 9s 2s/step - loss: 0.4307 - custom_accuracy: 0.810
6 - val_loss: 0.3840 - val_custom_accuracy: 0.3442
Epoch 43/300
4/4 [==============================] - 7s 2s/step - loss: 0.4300 - custom_accuracy: 0.813
8 - val_loss: 0.3824 - val_custom_accuracy: 0.3442
Epoch 44/300
4/4 [==============================] - 6s 2s/step - loss: 0.4255 - custom_accuracy: 0.643
9 - val_loss: 0.3815 - val_custom_accuracy: 0.3442
Epoch 45/300
4/4 [==============================] - 10s 2s/step - loss: 0.4287 - custom_accuracy: 0.70
85 - val_loss: 0.3810 - val_custom_accuracy: 0.3442
Epoch 46/300
4/4 [==============================] - 6s 2s/step - loss: 0.4316 - custom_accuracy: 0.662
6 - val_loss: 0.3800 - val_custom_accuracy: 0.3442
Epoch 47/300
4/4 [==============================] - 9s 2s/step - loss: 0.4278 - custom_accuracy: 0.741
1 - val_loss: 0.3789 - val_custom_accuracy: 0.3442
Epoch 48/300
4/4 [==============================] - 7s 2s/step - loss: 0.4316 - custom_accuracy: 0.768
7 - val_loss: 0.3769 - val_custom_accuracy: 0.3442
Epoch 49/300
4/4 [==============================] - 7s 2s/step - loss: 0.4226 - custom_accuracy: 0.774
3 - val_loss: 0.3759 - val_custom_accuracy: 0.3442
Epoch 50/300
4/4 [==============================] - 9s 2s/step - loss: 0.4251 - custom_accuracy: 0.817
3 - val_loss: 0.3747 - val_custom_accuracy: 0.3442
Epoch 51/300
4/4 [==============================] - 6s 2s/step - loss: 0.4305 - custom_accuracy: 0.773
9 - val_loss: 0.3742 - val_custom_accuracy: 0.3442
Epoch 52/300
4/4 [==============================] - 9s 2s/step - loss: 0.4324 - custom_accuracy: 0.760
2 - val_loss: 0.3742 - val_custom_accuracy: 0.3442
Epoch 53/300
4/4 [==============================] - 7s 2s/step - loss: 0.4277 - custom_accuracy: 0.702
0 - val_loss: 0.3737 - val_custom_accuracy: 0.3442
Epoch 54/300
4/4 [==============================] - 7s 2s/step - loss: 0.4243 - custom_accuracy: 0.816
9 - val_loss: 0.3739 - val_custom_accuracy: 0.3442
Epoch 55/300
4/4 [==============================] - 9s 2s/step - loss: 0.4239 - custom_accuracy: 0.685
2 - val_loss: 0.3744 - val_custom_accuracy: 0.3442
Epoch 56/300
4/4 [==============================] - 6s 2s/step - loss: 0.4252 - custom_accuracy: 0.774
8 - val_loss: 0.3730 - val_custom_accuracy: 0.3442
Epoch 57/300
4/4 [==============================] - 9s 2s/step - loss: 0.4281 - custom_accuracy: 0.779
```

```
9 - val_loss: 0.3718 - val_custom_accuracy: 0.3442
Epoch 58/300
4/4 [==============================] - 7s 2s/step - loss: 0.4231 - custom_accuracy: 0.705
6 - val_loss: 0.3703 - val_custom_accuracy: 0.3442
Epoch 59/300
4/4 [==============================] - 7s 2s/step - loss: 0.4274 - custom_accuracy: 0.812
8 - val_loss: 0.3686 - val_custom_accuracy: 0.3511
Epoch 60/300
4/4 [==============================] - 9s 2s/step - loss: 0.4302 - custom_accuracy: 0.808
6 - val_loss: 0.3688 - val_custom_accuracy: 0.3442
Epoch 61/300
4/4 [==============================] - 6s 2s/step - loss: 0.4261 - custom_accuracy: 0.810
5 - val_loss: 0.3693 - val_custom_accuracy: 0.3442
Epoch 62/300
4/4 [==============================] - 9s 3s/step - loss: 0.4302 - custom_accuracy: 0.810
6 - val_loss: 0.3713 - val_custom_accuracy: 0.3442
Epoch 63/300
4/4 [==============================] - 7s 2s/step - loss: 0.4237 - custom_accuracy: 0.757
5 - val_loss: 0.3743 - val_custom_accuracy: 0.3442
Epoch 64/300
4/4 [==============================] - 7s 2s/step - loss: 0.4314 - custom_accuracy: 0.808
5 - val_loss: 0.3767 - val_custom_accuracy: 0.3442
Epoch 65/300
4/4 [==============================] - 9s 2s/step - loss: 0.4243 - custom_accuracy: 0.726
0 - val_loss: 0.3789 - val_custom_accuracy: 0.3442
Epoch 66/300
4/4 [==============================] - 6s 2s/step - loss: 0.4390 - custom_accuracy: 0.584
9 - val_loss: 0.3815 - val_custom_accuracy: 0.3442
Epoch 67/300
4/4 [==============================] - 9s 3s/step - loss: 0.4234 - custom_accuracy: 0.818
2 - val_loss: 0.3826 - val_custom_accuracy: 0.3442
Epoch 68/300
4/4 [==============================] - 7s 2s/step - loss: 0.4285 - custom_accuracy: 0.749
1 - val_loss: 0.3858 - val_custom_accuracy: 0.3442
Epoch 69/300
4/4 [==============================] - 7s 2s/step - loss: 0.4265 - custom_accuracy: 0.813
4 - val_loss: 0.3888 - val_custom_accuracy: 0.3442
Epoch 70/300
4/4 [==============================] - 9s 2s/step - loss: 0.4290 - custom_accuracy: 0.662
6 - val_loss: 0.3900 - val_custom_accuracy: 0.3442
Epoch 71/300
4/4 [==============================] - 6s 2s/step - loss: 0.4325 - custom_accuracy: 0.752
9 - val_loss: 0.3896 - val_custom_accuracy: 0.3442
Epoch 72/300
4/4 [==============================] - 9s 2s/step - loss: 0.4230 - custom_accuracy: 0.699
1 - val_loss: 0.3883 - val_custom_accuracy: 0.3442
Epoch 73/300
4/4 [==============================] - 7s 2s/step - loss: 0.4286 - custom_accuracy: 0.738
0 - val_loss: 0.3853 - val_custom_accuracy: 0.3442
Epoch 74/300
4/4 [==============================] - 6s 2s/step - loss: 0.4264 - custom_accuracy: 0.813
5 - val_loss: 0.3833 - val_custom_accuracy: 0.3442
Epoch 75/300
4/4 [==============================] - 10s 2s/step - loss: 0.4309 - custom_accuracy: 0.66
38 - val_loss: 0.3821 - val_custom_accuracy: 0.3442
Epoch 76/300
4/4 [==============================] - 6s 2s/step - loss: 0.4239 - custom_accuracy: 0.682
2 - val_loss: 0.3810 - val_custom_accuracy: 0.3442
Epoch 77/300
4/4 [==============================] - 8s 2s/step - loss: 0.4358 - custom_accuracy: 0.813
7 - val_loss: 0.3802 - val_custom_accuracy: 0.3442
Epoch 78/300
4/4 [==============================] - 7s 2s/step - loss: 0.4260 - custom_accuracy: 0.737
4 - val_loss: 0.3801 - val_custom_accuracy: 0.3442
Epoch 79/300
4/4 [==============================] - 6s 2s/step - loss: 0.4298 - custom_accuracy: 0.758
9 - val_loss: 0.3807 - val_custom_accuracy: 0.3442
Epoch 80/300
4/4 [==============================] - 10s 2s/step - loss: 0.4292 - custom_accuracy: 0.75
76 - val_loss: 0.3803 - val_custom_accuracy: 0.3442
Epoch 81/300
4/4 [==============================] - 6s 2s/step - loss: 0.4229 - custom_accuracy: 0.754
```

```
9 - val_loss: 0.3799 - val_custom_accuracy: 0.3442
Epoch 82/300
4/4 [==============================] - 8s 2s/step - loss: 0.4344 - custom_accuracy: 0.802
6 - val_loss: 0.3804 - val_custom_accuracy: 0.3442
Epoch 83/300
4/4 [==============================] - 8s 2s/step - loss: 0.4283 - custom_accuracy: 0.737
9 - val_loss: 0.3799 - val_custom_accuracy: 0.3442
Epoch 84/300
4/4 [==============================] - 6s 2s/step - loss: 0.4317 - custom_accuracy: 0.811
7 - val_loss: 0.3779 - val_custom_accuracy: 0.3442
Epoch 85/300
4/4 [==============================] - 10s 2s/step - loss: 0.4233 - custom_accuracy: 0.73
95 - val_loss: 0.3757 - val_custom_accuracy: 0.3442
Epoch 86/300
4/4 [==============================] - 6s 2s/step - loss: 0.4234 - custom_accuracy: 0.757
7 - val_loss: 0.3741 - val_custom_accuracy: 0.3442
Epoch 87/300
4/4 [==============================] - 8s 2s/step - loss: 0.4233 - custom_accuracy: 0.752
9 - val_loss: 0.3740 - val_custom_accuracy: 0.3442
Epoch 88/300
4/4 [==============================] - 8s 2s/step - loss: 0.4238 - custom_accuracy: 0.821
3 - val_loss: 0.3742 - val_custom_accuracy: 0.3442
Epoch 89/300
4/4 [==============================] - 6s 2s/step - loss: 0.4260 - custom_accuracy: 0.739
4 - val_loss: 0.3753 - val_custom_accuracy: 0.3442
Epoch 90/300
4/4 [==============================] - 10s 3s/step - loss: 0.4255 - custom_accuracy: 0.74
01 - val_loss: 0.3771 - val_custom_accuracy: 0.3442
Epoch 91/300
4/4 [==============================] - 6s 2s/step - loss: 0.4291 - custom_accuracy: 0.757
4 - val_loss: 0.3799 - val_custom_accuracy: 0.3442
Epoch 92/300
4/4 [==============================] - 8s 2s/step - loss: 0.4255 - custom_accuracy: 0.818
6 - val_loss: 0.3826 - val_custom_accuracy: 0.3442
Epoch 93/300
4/4 [==============================] - 8s 2s/step - loss: 0.4227 - custom_accuracy: 0.816
2 - val_loss: 0.3850 - val_custom_accuracy: 0.3442
Epoch 94/300
4/4 [==============================] - 6s 2s/step - loss: 0.4211 - custom_accuracy: 0.708
3 - val_loss: 0.3857 - val_custom_accuracy: 0.3442
Epoch 95/300
4/4 [==============================] - 10s 2s/step - loss: 0.4205 - custom_accuracy: 0.81
63 - val_loss: 0.3835 - val_custom_accuracy: 0.3442
Epoch 96/300
4/4 [==============================] - 6s 2s/step - loss: 0.4268 - custom_accuracy: 0.813
2 - val_loss: 0.3818 - val_custom_accuracy: 0.3442
Epoch 97/300
4/4 [==============================] - 8s 2s/step - loss: 0.4257 - custom_accuracy: 0.697
6 - val_loss: 0.3797 - val_custom_accuracy: 0.3442
Epoch 98/300
4/4 [==============================] - 7s 2s/step - loss: 0.4276 - custom_accuracy: 0.757
3 - val_loss: 0.3758 - val_custom_accuracy: 0.3442
Epoch 99/300
4/4 [==============================] - 6s 2s/step - loss: 0.4213 - custom_accuracy: 0.646
9 - val_loss: 0.3729 - val_custom_accuracy: 0.3442
Epoch 100/300
4/4 [==============================] - 10s 2s/step - loss: 0.4228 - custom_accuracy: 0.81
38 - val_loss: 0.3689 - val_custom_accuracy: 0.3442
Epoch 101/300
4/4 [==============================] - 6s 2s/step - loss: 0.4228 - custom_accuracy: 0.816
3 - val_loss: 0.3677 - val_custom_accuracy: 0.3442
Epoch 102/300
4/4 [==============================] - 8s 2s/step - loss: 0.4296 - custom_accuracy: 0.726
3 - val_loss: 0.3684 - val_custom_accuracy: 0.3442
Epoch 103/300
4/4 [==============================] - 7s 2s/step - loss: 0.4279 - custom_accuracy: 0.723
9 - val_loss: 0.3685 - val_custom_accuracy: 0.3442
Epoch 104/300
4/4 [==============================] - 6s 2s/step - loss: 0.4173 - custom_accuracy: 0.813
4 - val_loss: 0.3681 - val_custom_accuracy: 0.3442
Epoch 105/300
4/4 [==============================] - 10s 2s/step - loss: 0.4219 - custom_accuracy: 0.66
```

```
89 - val_loss: 0.3681 - val_custom_accuracy: 0.3442
Epoch 106/300
4/4 [==============================] - 6s 2s/step - loss: 0.4277 - custom_accuracy: 0.589
2 - val_loss: 0.3692 - val_custom_accuracy: 0.3442
Epoch 107/300
4/4 [==============================] - 8s 2s/step - loss: 0.4274 - custom_accuracy: 0.725
2 - val_loss: 0.3712 - val_custom_accuracy: 0.3442
Epoch 108/300
4/4 [==============================] - 7s 2s/step - loss: 0.4214 - custom_accuracy: 0.820
3 - val_loss: 0.3738 - val_custom_accuracy: 0.3442
Epoch 109/300
4/4 [==============================] - 6s 2s/step - loss: 0.4276 - custom_accuracy: 0.725
7 - val_loss: 0.3758 - val_custom_accuracy: 0.3442
Epoch 110/300
4/4 [==============================] - 10s 2s/step - loss: 0.4272 - custom_accuracy: 0.73
58 - val_loss: 0.3774 - val_custom_accuracy: 0.3442
Epoch 111/300
4/4 [==============================] - 6s 2s/step - loss: 0.4379 - custom_accuracy: 0.807
7 - val_loss: 0.3785 - val_custom_accuracy: 0.3442
Epoch 112/300
4/4 [==============================] - 8s 2s/step - loss: 0.4267 - custom_accuracy: 0.774
7 - val_loss: 0.3787 - val_custom_accuracy: 0.3442
Epoch 113/300
4/4 [==============================] - 7s 2s/step - loss: 0.4278 - custom_accuracy: 0.772
1 - val_loss: 0.3787 - val_custom_accuracy: 0.3442
Epoch 114/300
4/4 [==============================] - 6s 2s/step - loss: 0.4228 - custom_accuracy: 0.817
9 - val_loss: 0.3778 - val_custom_accuracy: 0.3442
Epoch 115/300
4/4 [==============================] - 10s 2s/step - loss: 0.4225 - custom_accuracy: 0.73
13 - val_loss: 0.3769 - val_custom_accuracy: 0.3442
Epoch 116/300
4/4 [==============================] - 6s 2s/step - loss: 0.4280 - custom_accuracy: 0.726
0 - val_loss: 0.3778 - val_custom_accuracy: 0.3442
Epoch 117/300
4/4 [==============================] - 8s 2s/step - loss: 0.4263 - custom_accuracy: 0.811
7 - val_loss: 0.3764 - val_custom_accuracy: 0.3442
Epoch 118/300
4/4 [==============================] - 7s 2s/step - loss: 0.4214 - custom_accuracy: 0.724
1 - val_loss: 0.3749 - val_custom_accuracy: 0.3442
Epoch 119/300
4/4 [==============================] - 6s 2s/step - loss: 0.4320 - custom_accuracy: 0.765
9 - val_loss: 0.3727 - val_custom_accuracy: 0.3442
Epoch 120/300
4/4 [==============================] - 10s 2s/step - loss: 0.4252 - custom_accuracy: 0.77
75 - val_loss: 0.3717 - val_custom_accuracy: 0.3442
Epoch 121/300
4/4 [==============================] - 6s 2s/step - loss: 0.4274 - custom_accuracy: 0.813
8 - val_loss: 0.3708 - val_custom_accuracy: 0.3442
Epoch 122/300
4/4 [==============================] - 9s 2s/step - loss: 0.4206 - custom_accuracy: 0.816
2 - val_loss: 0.3709 - val_custom_accuracy: 0.3442
Epoch 123/300
4/4 [==============================] - 7s 2s/step - loss: 0.4287 - custom_accuracy: 0.807
8 - val_loss: 0.3728 - val_custom_accuracy: 0.3442
Epoch 124/300
4/4 [==============================] - 7s 2s/step - loss: 0.4248 - custom_accuracy: 0.758
2 - val_loss: 0.3751 - val_custom_accuracy: 0.3442
Epoch 125/300
4/4 [==============================] - 9s 2s/step - loss: 0.4248 - custom_accuracy: 0.708
6 - val_loss: 0.3778 - val_custom_accuracy: 0.3442
Epoch 126/300
4/4 [==============================] - 6s 2s/step - loss: 0.4248 - custom_accuracy: 0.741
6 - val_loss: 0.3785 - val_custom_accuracy: 0.3442
Epoch 127/300
4/4 [==============================] - 9s 2s/step - loss: 0.4307 - custom_accuracy: 0.769
1 - val_loss: 0.3771 - val_custom_accuracy: 0.3442
Epoch 128/300
4/4 [==============================] - 7s 2s/step - loss: 0.4205 - custom_accuracy: 0.816
3 - val_loss: 0.3769 - val_custom_accuracy: 0.3442
Epoch 129/300
4/4 [==============================] - 7s 2s/step - loss: 0.4328 - custom_accuracy: 0.733
```

```
6 - val_loss: 0.3768 - val_custom_accuracy: 0.3442
Epoch 130/300
4/4 [==============================] - 9s 2s/step - loss: 0.4247 - custom_accuracy: 0.753
6 - val_loss: 0.3773 - val_custom_accuracy: 0.3442
Epoch 131/300
4/4 [==============================] - 6s 1s/step - loss: 0.4162 - custom_accuracy: 0.767
9 - val_loss: 0.3761 - val_custom_accuracy: 0.3442
Epoch 132/300
4/4 [==============================] - 9s 3s/step - loss: 0.4267 - custom_accuracy: 0.805
5 - val_loss: 0.3735 - val_custom_accuracy: 0.3442
Epoch 133/300
4/4 [==============================] - 7s 2s/step - loss: 0.4254 - custom_accuracy: 0.666
0 - val_loss: 0.3743 - val_custom_accuracy: 0.3442
Epoch 134/300
4/4 [==============================] - 7s 2s/step - loss: 0.4270 - custom_accuracy: 0.813
8 - val_loss: 0.3768 - val_custom_accuracy: 0.3442
Epoch 135/300
4/4 [==============================] - 9s 2s/step - loss: 0.4242 - custom_accuracy: 0.809
8 - val_loss: 0.3800 - val_custom_accuracy: 0.3442
Epoch 136/300
4/4 [==============================] - 6s 2s/step - loss: 0.4303 - custom_accuracy: 0.804
7 - val_loss: 0.3826 - val_custom_accuracy: 0.3442
Epoch 137/300
4/4 [==============================] - 9s 2s/step - loss: 0.4335 - custom_accuracy: 0.772
8 - val_loss: 0.3843 - val_custom_accuracy: 0.3442
Epoch 138/300
4/4 [==============================] - 7s 2s/step - loss: 0.4353 - custom_accuracy: 0.580
9 - val_loss: 0.3834 - val_custom_accuracy: 0.3442
Epoch 139/300
4/4 [==============================] - 7s 2s/step - loss: 0.4269 - custom_accuracy: 0.803
4 - val_loss: 0.3754 - val_custom_accuracy: 0.3442
Epoch 140/300
4/4 [==============================] - 9s 2s/step - loss: 0.4293 - custom_accuracy: 0.663
4 - val_loss: 0.3710 - val_custom_accuracy: 0.3442
Epoch 141/300
4/4 [==============================] - 6s 2s/step - loss: 0.4212 - custom_accuracy: 0.806
2 - val_loss: 0.3681 - val_custom_accuracy: 0.3442
Epoch 142/300
4/4 [==============================] - 9s 2s/step - loss: 0.4187 - custom_accuracy: 0.813
6 - val_loss: 0.3662 - val_custom_accuracy: 0.3442
Epoch 143/300
4/4 [==============================] - 7s 2s/step - loss: 0.4173 - custom_accuracy: 0.817
7 - val_loss: 0.3650 - val_custom_accuracy: 0.3442
Epoch 144/300
4/4 [==============================] - 7s 2s/step - loss: 0.4251 - custom_accuracy: 0.727
5 - val_loss: 0.3652 - val_custom_accuracy: 0.3442
Epoch 145/300
4/4 [==============================] - 9s 2s/step - loss: 0.4212 - custom_accuracy: 0.751
7 - val_loss: 0.3647 - val_custom_accuracy: 0.3442
Epoch 146/300
4/4 [==============================] - 6s 2s/step - loss: 0.4255 - custom_accuracy: 0.812
1 - val_loss: 0.3646 - val_custom_accuracy: 0.3442
Epoch 147/300
4/4 [==============================] - 9s 3s/step - loss: 0.4226 - custom_accuracy: 0.768
9 - val_loss: 0.3655 - val_custom_accuracy: 0.3442
Epoch 148/300
4/4 [==============================] - 7s 2s/step - loss: 0.4362 - custom_accuracy: 0.811
0 - val_loss: 0.3674 - val_custom_accuracy: 0.3442
Epoch 149/300
4/4 [==============================] - 7s 2s/step - loss: 0.4261 - custom_accuracy: 0.649
8 - val_loss: 0.3691 - val_custom_accuracy: 0.3442
Epoch 150/300
4/4 [==============================] - 9s 2s/step - loss: 0.4250 - custom_accuracy: 0.816
6 - val_loss: 0.3679 - val_custom_accuracy: 0.3442
Epoch 151/300
4/4 [==============================] - 6s 2s/step - loss: 0.4231 - custom_accuracy: 0.809
9 - val_loss: 0.3665 - val_custom_accuracy: 0.3442
Epoch 152/300
4/4 [==============================] - 9s 3s/step - loss: 0.4219 - custom_accuracy: 0.814
0 - val_loss: 0.3661 - val_custom_accuracy: 0.3442
Epoch 153/300
4/4 [==============================] - 6s 2s/step - loss: 0.4192 - custom_accuracy: 0.813
```

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1 - val_loss: 0.3667 - val_custom_accuracy: 0.3442
Epoch 154/300
4/4 [==============================] - 7s 2s/step - loss: 0.4262 - custom_accuracy: 0.743
0 - val_loss: 0.3679 - val_custom_accuracy: 0.3442
Epoch 155/300
4/4 [==============================] - 9s 2s/step - loss: 0.4247 - custom_accuracy: 0.810
0 - val_loss: 0.3688 - val_custom_accuracy: 0.3442
Epoch 156/300
4/4 [==============================] - 6s 2s/step - loss: 0.4268 - custom_accuracy: 0.701
3 - val_loss: 0.3690 - val_custom_accuracy: 0.3442
Epoch 157/300
4/4 [==============================] - 10s 3s/step - loss: 0.4189 - custom_accuracy: 0.75
99 - val_loss: 0.3660 - val_custom_accuracy: 0.3442
Epoch 158/300
4/4 [==============================] - 6s 2s/step - loss: 0.4202 - custom_accuracy: 0.815
0 - val_loss: 0.3645 - val_custom_accuracy: 0.3442
Epoch 159/300
4/4 [==============================] - 8s 2s/step - loss: 0.4271 - custom_accuracy: 0.758
1 - val_loss: 0.3644 - val_custom_accuracy: 0.3442
Epoch 160/300
4/4 [==============================] - 8s 2s/step - loss: 0.4228 - custom_accuracy: 0.818
8 - val_loss: 0.3650 - val_custom_accuracy: 0.3442
Epoch 161/300
4/4 [==============================] - 6s 2s/step - loss: 0.4274 - custom_accuracy: 0.756
7 - val_loss: 0.3662 - val_custom_accuracy: 0.3442
Epoch 162/300
4/4 [==============================] - 10s 3s/step - loss: 0.4218 - custom_accuracy: 0.73
82 - val_loss: 0.3670 - val_custom_accuracy: 0.3442
Epoch 163/300
4/4 [==============================] - 6s 2s/step - loss: 0.4329 - custom_accuracy: 0.805
5 - val_loss: 0.3670 - val_custom_accuracy: 0.3442
Epoch 164/300
4/4 [==============================] - 8s 2s/step - loss: 0.4185 - custom_accuracy: 0.813
0 - val_loss: 0.3683 - val_custom_accuracy: 0.3442
Epoch 165/300
4/4 [==============================] - 8s 2s/step - loss: 0.4272 - custom_accuracy: 0.738
6 - val_loss: 0.3718 - val_custom_accuracy: 0.3442
Epoch 166/300
4/4 [==============================] - 6s 2s/step - loss: 0.4223 - custom_accuracy: 0.809
4 - val_loss: 0.3755 - val_custom_accuracy: 0.3442
Epoch 167/300
4/4 [==============================] - 10s 2s/step - loss: 0.4297 - custom_accuracy: 0.70
04 - val_loss: 0.3776 - val_custom_accuracy: 0.3442
Epoch 168/300
4/4 [==============================] - 6s 2s/step - loss: 0.4135 - custom_accuracy: 0.752
1 - val_loss: 0.3765 - val_custom_accuracy: 0.3442
Epoch 169/300
4/4 [==============================] - 8s 2s/step - loss: 0.4230 - custom_accuracy: 0.735
3 - val_loss: 0.3744 - val_custom_accuracy: 0.3442
Epoch 170/300
4/4 [==============================] - 7s 2s/step - loss: 0.4198 - custom_accuracy: 0.806
5 - val_loss: 0.3709 - val_custom_accuracy: 0.3442
Epoch 171/300
4/4 [==============================] - 6s 2s/step - loss: 0.4140 - custom_accuracy: 0.815
5 - val_loss: 0.3695 - val_custom_accuracy: 0.3442
Epoch 172/300
4/4 [==============================] - 10s 2s/step - loss: 0.4333 - custom_accuracy: 0.81
16 - val_loss: 0.3698 - val_custom_accuracy: 0.3442
Epoch 173/300
4/4 [==============================] - 6s 2s/step - loss: 0.4199 - custom_accuracy: 0.816
7 - val_loss: 0.3707 - val_custom_accuracy: 0.3442
Epoch 174/300
4/4 [==============================] - 8s 2s/step - loss: 0.4187 - custom_accuracy: 0.703
6 - val_loss: 0.3722 - val_custom_accuracy: 0.3442
Epoch 175/300
4/4 [==============================] - 7s 2s/step - loss: 0.4298 - custom_accuracy: 0.757
2 - val_loss: 0.3718 - val_custom_accuracy: 0.3442
Epoch 176/300
4/4 [==============================] - 7s 2s/step - loss: 0.4314 - custom_accuracy: 0.575
8 - val_loss: 0.3694 - val_custom_accuracy: 0.3442
Epoch 177/300
4/4 [==============================] - 10s 2s/step - loss: 0.4212 - custom_accuracy: 0.73
```

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85 - val_loss: 0.3662 - val_custom_accuracy: 0.3442
Epoch 178/300
4/4 [==============================] - 6s 2s/step - loss: 0.4312 - custom_accuracy: 0.771
5 - val_loss: 0.3652 - val_custom_accuracy: 0.3442
Epoch 179/300
4/4 [==============================] - 8s 2s/step - loss: 0.4243 - custom_accuracy: 0.812
6 - val_loss: 0.3652 - val_custom_accuracy: 0.3442
Epoch 180/300
4/4 [==============================] - 7s 2s/step - loss: 0.4257 - custom_accuracy: 0.778
4 - val_loss: 0.3656 - val_custom_accuracy: 0.3442
Epoch 181/300
4/4 [==============================] - 6s 2s/step - loss: 0.4252 - custom_accuracy: 0.780
4 - val_loss: 0.3657 - val_custom_accuracy: 0.3442
Epoch 182/300
4/4 [==============================] - 10s 2s/step - loss: 0.4137 - custom_accuracy: 0.81
65 - val_loss: 0.3672 - val_custom_accuracy: 0.3442
Epoch 183/300
4/4 [==============================] - 6s 2s/step - loss: 0.4276 - custom_accuracy: 0.775
7 - val_loss: 0.3687 - val_custom_accuracy: 0.3442
Epoch 184/300
4/4 [==============================] - 9s 2s/step - loss: 0.4268 - custom_accuracy: 0.809
5 - val_loss: 0.3701 - val_custom_accuracy: 0.3442
Epoch 185/300
4/4 [==============================] - 7s 2s/step - loss: 0.4228 - custom_accuracy: 0.759
6 - val_loss: 0.3716 - val_custom_accuracy: 0.3442
Epoch 186/300
4/4 [==============================] - 7s 2s/step - loss: 0.4132 - custom_accuracy: 0.759
5 - val_loss: 0.3713 - val_custom_accuracy: 0.3442
Epoch 187/300
4/4 [==============================] - 9s 2s/step - loss: 0.4205 - custom_accuracy: 0.757
8 - val_loss: 0.3697 - val_custom_accuracy: 0.3442
Epoch 188/300
4/4 [==============================] - 6s 2s/step - loss: 0.4276 - custom_accuracy: 0.758
4 - val_loss: 0.3679 - val_custom_accuracy: 0.3442
Epoch 189/300
4/4 [==============================] - 9s 2s/step - loss: 0.4243 - custom_accuracy: 0.825
2 - val_loss: 0.3660 - val_custom_accuracy: 0.3442
Epoch 190/300
4/4 [==============================] - 7s 2s/step - loss: 0.4294 - custom_accuracy: 0.740
5 - val_loss: 0.3661 - val_custom_accuracy: 0.3442
Epoch 191/300
4/4 [==============================] - 7s 2s/step - loss: 0.4238 - custom_accuracy: 0.736
7 - val_loss: 0.3673 - val_custom_accuracy: 0.3442
Epoch 192/300
4/4 [==============================] - 9s 2s/step - loss: 0.4213 - custom_accuracy: 0.781
5 - val_loss: 0.3696 - val_custom_accuracy: 0.3442
Epoch 193/300
4/4 [==============================] - 6s 2s/step - loss: 0.4139 - custom_accuracy: 0.819
3 - val_loss: 0.3731 - val_custom_accuracy: 0.3442
Epoch 194/300
4/4 [==============================] - 9s 3s/step - loss: 0.4229 - custom_accuracy: 0.684
5 - val_loss: 0.3772 - val_custom_accuracy: 0.3442
Epoch 195/300
4/4 [==============================] - 7s 2s/step - loss: 0.4243 - custom_accuracy: 0.756
6 - val_loss: 0.3790 - val_custom_accuracy: 0.3442
Epoch 196/300
4/4 [==============================] - 7s 2s/step - loss: 0.4202 - custom_accuracy: 0.770
3 - val_loss: 0.3809 - val_custom_accuracy: 0.3442
Epoch 197/300
4/4 [==============================] - 9s 2s/step - loss: 0.4186 - custom_accuracy: 0.738
5 - val_loss: 0.3812 - val_custom_accuracy: 0.3442
Epoch 198/300
4/4 [==============================] - 6s 2s/step - loss: 0.4217 - custom_accuracy: 0.817
4 - val_loss: 0.3810 - val_custom_accuracy: 0.3442
Epoch 199/300
4/4 [==============================] - 9s 3s/step - loss: 0.4118 - custom_accuracy: 0.747
5 - val_loss: 0.3818 - val_custom_accuracy: 0.3442
Epoch 200/300
4/4 [==============================] - 6s 2s/step - loss: 0.4157 - custom_accuracy: 0.770
3 - val_loss: 0.3830 - val_custom_accuracy: 0.3442
Epoch 201/300
4/4 [==============================] - 7s 2s/step - loss: 0.4232 - custom_accuracy: 0.664
```

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3 - val_loss: 0.3824 - val_custom_accuracy: 0.3442
Epoch 202/300
4/4 [==============================] - 9s 2s/step - loss: 0.4234 - custom_accuracy: 0.771
3 - val_loss: 0.3783 - val_custom_accuracy: 0.3442
Epoch 203/300
4/4 [==============================] - 6s 2s/step - loss: 0.4218 - custom_accuracy: 0.767
3 - val_loss: 0.3771 - val_custom_accuracy: 0.3442
Epoch 204/300
4/4 [==============================] - 10s 3s/step - loss: 0.4214 - custom_accuracy: 0.81
66 - val_loss: 0.3772 - val_custom_accuracy: 0.3442
Epoch 205/300
4/4 [==============================] - 6s 2s/step - loss: 0.4244 - custom_accuracy: 0.726
5 - val_loss: 0.3770 - val_custom_accuracy: 0.3442
Epoch 206/300
4/4 [==============================] - 7s 2s/step - loss: 0.4209 - custom_accuracy: 0.757
4 - val_loss: 0.3774 - val_custom_accuracy: 0.3442
Epoch 207/300
4/4 [==============================] - 8s 2s/step - loss: 0.4227 - custom_accuracy: 0.777
7 - val_loss: 0.3764 - val_custom_accuracy: 0.3442
Epoch 208/300
4/4 [==============================] - 6s 2s/step - loss: 0.4223 - custom_accuracy: 0.675
3 - val_loss: 0.3746 - val_custom_accuracy: 0.3442
Epoch 209/300
4/4 [==============================] - 10s 3s/step - loss: 0.4265 - custom_accuracy: 0.75
64 - val_loss: 0.3723 - val_custom_accuracy: 0.3442
Epoch 210/300
4/4 [==============================] - 6s 2s/step - loss: 0.4292 - custom_accuracy: 0.766
8 - val_loss: 0.3693 - val_custom_accuracy: 0.3442
Epoch 211/300
4/4 [==============================] - 8s 2s/step - loss: 0.4168 - custom_accuracy: 0.703
6 - val_loss: 0.3674 - val_custom_accuracy: 0.3442
Epoch 212/300
4/4 [==============================] - 8s 2s/step - loss: 0.4274 - custom_accuracy: 0.721
8 - val_loss: 0.3660 - val_custom_accuracy: 0.3403
Epoch 213/300
4/4 [==============================] - 6s 1s/step - loss: 0.4158 - custom_accuracy: 0.726
0 - val_loss: 0.3652 - val_custom_accuracy: 0.3403
Epoch 214/300
4/4 [==============================] - 9s 3s/step - loss: 0.4403 - custom_accuracy: 0.574
4 - val_loss: 0.3662 - val_custom_accuracy: 0.3403
Epoch 215/300
4/4 [==============================] - 6s 2s/step - loss: 0.4202 - custom_accuracy: 0.812
5 - val_loss: 0.3692 - val_custom_accuracy: 0.3403
Epoch 216/300
4/4 [==============================] - 10s 3s/step - loss: 0.4256 - custom_accuracy: 0.75
08 - val_loss: 0.3708 - val_custom_accuracy: 0.3403
Epoch 217/300
4/4 [==============================] - 7s 2s/step - loss: 0.4285 - custom_accuracy: 0.739
8 - val_loss: 0.3724 - val_custom_accuracy: 0.3442
Epoch 218/300
4/4 [==============================] - 7s 2s/step - loss: 0.4222 - custom_accuracy: 0.747
7 - val_loss: 0.3739 - val_custom_accuracy: 0.3442
Epoch 219/300
4/4 [==============================] - 9s 2s/step - loss: 0.4275 - custom_accuracy: 0.720
0 - val_loss: 0.3747 - val_custom_accuracy: 0.3442
Epoch 220/300
4/4 [==============================] - 6s 2s/step - loss: 0.4181 - custom_accuracy: 0.569
8 - val_loss: 0.3741 - val_custom_accuracy: 0.3442
Epoch 221/300
4/4 [==============================] - 9s 3s/step - loss: 0.4214 - custom_accuracy: 0.815
6 - val_loss: 0.3741 - val_custom_accuracy: 0.3442
Epoch 222/300
4/4 [==============================] - 6s 2s/step - loss: 0.4187 - custom_accuracy: 0.682
8 - val_loss: 0.3744 - val_custom_accuracy: 0.3442
Epoch 223/300
4/4 [==============================] - 7s 2s/step - loss: 0.4198 - custom_accuracy: 0.762
6 - val_loss: 0.3745 - val_custom_accuracy: 0.3442
Epoch 224/300
4/4 [==============================] - 9s 2s/step - loss: 0.4160 - custom_accuracy: 0.746
4 - val_loss: 0.3745 - val_custom_accuracy: 0.3442
Epoch 225/300
4/4 [==============================] - 6s 2s/step - loss: 0.4310 - custom_accuracy: 0.754
```

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7 - val_loss: 0.3751 - val_custom_accuracy: 0.3442
Epoch 226/300
4/4 [==============================] - 9s 3s/step - loss: 0.4257 - custom_accuracy: 0.723
2 - val_loss: 0.3750 - val_custom_accuracy: 0.3442
Epoch 227/300
4/4 [==============================] - 7s 2s/step - loss: 0.4074 - custom_accuracy: 0.817
5 - val_loss: 0.3752 - val_custom_accuracy: 0.3442
Epoch 228/300
4/4 [==============================] - 7s 2s/step - loss: 0.4175 - custom_accuracy: 0.685
7 - val_loss: 0.3760 - val_custom_accuracy: 0.3442
Epoch 229/300
4/4 [==============================] - 9s 2s/step - loss: 0.4224 - custom_accuracy: 0.813
6 - val_loss: 0.3750 - val_custom_accuracy: 0.3442
Epoch 230/300
4/4 [==============================] - 6s 2s/step - loss: 0.4226 - custom_accuracy: 0.810
7 - val_loss: 0.3742 - val_custom_accuracy: 0.3442
Epoch 231/300
4/4 [==============================] - 10s 3s/step - loss: 0.4217 - custom_accuracy: 0.73
48 - val_loss: 0.3734 - val_custom_accuracy: 0.3442
Epoch 232/300
4/4 [==============================] - 6s 2s/step - loss: 0.4145 - custom_accuracy: 0.708
9 - val_loss: 0.3734 - val_custom_accuracy: 0.3442
Epoch 233/300
4/4 [==============================] - 8s 2s/step - loss: 0.4239 - custom_accuracy: 0.738
6 - val_loss: 0.3737 - val_custom_accuracy: 0.3442
Epoch 234/300
4/4 [==============================] - 8s 2s/step - loss: 0.4190 - custom_accuracy: 0.769
3 - val_loss: 0.3738 - val_custom_accuracy: 0.3442
Epoch 235/300
4/4 [==============================] - 6s 2s/step - loss: 0.4227 - custom_accuracy: 0.812
9 - val_loss: 0.3727 - val_custom_accuracy: 0.3442
Epoch 236/300
4/4 [==============================] - 10s 3s/step - loss: 0.4298 - custom_accuracy: 0.70
07 - val_loss: 0.3724 - val_custom_accuracy: 0.3442
Epoch 237/300
4/4 [==============================] - 6s 2s/step - loss: 0.4209 - custom_accuracy: 0.777
8 - val_loss: 0.3743 - val_custom_accuracy: 0.3442
Epoch 238/300
4/4 [==============================] - 8s 2s/step - loss: 0.4180 - custom_accuracy: 0.814
1 - val_loss: 0.3766 - val_custom_accuracy: 0.3442
Epoch 239/300
4/4 [==============================] - 8s 2s/step - loss: 0.4196 - custom_accuracy: 0.757
6 - val_loss: 0.3793 - val_custom_accuracy: 0.3442
Epoch 240/300
4/4 [==============================] - 6s 2s/step - loss: 0.4178 - custom_accuracy: 0.770
5 - val_loss: 0.3812 - val_custom_accuracy: 0.3442
Epoch 241/300
4/4 [==============================] - 10s 3s/step - loss: 0.4201 - custom_accuracy: 0.76
86 - val_loss: 0.3822 - val_custom_accuracy: 0.3442
Epoch 242/300
4/4 [==============================] - 6s 2s/step - loss: 0.4127 - custom_accuracy: 0.817
9 - val_loss: 0.3826 - val_custom_accuracy: 0.3442
Epoch 243/300
4/4 [==============================] - 8s 2s/step - loss: 0.4158 - custom_accuracy: 0.810
7 - val_loss: 0.3842 - val_custom_accuracy: 0.3442
Epoch 244/300
4/4 [==============================] - 8s 2s/step - loss: 0.4204 - custom_accuracy: 0.816
3 - val_loss: 0.3854 - val_custom_accuracy: 0.3442
Epoch 245/300
4/4 [==============================] - 6s 2s/step - loss: 0.4203 - custom_accuracy: 0.814
7 - val_loss: 0.3859 - val_custom_accuracy: 0.3442
Epoch 246/300
4/4 [==============================] - 10s 3s/step - loss: 0.4229 - custom_accuracy: 0.73
79 - val_loss: 0.3861 - val_custom_accuracy: 0.3442
Epoch 247/300
4/4 [==============================] - 6s 2s/step - loss: 0.4244 - custom_accuracy: 0.697
7 - val_loss: 0.3873 - val_custom_accuracy: 0.3442
Epoch 248/300
4/4 [==============================] - 8s 2s/step - loss: 0.4189 - custom_accuracy: 0.810
9 - val_loss: 0.3899 - val_custom_accuracy: 0.3442
Epoch 249/300
4/4 [==============================] - 8s 2s/step - loss: 0.4247 - custom_accuracy: 0.813
```

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2 - val_loss: 0.3918 - val_custom_accuracy: 0.3442
Epoch 250/300
4/4 [==============================] - 6s 1s/step - loss: 0.4338 - custom_accuracy: 0.726
4 - val_loss: 0.3912 - val_custom_accuracy: 0.3442
Epoch 251/300
4/4 [==============================] - 10s 3s/step - loss: 0.4156 - custom_accuracy: 0.81
58 - val_loss: 0.3887 - val_custom_accuracy: 0.3442
Epoch 252/300
4/4 [==============================] - 6s 2s/step - loss: 0.4174 - custom_accuracy: 0.816
1 - val_loss: 0.3878 - val_custom_accuracy: 0.3442
Epoch 253/300
4/4 [==============================] - 7s 2s/step - loss: 0.4093 - custom_accuracy: 0.762
7 - val_loss: 0.3875 - val_custom_accuracy: 0.3442
Epoch 254/300
4/4 [==============================] - 8s 2s/step - loss: 0.4178 - custom_accuracy: 0.738
7 - val_loss: 0.3852 - val_custom_accuracy: 0.3442
Epoch 255/300
4/4 [==============================] - 6s 2s/step - loss: 0.4222 - custom_accuracy: 0.728
4 - val_loss: 0.3836 - val_custom_accuracy: 0.3442
Epoch 256/300
4/4 [==============================] - 10s 3s/step - loss: 0.4163 - custom_accuracy: 0.81
46 - val_loss: 0.3817 - val_custom_accuracy: 0.3442
Epoch 257/300
4/4 [==============================] - 6s 2s/step - loss: 0.4171 - custom_accuracy: 0.812
9 - val_loss: 0.3808 - val_custom_accuracy: 0.3442
Epoch 258/300
4/4 [==============================] - 7s 2s/step - loss: 0.4255 - custom_accuracy: 0.725
6 - val_loss: 0.3801 - val_custom_accuracy: 0.3442
Epoch 259/300
4/4 [==============================] - 8s 2s/step - loss: 0.4083 - custom_accuracy: 0.824
4 - val_loss: 0.3793 - val_custom_accuracy: 0.3442
Epoch 260/300
4/4 [==============================] - 6s 2s/step - loss: 0.4166 - custom_accuracy: 0.772
7 - val_loss: 0.3794 - val_custom_accuracy: 0.3442
Epoch 261/300
4/4 [==============================] - 10s 3s/step - loss: 0.4177 - custom_accuracy: 0.77
63 - val_loss: 0.3805 - val_custom_accuracy: 0.3442
Epoch 262/300
4/4 [==============================] - 6s 2s/step - loss: 0.4213 - custom_accuracy: 0.814
6 - val_loss: 0.3822 - val_custom_accuracy: 0.3442
Epoch 263/300
4/4 [==============================] - 7s 2s/step - loss: 0.4196 - custom_accuracy: 0.770
8 - val_loss: 0.3846 - val_custom_accuracy: 0.3442
Epoch 264/300
4/4 [==============================] - 9s 2s/step - loss: 0.4285 - custom_accuracy: 0.697
4 - val_loss: 0.3855 - val_custom_accuracy: 0.3442
Epoch 265/300
4/4 [==============================] - 6s 1s/step - loss: 0.4213 - custom_accuracy: 0.813
2 - val_loss: 0.3843 - val_custom_accuracy: 0.3442
Epoch 266/300
4/4 [==============================] - 9s 3s/step - loss: 0.4140 - custom_accuracy: 0.699
7 - val_loss: 0.3834 - val_custom_accuracy: 0.3442
Epoch 267/300
4/4 [==============================] - 6s 2s/step - loss: 0.4136 - custom_accuracy: 0.813
7 - val_loss: 0.3802 - val_custom_accuracy: 0.3442
Epoch 268/300
4/4 [==============================] - 7s 2s/step - loss: 0.4243 - custom_accuracy: 0.808
7 - val_loss: 0.3784 - val_custom_accuracy: 0.3442
Epoch 269/300
4/4 [==============================] - 9s 2s/step - loss: 0.4236 - custom_accuracy: 0.720
5 - val_loss: 0.3778 - val_custom_accuracy: 0.3442
Epoch 270/300
4/4 [==============================] - 6s 2s/step - loss: 0.4142 - custom_accuracy: 0.771
8 - val_loss: 0.3775 - val_custom_accuracy: 0.3442
Epoch 271/300
4/4 [==============================] - 9s 3s/step - loss: 0.4176 - custom_accuracy: 0.592
4 - val_loss: 0.3774 - val_custom_accuracy: 0.3442
Epoch 272/300
4/4 [==============================] - 6s 2s/step - loss: 0.4218 - custom_accuracy: 0.776
0 - val_loss: 0.3752 - val_custom_accuracy: 0.3442
Epoch 273/300
4/4 [==============================] - 7s 2s/step - loss: 0.4191 - custom_accuracy: 0.816
```

```
1 - val_loss: 0.3735 - val_custom_accuracy: 0.3442
Epoch 274/300
4/4 [==============================] - 9s 2s/step - loss: 0.4210 - custom_accuracy: 0.702
4 - val_loss: 0.3723 - val_custom_accuracy: 0.3442
Epoch 275/300
4/4 [==============================] - 6s 2s/step - loss: 0.4201 - custom_accuracy: 0.736
8 - val_loss: 0.3705 - val_custom_accuracy: 0.3442
Epoch 276/300
4/4 [==============================] - 9s 3s/step - loss: 0.4193 - custom_accuracy: 0.774
9 - val_loss: 0.3681 - val_custom_accuracy: 0.3442
Epoch 277/300
4/4 [==============================] - 6s 2s/step - loss: 0.4186 - custom_accuracy: 0.756
4 - val_loss: 0.3670 - val_custom_accuracy: 0.3403
Epoch 278/300
4/4 [==============================] - 7s 2s/step - loss: 0.4169 - custom_accuracy: 0.704
3 - val_loss: 0.3668 - val_custom_accuracy: 0.3403
Epoch 279/300
4/4 [==============================] - 9s 2s/step - loss: 0.4103 - custom_accuracy: 0.817
1 - val_loss: 0.3658 - val_custom_accuracy: 0.3403
Epoch 280/300
4/4 [==============================] - 6s 2s/step - loss: 0.4179 - custom_accuracy: 0.738
5 - val_loss: 0.3658 - val_custom_accuracy: 0.3403
Epoch 281/300
4/4 [==============================] - 10s 3s/step - loss: 0.4167 - custom_accuracy: 0.75
78 - val_loss: 0.3664 - val_custom_accuracy: 0.3403
Epoch 282/300
4/4 [==============================] - 6s 2s/step - loss: 0.4175 - custom_accuracy: 0.808
9 - val_loss: 0.3664 - val_custom_accuracy: 0.3403
Epoch 283/300
4/4 [==============================] - 7s 2s/step - loss: 0.4164 - custom_accuracy: 0.812
5 - val_loss: 0.3669 - val_custom_accuracy: 0.3442
Epoch 284/300
4/4 [==============================] - 8s 2s/step - loss: 0.4208 - custom_accuracy: 0.813
5 - val_loss: 0.3686 - val_custom_accuracy: 0.3442
Epoch 285/300
4/4 [==============================] - 6s 2s/step - loss: 0.4137 - custom_accuracy: 0.818
9 - val_loss: 0.3712 - val_custom_accuracy: 0.3442
Epoch 286/300
4/4 [==============================] - 9s 3s/step - loss: 0.4189 - custom_accuracy: 0.813
0 - val_loss: 0.3747 - val_custom_accuracy: 0.3442
Epoch 287/300
4/4 [==============================] - 6s 2s/step - loss: 0.4206 - custom_accuracy: 0.698
7 - val_loss: 0.3772 - val_custom_accuracy: 0.3442
Epoch 288/300
4/4 [==============================] - 10s 3s/step - loss: 0.4211 - custom_accuracy: 0.81
68 - val_loss: 0.3797 - val_custom_accuracy: 0.3442
Epoch 289/300
4/4 [==============================] - 7s 2s/step - loss: 0.4193 - custom_accuracy: 0.811
0 - val_loss: 0.3822 - val_custom_accuracy: 0.3442
Epoch 290/300
4/4 [==============================] - 7s 2s/step - loss: 0.4123 - custom_accuracy: 0.686
9 - val_loss: 0.3827 - val_custom_accuracy: 0.3442
Epoch 291/300
4/4 [==============================] - 9s 2s/step - loss: 0.4235 - custom_accuracy: 0.700
0 - val_loss: 0.3778 - val_custom_accuracy: 0.3442
Epoch 292/300
4/4 [==============================] - 6s 2s/step - loss: 0.4202 - custom_accuracy: 0.815
5 - val_loss: 0.3721 - val_custom_accuracy: 0.3442
Epoch 293/300
4/4 [==============================] - 9s 3s/step - loss: 0.4104 - custom_accuracy: 0.817
5 - val_loss: 0.3690 - val_custom_accuracy: 0.3442
Epoch 294/300
4/4 [==============================] - 7s 2s/step - loss: 0.4119 - custom_accuracy: 0.814
4 - val_loss: 0.3674 - val_custom_accuracy: 0.3442
Epoch 295/300
4/4 [==============================] - 7s 2s/step - loss: 0.4069 - custom_accuracy: 0.715
0 - val_loss: 0.3670 - val_custom_accuracy: 0.3442
Epoch 296/300
4/4 [==============================] - 9s 2s/step - loss: 0.4174 - custom_accuracy: 0.816
8 - val_loss: 0.3664 - val_custom_accuracy: 0.3442
Epoch 297/300
4/4 [==============================] - 6s 2s/step - loss: 0.4207 - custom_accuracy: 0.810
```

```
5 - val_loss: 0.3673 - val_custom_accuracy: 0.3442
Epoch 298/300
4/4 [==============================] - 9s 2s/step - loss: 0.4241 - custom_accuracy: 0.738
4 - val_loss: 0.3679 - val_custom_accuracy: 0.3442
Epoch 299/300
4/4 [==============================] - 7s 2s/step - loss: 0.4119 - custom_accuracy: 0.728
8 - val_loss: 0.3681 - val_custom_accuracy: 0.3442
Epoch 300/300
4/4 [==============================] - 7s 2s/step - loss: 0.4242 - custom_accuracy: 0.806
9 - val_loss: 0.3676 - val_custom_accuracy: 0.3442
```

In [ ]:

```
plt.plot(H.history['loss'])
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.title("Discriminator's Loss in cycle four")
plt.show()
```

```
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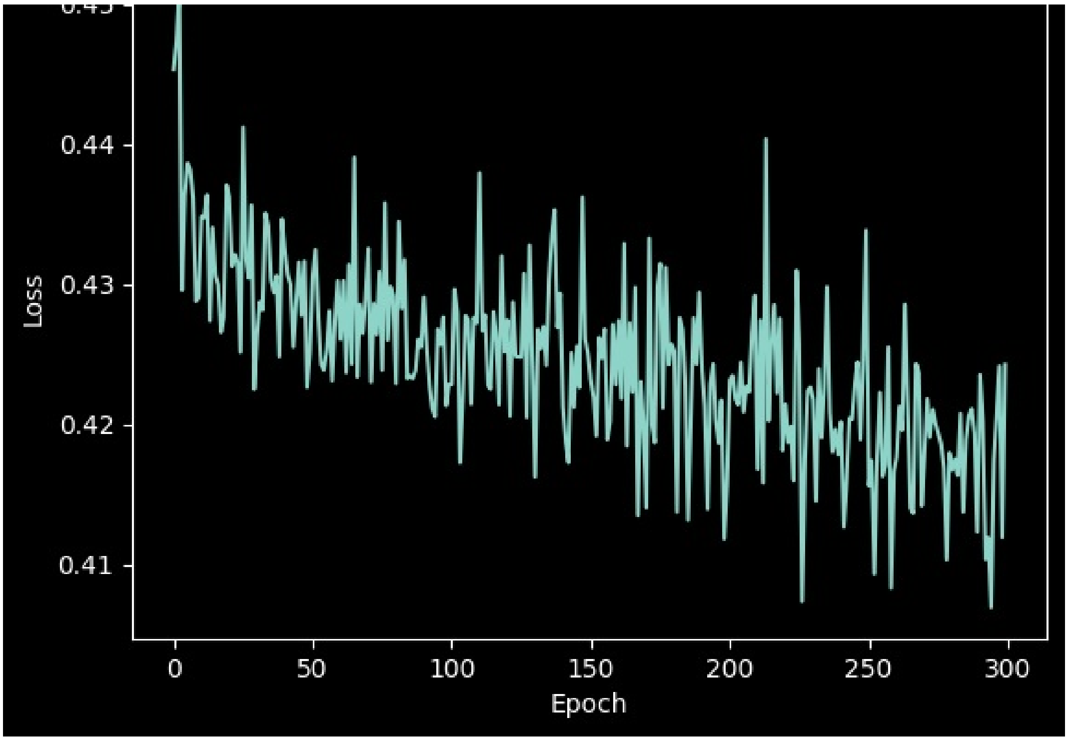
```



In [ ]:

```
plt.plot(H.history['custom_accuracy'])
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.title("Discriminator's Accuracy in cycle four")
plt.show()
```

```
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WARNING:matplotlib.font_manager:findfont: Font family 'Arial' not found.
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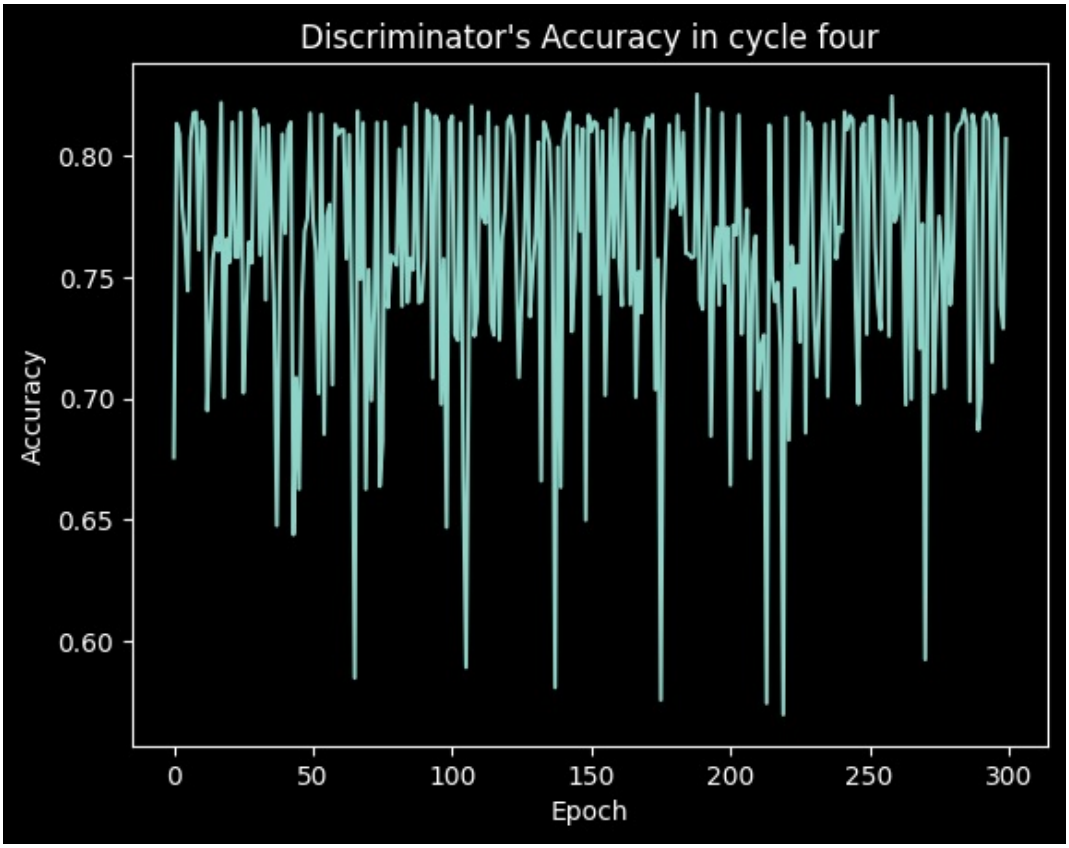
```



In [ ]:

```
custom_accuracy(np.array(y_gen_test, dtype=np.float32), qdisc_model.predict(gen_data_tes
t))
```

Out[ ]:

```
<tf.Tensor: shape=(), dtype=float32, numpy=0.71>
```

In the fifth cycle of training, the focus is on achieving the best possible classification performance. This is reflected in the loss function, where the weight assigned to the classification loss is the highest. As a result, the contribution of the detection loss becomes negligible.

Therefore, in this cycle, the primary objective is to train the discriminator to become a highly effective classifier by optimizing the classification loss.

$$L = (1 - C_{weight})L_D + C_{weight}L_C$$

In [ ]:

```
# fit the model
history = qdisc_model.fit(x=train_quantum_data,
                          y=y_train,
                          batch_size=32,
                          epochs=1000,
                          verbose=1,
                          callbacks=[disc_model_cp],
                          validation_data=(test_quantum_data, y_test)
                          )
```

```
Epoch 1/1000
4/4 [==============================] - 2s 570ms/step - loss: 0.3143 - custom_accuracy: 0
```

```
8125 - val_loss: 0.3468 - val_custom_accuracy: 0.7734
Epoch 2/1000
4/4 [==============================] - 2s 513ms/step - loss: 0.3126 - custom_accuracy: 0.
7578 - val_loss: 0.3452 - val_custom_accuracy: 0.7734
Epoch 3/1000
4/4 [==============================] - 1s 389ms/step - loss: 0.3109 - custom_accuracy: 0.
8125 - val_loss: 0.3434 - val_custom_accuracy: 0.7734
Epoch 4/1000
4/4 [==============================] - 1s 328ms/step - loss: 0.3095 - custom_accuracy: 0.
7578 - val_loss: 0.3426 - val_custom_accuracy: 0.7734
Epoch 5/1000
4/4 [==============================] - 1s 326ms/step - loss: 0.3087 - custom_accuracy: 0.
7031 - val_loss: 0.3413 - val_custom_accuracy: 0.7734
Epoch 6/1000
4/4 [==============================] - 1s 329ms/step - loss: 0.3072 - custom_accuracy: 0.
7578 - val_loss: 0.3408 - val_custom_accuracy: 0.7734
Epoch 7/1000
4/4 [==============================] - 1s 325ms/step - loss: 0.3062 - custom_accuracy: 0.
8125 - val_loss: 0.3408 - val_custom_accuracy: 0.7734
Epoch 8/1000
4/4 [==============================] - 1s 331ms/step - loss: 0.3042 - custom_accuracy: 0.
8125 - val_loss: 0.3402 - val_custom_accuracy: 0.7734
Epoch 9/1000
4/4 [==============================] - 1s 343ms/step - loss: 0.3029 - custom_accuracy: 0.
7031 - val_loss: 0.3396 - val_custom_accuracy: 0.7734
Epoch 10/1000
4/4 [==============================] - 1s 348ms/step - loss: 0.3016 - custom_accuracy: 0.
8125 - val_loss: 0.3393 - val_custom_accuracy: 0.7734
Epoch 11/1000
4/4 [==============================] - 2s 577ms/step - loss: 0.3010 - custom_accuracy: 0.
8125 - val_loss: 0.3400 - val_custom_accuracy: 0.7734
Epoch 12/1000
4/4 [==============================] - 2s 544ms/step - loss: 0.3001 - custom_accuracy: 0.
7031 - val_loss: 0.3404 - val_custom_accuracy: 0.7734
Epoch 13/1000
4/4 [==============================] - 2s 550ms/step - loss: 0.2998 - custom_accuracy: 0.
7031 - val_loss: 0.3391 - val_custom_accuracy: 0.7734
Epoch 14/1000
4/4 [==============================] - 2s 539ms/step - loss: 0.2984 - custom_accuracy: 0.
7578 - val_loss: 0.3359 - val_custom_accuracy: 0.7734
Epoch 15/1000
4/4 [==============================] - 1s 326ms/step - loss: 0.2978 - custom_accuracy: 0.
6484 - val_loss: 0.3330 - val_custom_accuracy: 0.7734
Epoch 16/1000
4/4 [==============================] - 1s 325ms/step - loss: 0.2966 - custom_accuracy: 0.
7031 - val_loss: 0.3311 - val_custom_accuracy: 0.7734
Epoch 17/1000
4/4 [==============================] - 1s 316ms/step - loss: 0.2973 - custom_accuracy: 0.
7578 - val_loss: 0.3296 - val_custom_accuracy: 0.7734
Epoch 18/1000
4/4 [==============================] - 1s 330ms/step - loss: 0.2973 - custom_accuracy: 0.
6484 - val_loss: 0.3287 - val_custom_accuracy: 0.7734
Epoch 19/1000
4/4 [==============================] - 1s 323ms/step - loss: 0.2967 - custom_accuracy: 0.
8125 - val_loss: 0.3289 - val_custom_accuracy: 0.7734
Epoch 20/1000
4/4 [==============================] - 1s 320ms/step - loss: 0.2957 - custom_accuracy: 0.
8125 - val_loss: 0.3291 - val_custom_accuracy: 0.7734
Epoch 21/1000
4/4 [==============================] - 1s 323ms/step - loss: 0.2943 - custom_accuracy: 0.
7578 - val_loss: 0.3299 - val_custom_accuracy: 0.7734
Epoch 22/1000
4/4 [==============================] - 1s 322ms/step - loss: 0.2934 - custom_accuracy: 0.
7031 - val_loss: 0.3312 - val_custom_accuracy: 0.7734
Epoch 23/1000
4/4 [==============================] - 2s 463ms/step - loss: 0.2926 - custom_accuracy: 0.
8125 - val_loss: 0.3311 - val_custom_accuracy: 0.7734
Epoch 24/1000
4/4 [==============================] - 2s 573ms/step - loss: 0.2922 - custom_accuracy: 0.
7031 - val_loss: 0.3314 - val_custom_accuracy: 0.7734
Epoch 25/1000
```

```
4/4 [==============================] - 3s 724ms/step - loss: 0.2910 - custom_accuracy: 0.
7578 - val_loss: 0.3317 - val_custom_accuracy: 0.7734
Epoch 26/1000
4/4 [==============================] - 2s 554ms/step - loss: 0.2910 - custom_accuracy: 0.
7578 - val_loss: 0.3308 - val_custom_accuracy: 0.7734
Epoch 27/1000
4/4 [==============================] - 2s 376ms/step - loss: 0.2905 - custom_accuracy: 0.
7578 - val_loss: 0.3302 - val_custom_accuracy: 0.7734
Epoch 28/1000
4/4 [==============================] - 1s 334ms/step - loss: 0.2899 - custom_accuracy: 0.
7578 - val_loss: 0.3303 - val_custom_accuracy: 0.7734
Epoch 29/1000
4/4 [==============================] - 1s 333ms/step - loss: 0.2894 - custom_accuracy: 0.
7578 - val_loss: 0.3306 - val_custom_accuracy: 0.7734
Epoch 30/1000
4/4 [==============================] - 1s 321ms/step - loss: 0.2894 - custom_accuracy: 0.
8125 - val_loss: 0.3314 - val_custom_accuracy: 0.7734
Epoch 31/1000
4/4 [==============================] - 1s 327ms/step - loss: 0.2891 - custom_accuracy: 0.
7578 - val_loss: 0.3319 - val_custom_accuracy: 0.7734
Epoch 32/1000
4/4 [==============================] - 1s 323ms/step - loss: 0.2888 - custom_accuracy: 0.
7578 - val_loss: 0.3309 - val_custom_accuracy: 0.7734
Epoch 33/1000
4/4 [==============================] - 1s 323ms/step - loss: 0.2881 - custom_accuracy: 0.
7031 - val_loss: 0.3284 - val_custom_accuracy: 0.7734
Epoch 34/1000
4/4 [==============================] - 1s 325ms/step - loss: 0.2871 - custom_accuracy: 0.
8125 - val_loss: 0.3262 - val_custom_accuracy: 0.7734
Epoch 35/1000
4/4 [==============================] - 2s 437ms/step - loss: 0.2863 - custom_accuracy: 0.
7031 - val_loss: 0.3251 - val_custom_accuracy: 0.7734
Epoch 36/1000
4/4 [==============================] - 2s 557ms/step - loss: 0.2857 - custom_accuracy: 0.
7578 - val_loss: 0.3238 - val_custom_accuracy: 0.7734
Epoch 37/1000
4/4 [==============================] - 2s 532ms/step - loss: 0.2850 - custom_accuracy: 0.
7031 - val_loss: 0.3224 - val_custom_accuracy: 0.7734
Epoch 38/1000
4/4 [==============================] - 2s 549ms/step - loss: 0.2846 - custom_accuracy: 0.
8125 - val_loss: 0.3210 - val_custom_accuracy: 0.7734
Epoch 39/1000
4/4 [==============================] - 2s 543ms/step - loss: 0.2842 - custom_accuracy: 0.
7578 - val_loss: 0.3203 - val_custom_accuracy: 0.7734
Epoch 40/1000
4/4 [==============================] - 1s 324ms/step - loss: 0.2836 - custom_accuracy: 0.
8125 - val_loss: 0.3205 - val_custom_accuracy: 0.7734
Epoch 41/1000
4/4 [==============================] - 1s 326ms/step - loss: 0.2831 - custom_accuracy: 0.
8125 - val_loss: 0.3216 - val_custom_accuracy: 0.7734
Epoch 42/1000
4/4 [==============================] - 1s 329ms/step - loss: 0.2829 - custom_accuracy: 0.
7578 - val_loss: 0.3226 - val_custom_accuracy: 0.7734
Epoch 43/1000
4/4 [==============================] - 1s 333ms/step - loss: 0.2827 - custom_accuracy: 0.
8125 - val_loss: 0.3224 - val_custom_accuracy: 0.7734
Epoch 44/1000
4/4 [==============================] - 1s 324ms/step - loss: 0.2822 - custom_accuracy: 0.
8125 - val_loss: 0.3222 - val_custom_accuracy: 0.7734
Epoch 45/1000
4/4 [==============================] - 1s 327ms/step - loss: 0.2819 - custom_accuracy: 0.
8125 - val_loss: 0.3221 - val_custom_accuracy: 0.7734
Epoch 46/1000
4/4 [==============================] - 1s 320ms/step - loss: 0.2816 - custom_accuracy: 0.
8125 - val_loss: 0.3216 - val_custom_accuracy: 0.7734
Epoch 47/1000
4/4 [==============================] - 1s 324ms/step - loss: 0.2814 - custom_accuracy: 0.
7578 - val_loss: 0.3206 - val_custom_accuracy: 0.7734
Epoch 48/1000
4/4 [==============================] - 2s 552ms/step - loss: 0.2809 - custom_accuracy: 0.
8125 - val_loss: 0.3190 - val_custom_accuracy: 0.7734
Epoch 49/1000
4/4 [==============================] - 2s 545ms/step - loss: 0.2804 - custom_accuracy: 0.
```

4/4 [==========] - 2s 545ms/step - loss: 0.2804 - custom_accuracy: 0.
8125 - val_loss: 0.3179 - val_custom_accuracy: 0.7734
Epoch 50/1000
4/4 [==========] - 2s 547ms/step - loss: 0.2802 - custom_accuracy: 0.
7031 - val_loss: 0.3168 - val_custom_accuracy: 0.7734
Epoch 51/1000
4/4 [==========] - 2s 536ms/step - loss: 0.2797 - custom_accuracy: 0.
8125 - val_loss: 0.3152 - val_custom_accuracy: 0.7734
Epoch 52/1000
4/4 [==========] - 2s 415ms/step - loss: 0.2792 - custom_accuracy: 0.
7031 - val_loss: 0.3144 - val_custom_accuracy: 0.7734
Epoch 53/1000
4/4 [==========] - 1s 330ms/step - loss: 0.2787 - custom_accuracy: 0.
5938 - val_loss: 0.3143 - val_custom_accuracy: 0.7734
Epoch 54/1000
4/4 [==========] - 1s 328ms/step - loss: 0.2778 - custom_accuracy: 0.
7578 - val_loss: 0.3136 - val_custom_accuracy: 0.7734
Epoch 55/1000
4/4 [==========] - 1s 322ms/step - loss: 0.2775 - custom_accuracy: 0.
7578 - val_loss: 0.3133 - val_custom_accuracy: 0.7734
Epoch 56/1000
4/4 [==========] - 1s 322ms/step - loss: 0.2777 - custom_accuracy: 0.
8125 - val_loss: 0.3138 - val_custom_accuracy: 0.7734
Epoch 57/1000
4/4 [==========] - 1s 324ms/step - loss: 0.2773 - custom_accuracy: 0.
7578 - val_loss: 0.3138 - val_custom_accuracy: 0.7734
Epoch 58/1000
4/4 [==========] - 1s 328ms/step - loss: 0.2768 - custom_accuracy: 0.
7031 - val_loss: 0.3132 - val_custom_accuracy: 0.7734
Epoch 59/1000
4/4 [==========] - 1s 326ms/step - loss: 0.2763 - custom_accuracy: 0.
7578 - val_loss: 0.3124 - val_custom_accuracy: 0.7734
Epoch 60/1000
4/4 [==========] - 1s 389ms/step - loss: 0.2759 - custom_accuracy: 0.
7578 - val_loss: 0.3120 - val_custom_accuracy: 0.7734
Epoch 61/1000
4/4 [==========] - 2s 591ms/step - loss: 0.2755 - custom_accuracy: 0.
8125 - val_loss: 0.3116 - val_custom_accuracy: 0.7734
Epoch 62/1000
4/4 [==========] - 2s 541ms/step - loss: 0.2750 - custom_accuracy: 0.
8125 - val_loss: 0.3116 - val_custom_accuracy: 0.7734
Epoch 63/1000
4/4 [==========] - 2s 538ms/step - loss: 0.2746 - custom_accuracy: 0.
7578 - val_loss: 0.3115 - val_custom_accuracy: 0.7734
Epoch 64/1000
4/4 [==========] - 2s 538ms/step - loss: 0.2745 - custom_accuracy: 0.
6484 - val_loss: 0.3101 - val_custom_accuracy: 0.7734
Epoch 65/1000
4/4 [==========] - 1s 325ms/step - loss: 0.2740 - custom_accuracy: 0.
8125 - val_loss: 0.3086 - val_custom_accuracy: 0.7734
Epoch 66/1000
4/4 [==========] - 1s 327ms/step - loss: 0.2737 - custom_accuracy: 0.
7578 - val_loss: 0.3081 - val_custom_accuracy: 0.7734
Epoch 67/1000
4/4 [==========] - 1s 330ms/step - loss: 0.2737 - custom_accuracy: 0.
8125 - val_loss: 0.3073 - val_custom_accuracy: 0.7812
Epoch 68/1000
4/4 [==========] - 1s 332ms/step - loss: 0.2731 - custom_accuracy: 0.
8125 - val_loss: 0.3072 - val_custom_accuracy: 0.7734
Epoch 69/1000
4/4 [==========] - 1s 333ms/step - loss: 0.2729 - custom_accuracy: 0.
7031 - val_loss: 0.3072 - val_custom_accuracy: 0.7734
Epoch 70/1000
4/4 [==========] - 1s 329ms/step - loss: 0.2725 - custom_accuracy: 0.
7578 - val_loss: 0.3071 - val_custom_accuracy: 0.7734
Epoch 71/1000
4/4 [==========] - 1s 326ms/step - loss: 0.2722 - custom_accuracy: 0.
7578 - val_loss: 0.3069 - val_custom_accuracy: 0.7734
Epoch 72/1000
4/4 [==========] - 1s 327ms/step - loss: 0.2719 - custom_accuracy: 0.
7578 - val_loss: 0.3070 - val_custom_accuracy: 0.7734
Epoch 73/1000
4/4 [==========] - 2s 546ms/step - loss: 0.2717 - custom_accuracy: 0.

4/4 [==========] - 2s 540ms/step - loss: 0.2717 - custom_accuracy: 0.
7578 - val_loss: 0.3062 - val_custom_accuracy: 0.7734
Epoch 74/1000
4/4 [==========] - 2s 538ms/step - loss: 0.2715 - custom_accuracy: 0.
8125 - val_loss: 0.3054 - val_custom_accuracy: 0.7734
Epoch 75/1000
4/4 [==========] - 2s 536ms/step - loss: 0.2710 - custom_accuracy: 0.
7578 - val_loss: 0.3054 - val_custom_accuracy: 0.7734
Epoch 76/1000
4/4 [==========] - 2s 543ms/step - loss: 0.2705 - custom_accuracy: 0.
7578 - val_loss: 0.3062 - val_custom_accuracy: 0.7734
Epoch 77/1000
4/4 [==========] - 2s 435ms/step - loss: 0.2704 - custom_accuracy: 0.
7578 - val_loss: 0.3070 - val_custom_accuracy: 0.7734
Epoch 78/1000
4/4 [==========] - 1s 319ms/step - loss: 0.2704 - custom_accuracy: 0.
8125 - val_loss: 0.3079 - val_custom_accuracy: 0.7734
Epoch 79/1000
4/4 [==========] - 1s 320ms/step - loss: 0.2703 - custom_accuracy: 0.
7578 - val_loss: 0.3089 - val_custom_accuracy: 0.7734
Epoch 80/1000
4/4 [==========] - 1s 326ms/step - loss: 0.2706 - custom_accuracy: 0.
7578 - val_loss: 0.3099 - val_custom_accuracy: 0.7734
Epoch 81/1000
4/4 [==========] - 1s 324ms/step - loss: 0.2704 - custom_accuracy: 0.
7578 - val_loss: 0.3101 - val_custom_accuracy: 0.7734
Epoch 82/1000
4/4 [==========] - 1s 323ms/step - loss: 0.2702 - custom_accuracy: 0.
7578 - val_loss: 0.3107 - val_custom_accuracy: 0.7734
Epoch 83/1000
4/4 [==========] - 1s 326ms/step - loss: 0.2701 - custom_accuracy: 0.
7578 - val_loss: 0.3108 - val_custom_accuracy: 0.7734
Epoch 84/1000
4/4 [==========] - 1s 330ms/step - loss: 0.2700 - custom_accuracy: 0.
8125 - val_loss: 0.3115 - val_custom_accuracy: 0.7734
Epoch 85/1000
4/4 [==========] - 1s 365ms/step - loss: 0.2704 - custom_accuracy: 0.
7578 - val_loss: 0.3122 - val_custom_accuracy: 0.7734
Epoch 86/1000
4/4 [==========] - 2s 581ms/step - loss: 0.2701 - custom_accuracy: 0.
7578 - val_loss: 0.3128 - val_custom_accuracy: 0.7734
Epoch 87/1000
4/4 [==========] - 2s 537ms/step - loss: 0.2704 - custom_accuracy: 0.
7578 - val_loss: 0.3129 - val_custom_accuracy: 0.7734
Epoch 88/1000
4/4 [==========] - 2s 558ms/step - loss: 0.2699 - custom_accuracy: 0.
7578 - val_loss: 0.3110 - val_custom_accuracy: 0.7734
Epoch 89/1000
4/4 [==========] - 2s 524ms/step - loss: 0.2691 - custom_accuracy: 0.
7578 - val_loss: 0.3092 - val_custom_accuracy: 0.7734
Epoch 90/1000
4/4 [==========] - 1s 321ms/step - loss: 0.2686 - custom_accuracy: 0.
8125 - val_loss: 0.3082 - val_custom_accuracy: 0.7734
Epoch 91/1000
4/4 [==========] - 1s 330ms/step - loss: 0.2682 - custom_accuracy: 0.
6484 - val_loss: 0.3071 - val_custom_accuracy: 0.7734
Epoch 92/1000
4/4 [==========] - 1s 327ms/step - loss: 0.2676 - custom_accuracy: 0.
8125 - val_loss: 0.3059 - val_custom_accuracy: 0.7734
Epoch 93/1000
4/4 [==========] - 1s 327ms/step - loss: 0.2675 - custom_accuracy: 0.
7031 - val_loss: 0.3057 - val_custom_accuracy: 0.7734
Epoch 94/1000
4/4 [==========] - 1s 329ms/step - loss: 0.2671 - custom_accuracy: 0.
7578 - val_loss: 0.3056 - val_custom_accuracy: 0.7734
Epoch 95/1000
4/4 [==========] - 1s 324ms/step - loss: 0.2672 - custom_accuracy: 0.
7031 - val_loss: 0.3057 - val_custom_accuracy: 0.7734
Epoch 96/1000
4/4 [==========] - 1s 326ms/step - loss: 0.2668 - custom_accuracy: 0.
7031 - val_loss: 0.3046 - val_custom_accuracy: 0.7734
Epoch 97/1000
4/4 [==========] - 1s 324ms/step - loss: 0.2669 - custom_accuracy: 0.

4/4 [==========] - 1s 324ms/step - loss: 0.2609 - custom_accuracy: 0.
8125 - val_loss: 0.3035 - val_custom_accuracy: 0.7812
Epoch 98/1000
4/4 [==========] - 2s 504ms/step - loss: 0.2665 - custom_accuracy: 0.
7578 - val_loss: 0.3029 - val_custom_accuracy: 0.7812
Epoch 99/1000
4/4 [==========] - 2s 558ms/step - loss: 0.2661 - custom_accuracy: 0.
8125 - val_loss: 0.3028 - val_custom_accuracy: 0.7812
Epoch 100/1000
4/4 [==========] - 2s 534ms/step - loss: 0.2657 - custom_accuracy: 0.
8125 - val_loss: 0.3029 - val_custom_accuracy: 0.7734
Epoch 101/1000
4/4 [==========] - 2s 540ms/step - loss: 0.2656 - custom_accuracy: 0.
7578 - val_loss: 0.3034 - val_custom_accuracy: 0.7734
Epoch 102/1000
4/4 [==========] - 2s 467ms/step - loss: 0.2655 - custom_accuracy: 0.
7031 - val_loss: 0.3034 - val_custom_accuracy: 0.7734
Epoch 103/1000
4/4 [==========] - 1s 331ms/step - loss: 0.2649 - custom_accuracy: 0.
8125 - val_loss: 0.3019 - val_custom_accuracy: 0.7734
Epoch 104/1000
4/4 [==========] - 1s 325ms/step - loss: 0.2646 - custom_accuracy: 0.
8125 - val_loss: 0.3011 - val_custom_accuracy: 0.7734
Epoch 105/1000
4/4 [==========] - 1s 327ms/step - loss: 0.2646 - custom_accuracy: 0.
7031 - val_loss: 0.3002 - val_custom_accuracy: 0.7812
Epoch 106/1000
4/4 [==========] - 1s 325ms/step - loss: 0.2644 - custom_accuracy: 0.
7578 - val_loss: 0.2988 - val_custom_accuracy: 0.7812
Epoch 107/1000
4/4 [==========] - 1s 330ms/step - loss: 0.2640 - custom_accuracy: 0.
7031 - val_loss: 0.2982 - val_custom_accuracy: 0.7812
Epoch 108/1000
4/4 [==========] - 1s 323ms/step - loss: 0.2638 - custom_accuracy: 0.
7578 - val_loss: 0.2976 - val_custom_accuracy: 0.7812
Epoch 109/1000
4/4 [==========] - 1s 336ms/step - loss: 0.2635 - custom_accuracy: 0.
7578 - val_loss: 0.2976 - val_custom_accuracy: 0.7812
Epoch 110/1000
4/4 [==========] - 1s 358ms/step - loss: 0.2632 - custom_accuracy: 0.
8125 - val_loss: 0.2982 - val_custom_accuracy: 0.7812
Epoch 111/1000
4/4 [==========] - 2s 583ms/step - loss: 0.2636 - custom_accuracy: 0.
7031 - val_loss: 0.2994 - val_custom_accuracy: 0.7812
Epoch 112/1000
4/4 [==========] - 2s 541ms/step - loss: 0.2633 - custom_accuracy: 0.
8125 - val_loss: 0.2997 - val_custom_accuracy: 0.7812
Epoch 113/1000
4/4 [==========] - 3s 727ms/step - loss: 0.2630 - custom_accuracy: 0.
7031 - val_loss: 0.2993 - val_custom_accuracy: 0.7812
Epoch 114/1000
4/4 [==========] - 2s 490ms/step - loss: 0.2628 - custom_accuracy: 0.
8125 - val_loss: 0.2983 - val_custom_accuracy: 0.7812
Epoch 115/1000
4/4 [==========] - 1s 321ms/step - loss: 0.2626 - custom_accuracy: 0.
7578 - val_loss: 0.2984 - val_custom_accuracy: 0.7812
Epoch 116/1000
4/4 [==========] - 1s 327ms/step - loss: 0.2625 - custom_accuracy: 0.
8125 - val_loss: 0.2991 - val_custom_accuracy: 0.7812
Epoch 117/1000
4/4 [==========] - 1s 324ms/step - loss: 0.2622 - custom_accuracy: 0.
8125 - val_loss: 0.2998 - val_custom_accuracy: 0.7812
Epoch 118/1000
4/4 [==========] - 1s 333ms/step - loss: 0.2621 - custom_accuracy: 0.
7578 - val_loss: 0.3001 - val_custom_accuracy: 0.7812
Epoch 119/1000
4/4 [==========] - 1s 328ms/step - loss: 0.2622 - custom_accuracy: 0.
8125 - val_loss: 0.2999 - val_custom_accuracy: 0.7812
Epoch 120/1000
4/4 [==========] - 1s 333ms/step - loss: 0.2619 - custom_accuracy: 0.
8125 - val_loss: 0.3003 - val_custom_accuracy: 0.7812
Epoch 121/1000
4/4 [==========] - 1s 312ms/step - loss: 0.2624 - custom_accuracy: 0.

4/4 [==========] - 1s 312ms/step - loss: 0.2624 - custom_accuracy: 0.
7031 - val_loss: 0.3005 - val_custom_accuracy: 0.7734
Epoch 122/1000
4/4 [==========] - 1s 325ms/step - loss: 0.2620 - custom_accuracy: 0.
7031 - val_loss: 0.3009 - val_custom_accuracy: 0.7734
Epoch 123/1000
4/4 [==========] - 2s 576ms/step - loss: 0.2621 - custom_accuracy: 0.
8125 - val_loss: 0.3017 - val_custom_accuracy: 0.7734
Epoch 124/1000
4/4 [==========] - 2s 546ms/step - loss: 0.2619 - custom_accuracy: 0.
7578 - val_loss: 0.3021 - val_custom_accuracy: 0.7734
Epoch 125/1000
4/4 [==========] - 2s 543ms/step - loss: 0.2616 - custom_accuracy: 0.
7031 - val_loss: 0.3010 - val_custom_accuracy: 0.7734
Epoch 126/1000
4/4 [==========] - 2s 545ms/step - loss: 0.2618 - custom_accuracy: 0.
8125 - val_loss: 0.2985 - val_custom_accuracy: 0.7812
Epoch 127/1000
4/4 [==========] - 1s 353ms/step - loss: 0.2609 - custom_accuracy: 0.
8125 - val_loss: 0.2972 - val_custom_accuracy: 0.7812
Epoch 128/1000
4/4 [==========] - 1s 334ms/step - loss: 0.2606 - custom_accuracy: 0.
8125 - val_loss: 0.2967 - val_custom_accuracy: 0.7812
Epoch 129/1000
4/4 [==========] - 1s 333ms/step - loss: 0.2606 - custom_accuracy: 0.
7578 - val_loss: 0.2968 - val_custom_accuracy: 0.7812
Epoch 130/1000
4/4 [==========] - 1s 324ms/step - loss: 0.2606 - custom_accuracy: 0.
7578 - val_loss: 0.2967 - val_custom_accuracy: 0.7812
Epoch 131/1000
4/4 [==========] - 1s 322ms/step - loss: 0.2608 - custom_accuracy: 0.
7578 - val_loss: 0.2970 - val_custom_accuracy: 0.7812
Epoch 132/1000
4/4 [==========] - 1s 321ms/step - loss: 0.2602 - custom_accuracy: 0.
7578 - val_loss: 0.2970 - val_custom_accuracy: 0.7812
Epoch 133/1000
4/4 [==========] - 1s 326ms/step - loss: 0.2602 - custom_accuracy: 0.
7578 - val_loss: 0.2967 - val_custom_accuracy: 0.7812
Epoch 134/1000
4/4 [==========] - 1s 321ms/step - loss: 0.2600 - custom_accuracy: 0.
8125 - val_loss: 0.2974 - val_custom_accuracy: 0.7812
Epoch 135/1000
4/4 [==========] - 2s 466ms/step - loss: 0.2597 - custom_accuracy: 0.
8125 - val_loss: 0.2988 - val_custom_accuracy: 0.7812
Epoch 136/1000
4/4 [==========] - 2s 564ms/step - loss: 0.2602 - custom_accuracy: 0.
8125 - val_loss: 0.3012 - val_custom_accuracy: 0.7734
Epoch 137/1000
4/4 [==========] - 2s 535ms/step - loss: 0.2609 - custom_accuracy: 0.
7031 - val_loss: 0.3033 - val_custom_accuracy: 0.7734
Epoch 138/1000
4/4 [==========] - 2s 542ms/step - loss: 0.2606 - custom_accuracy: 0.
8125 - val_loss: 0.3034 - val_custom_accuracy: 0.7734
Epoch 139/1000
4/4 [==========] - 2s 506ms/step - loss: 0.2608 - custom_accuracy: 0.
7578 - val_loss: 0.3039 - val_custom_accuracy: 0.7734
Epoch 140/1000
4/4 [==========] - 1s 324ms/step - loss: 0.2607 - custom_accuracy: 0.
7578 - val_loss: 0.3026 - val_custom_accuracy: 0.7734
Epoch 141/1000
4/4 [==========] - 1s 330ms/step - loss: 0.2603 - custom_accuracy: 0.
7578 - val_loss: 0.3008 - val_custom_accuracy: 0.7734
Epoch 142/1000
4/4 [==========] - 1s 329ms/step - loss: 0.2597 - custom_accuracy: 0.
8125 - val_loss: 0.2997 - val_custom_accuracy: 0.7812
Epoch 143/1000
4/4 [==========] - 1s 331ms/step - loss: 0.2595 - custom_accuracy: 0.
7031 - val_loss: 0.2991 - val_custom_accuracy: 0.7812
Epoch 144/1000
4/4 [==========] - 1s 326ms/step - loss: 0.2594 - custom_accuracy: 0.
7578 - val_loss: 0.2981 - val_custom_accuracy: 0.7812
Epoch 145/1000
4/4 [==========] - 1s 324ms/step - loss: 0.2590 - custom_accuracy: 0.

4/4 [==========] - 1s 324ms/step - loss: 0.2590 - custom_accuracy: 0.
7031 - val_loss: 0.2981 - val_custom_accuracy: 0.7812
Epoch 146/1000
4/4 [==========] - 1s 322ms/step - loss: 0.2593 - custom_accuracy: 0.
7578 - val_loss: 0.2987 - val_custom_accuracy: 0.7812
Epoch 147/1000
4/4 [==========] - 1s 334ms/step - loss: 0.2592 - custom_accuracy: 0.
8125 - val_loss: 0.2997 - val_custom_accuracy: 0.7812
Epoch 148/1000
4/4 [==========] - 2s 572ms/step - loss: 0.2593 - custom_accuracy: 0.
8125 - val_loss: 0.3007 - val_custom_accuracy: 0.7812
Epoch 149/1000
4/4 [==========] - 2s 548ms/step - loss: 0.2594 - custom_accuracy: 0.
7578 - val_loss: 0.3017 - val_custom_accuracy: 0.7812
Epoch 150/1000
4/4 [==========] - 2s 549ms/step - loss: 0.2594 - custom_accuracy: 0.
8125 - val_loss: 0.3014 - val_custom_accuracy: 0.7812
Epoch 151/1000
4/4 [==========] - 2s 543ms/step - loss: 0.2591 - custom_accuracy: 0.
8125 - val_loss: 0.3011 - val_custom_accuracy: 0.7812
Epoch 152/1000
4/4 [==========] - 2s 378ms/step - loss: 0.2590 - custom_accuracy: 0.
8125 - val_loss: 0.3019 - val_custom_accuracy: 0.7734
Epoch 153/1000
4/4 [==========] - 1s 328ms/step - loss: 0.2596 - custom_accuracy: 0.
7578 - val_loss: 0.3036 - val_custom_accuracy: 0.7734
Epoch 154/1000
4/4 [==========] - 1s 324ms/step - loss: 0.2597 - custom_accuracy: 0.
8125 - val_loss: 0.3050 - val_custom_accuracy: 0.7734
Epoch 155/1000
4/4 [==========] - 1s 329ms/step - loss: 0.2603 - custom_accuracy: 0.
7578 - val_loss: 0.3060 - val_custom_accuracy: 0.7734
Epoch 156/1000
4/4 [==========] - 1s 326ms/step - loss: 0.2608 - custom_accuracy: 0.
7031 - val_loss: 0.3062 - val_custom_accuracy: 0.7734
Epoch 157/1000
4/4 [==========] - 1s 323ms/step - loss: 0.2602 - custom_accuracy: 0.
7578 - val_loss: 0.3040 - val_custom_accuracy: 0.7734
Epoch 158/1000
4/4 [==========] - 1s 330ms/step - loss: 0.2591 - custom_accuracy: 0.
8125 - val_loss: 0.3010 - val_custom_accuracy: 0.7812
Epoch 159/1000
4/4 [==========] - 1s 324ms/step - loss: 0.2589 - custom_accuracy: 0.
8125 - val_loss: 0.2987 - val_custom_accuracy: 0.7812
Epoch 160/1000
4/4 [==========] - 1s 412ms/step - loss: 0.2576 - custom_accuracy: 0.
7031 - val_loss: 0.2971 - val_custom_accuracy: 0.7812
Epoch 161/1000
4/4 [==========] - 2s 566ms/step - loss: 0.2576 - custom_accuracy: 0.
8125 - val_loss: 0.2946 - val_custom_accuracy: 0.7812
Epoch 162/1000
4/4 [==========] - 2s 547ms/step - loss: 0.2577 - custom_accuracy: 0.
7578 - val_loss: 0.2940 - val_custom_accuracy: 0.7812
Epoch 163/1000
4/4 [==========] - 2s 540ms/step - loss: 0.2576 - custom_accuracy: 0.
7578 - val_loss: 0.2937 - val_custom_accuracy: 0.7812
Epoch 164/1000
4/4 [==========] - 2s 524ms/step - loss: 0.2576 - custom_accuracy: 0.
7031 - val_loss: 0.2939 - val_custom_accuracy: 0.7812
Epoch 165/1000
4/4 [==========] - 1s 323ms/step - loss: 0.2573 - custom_accuracy: 0.
7578 - val_loss: 0.2942 - val_custom_accuracy: 0.7812
Epoch 166/1000
4/4 [==========] - 1s 325ms/step - loss: 0.2571 - custom_accuracy: 0.
7578 - val_loss: 0.2944 - val_custom_accuracy: 0.7812
Epoch 167/1000
4/4 [==========] - 1s 326ms/step - loss: 0.2571 - custom_accuracy: 0.
8125 - val_loss: 0.2944 - val_custom_accuracy: 0.7812
Epoch 168/1000
4/4 [==========] - 1s 331ms/step - loss: 0.2568 - custom_accuracy: 0.
7578 - val_loss: 0.2949 - val_custom_accuracy: 0.7812
Epoch 169/1000
4/4 [==========] - 1s 336ms/step - loss: 0.2569 - custom_accuracy: 0.

4/4 [==============================] - 1s 350ms/step - loss: 0.2569 - custom_accuracy: 0.
7031 - val_loss: 0.2953 - val_custom_accuracy: 0.7812
Epoch 170/1000
4/4 [==============================] - 1s 325ms/step - loss: 0.2566 - custom_accuracy: 0.
8125 - val_loss: 0.2964 - val_custom_accuracy: 0.7812
Epoch 171/1000
4/4 [==============================] - 1s 328ms/step - loss: 0.2570 - custom_accuracy: 0.
7031 - val_loss: 0.2980 - val_custom_accuracy: 0.7812
Epoch 172/1000
4/4 [==============================] - 1s 329ms/step - loss: 0.2572 - custom_accuracy: 0.
7578 - val_loss: 0.2981 - val_custom_accuracy: 0.7812
Epoch 173/1000
4/4 [==============================] - 2s 565ms/step - loss: 0.2574 - custom_accuracy: 0.
8125 - val_loss: 0.2988 - val_custom_accuracy: 0.7812
Epoch 174/1000
4/4 [==============================] - 2s 549ms/step - loss: 0.2579 - custom_accuracy: 0.
8125 - val_loss: 0.2996 - val_custom_accuracy: 0.7812
Epoch 175/1000
4/4 [==============================] - 2s 536ms/step - loss: 0.2581 - custom_accuracy: 0.
6484 - val_loss: 0.2994 - val_custom_accuracy: 0.7812
Epoch 176/1000
4/4 [==============================] - 2s 535ms/step - loss: 0.2574 - custom_accuracy: 0.
7578 - val_loss: 0.2964 - val_custom_accuracy: 0.7812
Epoch 177/1000
4/4 [==============================] - 2s 414ms/step - loss: 0.2565 - custom_accuracy: 0.
7578 - val_loss: 0.2931 - val_custom_accuracy: 0.7812
Epoch 178/1000
4/4 [==============================] - 1s 327ms/step - loss: 0.2568 - custom_accuracy: 0.
8125 - val_loss: 0.2909 - val_custom_accuracy: 0.7812
Epoch 179/1000
4/4 [==============================] - 1s 335ms/step - loss: 0.2568 - custom_accuracy: 0.
7656 - val_loss: 0.2898 - val_custom_accuracy: 0.7812
Epoch 180/1000
4/4 [==============================] - 1s 328ms/step - loss: 0.2575 - custom_accuracy: 0.
8203 - val_loss: 0.2892 - val_custom_accuracy: 0.7812
Epoch 181/1000
4/4 [==============================] - 1s 323ms/step - loss: 0.2571 - custom_accuracy: 0.
7656 - val_loss: 0.2896 - val_custom_accuracy: 0.7812
Epoch 182/1000
4/4 [==============================] - 1s 321ms/step - loss: 0.2566 - custom_accuracy: 0.
7656 - val_loss: 0.2903 - val_custom_accuracy: 0.7812
Epoch 183/1000
4/4 [==============================] - 1s 329ms/step - loss: 0.2565 - custom_accuracy: 0.
7656 - val_loss: 0.2905 - val_custom_accuracy: 0.7812
Epoch 184/1000
4/4 [==============================] - 1s 325ms/step - loss: 0.2565 - custom_accuracy: 0.
7109 - val_loss: 0.2904 - val_custom_accuracy: 0.7812
Epoch 185/1000
4/4 [==============================] - 1s 390ms/step - loss: 0.2565 - custom_accuracy: 0.
7109 - val_loss: 0.2899 - val_custom_accuracy: 0.7812
Epoch 186/1000
4/4 [==============================] - 2s 577ms/step - loss: 0.2568 - custom_accuracy: 0.
7656 - val_loss: 0.2890 - val_custom_accuracy: 0.7812
Epoch 187/1000
4/4 [==============================] - 2s 549ms/step - loss: 0.2569 - custom_accuracy: 0.
7109 - val_loss: 0.2891 - val_custom_accuracy: 0.7734
Epoch 188/1000
4/4 [==============================] - 2s 554ms/step - loss: 0.2587 - custom_accuracy: 0.
8203 - val_loss: 0.2895 - val_custom_accuracy: 0.7734
Epoch 189/1000
4/4 [==============================] - 2s 543ms/step - loss: 0.2587 - custom_accuracy: 0.
7656 - val_loss: 0.2898 - val_custom_accuracy: 0.7734
Epoch 190/1000
4/4 [==============================] - 1s 322ms/step - loss: 0.2582 - custom_accuracy: 0.
7656 - val_loss: 0.2907 - val_custom_accuracy: 0.7812
Epoch 191/1000
4/4 [==============================] - 1s 327ms/step - loss: 0.2562 - custom_accuracy: 0.
7109 - val_loss: 0.2920 - val_custom_accuracy: 0.7812
Epoch 192/1000
4/4 [==============================] - 1s 328ms/step - loss: 0.2558 - custom_accuracy: 0.
8125 - val_loss: 0.2939 - val_custom_accuracy: 0.7812
Epoch 193/1000
4/4 [==============================] - 1s 327ms/step - loss: 0.2561 - custom_accuracy: 0.

4/4 [==============================] - 1s 327ms/step - loss: 0.2561 - custom_accuracy: 0.
7031 - val_loss: 0.2961 - val_custom_accuracy: 0.7812
Epoch 194/1000
4/4 [==============================] - 1s 331ms/step - loss: 0.2561 - custom_accuracy: 0.
7031 - val_loss: 0.2977 - val_custom_accuracy: 0.7812
Epoch 195/1000
4/4 [==============================] - 1s 320ms/step - loss: 0.2565 - custom_accuracy: 0.
7578 - val_loss: 0.2973 - val_custom_accuracy: 0.7812
Epoch 196/1000
4/4 [==============================] - 1s 325ms/step - loss: 0.2562 - custom_accuracy: 0.
7578 - val_loss: 0.2962 - val_custom_accuracy: 0.7812
Epoch 197/1000
4/4 [==============================] - 1s 327ms/step - loss: 0.2562 - custom_accuracy: 0.
7031 - val_loss: 0.2955 - val_custom_accuracy: 0.7812
Epoch 198/1000
4/4 [==============================] - 2s 525ms/step - loss: 0.2563 - custom_accuracy: 0.
8125 - val_loss: 0.2942 - val_custom_accuracy: 0.7812
Epoch 199/1000
4/4 [==============================] - 2s 565ms/step - loss: 0.2561 - custom_accuracy: 0.
7578 - val_loss: 0.2931 - val_custom_accuracy: 0.7812
Epoch 200/1000
4/4 [==============================] - 2s 524ms/step - loss: 0.2559 - custom_accuracy: 0.
7578 - val_loss: 0.2922 - val_custom_accuracy: 0.7812
Epoch 201/1000
4/4 [==============================] - 2s 536ms/step - loss: 0.2558 - custom_accuracy: 0.
7109 - val_loss: 0.2919 - val_custom_accuracy: 0.7812
Epoch 202/1000
4/4 [==============================] - 2s 445ms/step - loss: 0.2556 - custom_accuracy: 0.
7656 - val_loss: 0.2914 - val_custom_accuracy: 0.7812
Epoch 203/1000
4/4 [==============================] - 1s 317ms/step - loss: 0.2557 - custom_accuracy: 0.
8203 - val_loss: 0.2911 - val_custom_accuracy: 0.7812
Epoch 204/1000
4/4 [==============================] - 1s 320ms/step - loss: 0.2557 - custom_accuracy: 0.
7656 - val_loss: 0.2913 - val_custom_accuracy: 0.7812
Epoch 205/1000
4/4 [==============================] - 1s 326ms/step - loss: 0.2554 - custom_accuracy: 0.
7109 - val_loss: 0.2909 - val_custom_accuracy: 0.7812
Epoch 206/1000
4/4 [==============================] - 1s 323ms/step - loss: 0.2554 - custom_accuracy: 0.
7109 - val_loss: 0.2904 - val_custom_accuracy: 0.7734
Epoch 207/1000
4/4 [==============================] - 1s 319ms/step - loss: 0.2557 - custom_accuracy: 0.
8203 - val_loss: 0.2904 - val_custom_accuracy: 0.7734
Epoch 208/1000
4/4 [==============================] - 1s 329ms/step - loss: 0.2556 - custom_accuracy: 0.
7656 - val_loss: 0.2908 - val_custom_accuracy: 0.7734
Epoch 209/1000
4/4 [==============================] - 1s 326ms/step - loss: 0.2552 - custom_accuracy: 0.
7656 - val_loss: 0.2923 - val_custom_accuracy: 0.7812
Epoch 210/1000
4/4 [==============================] - 1s 327ms/step - loss: 0.2553 - custom_accuracy: 0.
7578 - val_loss: 0.2936 - val_custom_accuracy: 0.7812
Epoch 211/1000
4/4 [==============================] - 2s 564ms/step - loss: 0.2552 - custom_accuracy: 0.
7578 - val_loss: 0.2942 - val_custom_accuracy: 0.7812
Epoch 212/1000
4/4 [==============================] - 2s 547ms/step - loss: 0.2551 - custom_accuracy: 0.
8125 - val_loss: 0.2954 - val_custom_accuracy: 0.7812
Epoch 213/1000
4/4 [==============================] - 2s 536ms/step - loss: 0.2554 - custom_accuracy: 0.
7578 - val_loss: 0.2970 - val_custom_accuracy: 0.7812
Epoch 214/1000
4/4 [==============================] - 2s 534ms/step - loss: 0.2555 - custom_accuracy: 0.
7031 - val_loss: 0.2986 - val_custom_accuracy: 0.7812
Epoch 215/1000
4/4 [==============================] - 1s 368ms/step - loss: 0.2557 - custom_accuracy: 0.
8125 - val_loss: 0.2986 - val_custom_accuracy: 0.7812
Epoch 216/1000
4/4 [==============================] - 1s 320ms/step - loss: 0.2557 - custom_accuracy: 0.
7578 - val_loss: 0.2992 - val_custom_accuracy: 0.7812
Epoch 217/1000
4/4 [==============================] - 1s 320ms/step - loss: 0.2556 - custom_accuracy: 0.

4/4 [==============================] - 1s 320ms/step - loss: 0.2550 - custom_accuracy: 0.
8125 - val_loss: 0.3004 - val_custom_accuracy: 0.7812
Epoch 218/1000
4/4 [==============================] - 1s 320ms/step - loss: 0.2558 - custom_accuracy: 0.
8125 - val_loss: 0.3022 - val_custom_accuracy: 0.7812
Epoch 219/1000
4/4 [==============================] - 1s 319ms/step - loss: 0.2562 - custom_accuracy: 0.
7578 - val_loss: 0.3034 - val_custom_accuracy: 0.7812
Epoch 220/1000
4/4 [==============================] - 1s 323ms/step - loss: 0.2560 - custom_accuracy: 0.
7578 - val_loss: 0.3024 - val_custom_accuracy: 0.7812
Epoch 221/1000
4/4 [==============================] - 1s 376ms/step - loss: 0.2557 - custom_accuracy: 0.
8125 - val_loss: 0.3006 - val_custom_accuracy: 0.7812
Epoch 222/1000
4/4 [==============================] - 1s 320ms/step - loss: 0.2554 - custom_accuracy: 0.
8125 - val_loss: 0.2989 - val_custom_accuracy: 0.7812
Epoch 223/1000
4/4 [==============================] - 2s 428ms/step - loss: 0.2551 - custom_accuracy: 0.
7578 - val_loss: 0.2975 - val_custom_accuracy: 0.7812
Epoch 224/1000
4/4 [==============================] - 2s 568ms/step - loss: 0.2552 - custom_accuracy: 0.
8125 - val_loss: 0.2963 - val_custom_accuracy: 0.7812
Epoch 225/1000
4/4 [==============================] - 2s 546ms/step - loss: 0.2556 - custom_accuracy: 0.
7578 - val_loss: 0.2957 - val_custom_accuracy: 0.7812
Epoch 226/1000
4/4 [==============================] - 2s 530ms/step - loss: 0.2558 - custom_accuracy: 0.
7578 - val_loss: 0.2956 - val_custom_accuracy: 0.7812
Epoch 227/1000
4/4 [==============================] - 2s 528ms/step - loss: 0.2561 - custom_accuracy: 0.
7031 - val_loss: 0.2950 - val_custom_accuracy: 0.7734
Epoch 228/1000
4/4 [==============================] - 1s 330ms/step - loss: 0.2563 - custom_accuracy: 0.
8125 - val_loss: 0.2949 - val_custom_accuracy: 0.7734
Epoch 229/1000
4/4 [==============================] - 1s 322ms/step - loss: 0.2553 - custom_accuracy: 0.
6484 - val_loss: 0.2951 - val_custom_accuracy: 0.7812
Epoch 230/1000
4/4 [==============================] - 1s 322ms/step - loss: 0.2553 - custom_accuracy: 0.
7578 - val_loss: 0.2952 - val_custom_accuracy: 0.7734
Epoch 231/1000
4/4 [==============================] - 1s 325ms/step - loss: 0.2551 - custom_accuracy: 0.
8125 - val_loss: 0.2953 - val_custom_accuracy: 0.7734
Epoch 232/1000
4/4 [==============================] - 1s 324ms/step - loss: 0.2546 - custom_accuracy: 0.
7031 - val_loss: 0.2955 - val_custom_accuracy: 0.7734
Epoch 233/1000
4/4 [==============================] - 1s 324ms/step - loss: 0.2548 - custom_accuracy: 0.
7031 - val_loss: 0.2944 - val_custom_accuracy: 0.7734
Epoch 234/1000
4/4 [==============================] - 1s 335ms/step - loss: 0.2546 - custom_accuracy: 0.
7109 - val_loss: 0.2939 - val_custom_accuracy: 0.7734
Epoch 235/1000
4/4 [==============================] - 1s 323ms/step - loss: 0.2550 - custom_accuracy: 0.
7109 - val_loss: 0.2941 - val_custom_accuracy: 0.7734
Epoch 236/1000
4/4 [==============================] - 2s 552ms/step - loss: 0.2550 - custom_accuracy: 0.
8203 - val_loss: 0.2941 - val_custom_accuracy: 0.7734
Epoch 237/1000
4/4 [==============================] - 2s 554ms/step - loss: 0.2555 - custom_accuracy: 0.
6562 - val_loss: 0.2943 - val_custom_accuracy: 0.7734
Epoch 238/1000
4/4 [==============================] - 2s 537ms/step - loss: 0.2545 - custom_accuracy: 0.
6562 - val_loss: 0.2926 - val_custom_accuracy: 0.7734
Epoch 239/1000
4/4 [==============================] - 2s 543ms/step - loss: 0.2580 - custom_accuracy: 0.
7656 - val_loss: 0.2927 - val_custom_accuracy: 0.7734
Epoch 240/1000
4/4 [==============================] - 2s 401ms/step - loss: 0.2601 - custom_accuracy: 0.
6953 - val_loss: 0.2932 - val_custom_accuracy: 0.7734
Epoch 241/1000
4/4 [==============================] - 1s 319ms/step - loss: 0.2618 - custom_accuracy: 0.

4/4 [==============================] - 1s 319ms/step - loss: 0.2618 - custom_accuracy: 0.
7500 - val_loss: 0.2932 - val_custom_accuracy: 0.7734
Epoch 242/1000
4/4 [==============================] - 1s 334ms/step - loss: 0.2610 - custom_accuracy: 0.
7500 - val_loss: 0.2923 - val_custom_accuracy: 0.7734
Epoch 243/1000
4/4 [==============================] - 1s 339ms/step - loss: 0.2588 - custom_accuracy: 0.
7031 - val_loss: 0.2921 - val_custom_accuracy: 0.7734
Epoch 244/1000
4/4 [==============================] - 1s 321ms/step - loss: 0.2564 - custom_accuracy: 0.
8203 - val_loss: 0.2922 - val_custom_accuracy: 0.7734
Epoch 245/1000
4/4 [==============================] - 1s 326ms/step - loss: 0.2557 - custom_accuracy: 0.
7656 - val_loss: 0.2928 - val_custom_accuracy: 0.7734
Epoch 246/1000
4/4 [==============================] - 1s 321ms/step - loss: 0.2547 - custom_accuracy: 0.
7656 - val_loss: 0.2939 - val_custom_accuracy: 0.7734
Epoch 247/1000
4/4 [==============================] - 1s 324ms/step - loss: 0.2540 - custom_accuracy: 0.
7109 - val_loss: 0.2952 - val_custom_accuracy: 0.7812
Epoch 248/1000
4/4 [==============================] - 1s 410ms/step - loss: 0.2542 - custom_accuracy: 0.
7031 - val_loss: 0.2964 - val_custom_accuracy: 0.7812
Epoch 249/1000
4/4 [==============================] - 2s 583ms/step - loss: 0.2547 - custom_accuracy: 0.
7578 - val_loss: 0.2954 - val_custom_accuracy: 0.7812
Epoch 250/1000
4/4 [==============================] - 2s 553ms/step - loss: 0.2546 - custom_accuracy: 0.
7656 - val_loss: 0.2952 - val_custom_accuracy: 0.7734
Epoch 251/1000
4/4 [==============================] - 2s 546ms/step - loss: 0.2548 - custom_accuracy: 0.
6562 - val_loss: 0.2953 - val_custom_accuracy: 0.7734
Epoch 252/1000
4/4 [==============================] - 2s 547ms/step - loss: 0.2545 - custom_accuracy: 0.
8203 - val_loss: 0.2941 - val_custom_accuracy: 0.7734
Epoch 253/1000
4/4 [==============================] - 1s 347ms/step - loss: 0.2546 - custom_accuracy: 0.
8203 - val_loss: 0.2944 - val_custom_accuracy: 0.7734
Epoch 254/1000
4/4 [==============================] - 1s 342ms/step - loss: 0.2547 - custom_accuracy: 0.
8203 - val_loss: 0.2956 - val_custom_accuracy: 0.7812
Epoch 255/1000
4/4 [==============================] - 1s 338ms/step - loss: 0.2544 - custom_accuracy: 0.
8203 - val_loss: 0.2956 - val_custom_accuracy: 0.7812
Epoch 256/1000
4/4 [==============================] - 1s 329ms/step - loss: 0.2542 - custom_accuracy: 0.
7031 - val_loss: 0.2955 - val_custom_accuracy: 0.7812
Epoch 257/1000
4/4 [==============================] - 1s 334ms/step - loss: 0.2540 - custom_accuracy: 0.
7578 - val_loss: 0.2950 - val_custom_accuracy: 0.7812
Epoch 258/1000
4/4 [==============================] - 1s 336ms/step - loss: 0.2541 - custom_accuracy: 0.
7656 - val_loss: 0.2947 - val_custom_accuracy: 0.7734
Epoch 259/1000
4/4 [==============================] - 1s 333ms/step - loss: 0.2538 - custom_accuracy: 0.
8203 - val_loss: 0.2941 - val_custom_accuracy: 0.7734
Epoch 260/1000
4/4 [==============================] - 1s 331ms/step - loss: 0.2537 - custom_accuracy: 0.
8203 - val_loss: 0.2939 - val_custom_accuracy: 0.7734
Epoch 261/1000
4/4 [==============================] - 2s 586ms/step - loss: 0.2538 - custom_accuracy: 0.
7109 - val_loss: 0.2941 - val_custom_accuracy: 0.7734
Epoch 262/1000
4/4 [==============================] - 2s 560ms/step - loss: 0.2537 - custom_accuracy: 0.
7656 - val_loss: 0.2940 - val_custom_accuracy: 0.7734
Epoch 263/1000
4/4 [==============================] - 2s 551ms/step - loss: 0.2537 - custom_accuracy: 0.
8203 - val_loss: 0.2943 - val_custom_accuracy: 0.7734
Epoch 264/1000
4/4 [==============================] - 2s 551ms/step - loss: 0.2538 - custom_accuracy: 0.
7656 - val_loss: 0.2949 - val_custom_accuracy: 0.7812
Epoch 265/1000
4/4 [==============================] - 2s 389ms/step - loss: 0.2537 - custom_accuracy: 0.

4/4 [==========] - 2s 509ms/step - loss: 0.2537 - custom_accuracy: 0.
7109 - val_loss: 0.2945 - val_custom_accuracy: 0.7734
Epoch 266/1000
4/4 [==========] - 1s 332ms/step - loss: 0.2537 - custom_accuracy: 0.
7656 - val_loss: 0.2942 - val_custom_accuracy: 0.7734
Epoch 267/1000
4/4 [==========] - 1s 337ms/step - loss: 0.2536 - custom_accuracy: 0.
8203 - val_loss: 0.2939 - val_custom_accuracy: 0.7734
Epoch 268/1000
4/4 [==========] - 1s 340ms/step - loss: 0.2534 - custom_accuracy: 0.
7656 - val_loss: 0.2947 - val_custom_accuracy: 0.7734
Epoch 269/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2540 - custom_accuracy: 0.
7578 - val_loss: 0.2960 - val_custom_accuracy: 0.7812
Epoch 270/1000
4/4 [==========] - 1s 338ms/step - loss: 0.2539 - custom_accuracy: 0.
7578 - val_loss: 0.2960 - val_custom_accuracy: 0.7812
Epoch 271/1000
4/4 [==========] - 1s 346ms/step - loss: 0.2539 - custom_accuracy: 0.
8125 - val_loss: 0.2970 - val_custom_accuracy: 0.7812
Epoch 272/1000
4/4 [==========] - 1s 343ms/step - loss: 0.2541 - custom_accuracy: 0.
8125 - val_loss: 0.2984 - val_custom_accuracy: 0.7812
Epoch 273/1000
4/4 [==========] - 2s 530ms/step - loss: 0.2554 - custom_accuracy: 0.
7031 - val_loss: 0.2997 - val_custom_accuracy: 0.7812
Epoch 274/1000
4/4 [==========] - 2s 570ms/step - loss: 0.2547 - custom_accuracy: 0.
8125 - val_loss: 0.2968 - val_custom_accuracy: 0.7812
Epoch 275/1000
4/4 [==========] - 2s 563ms/step - loss: 0.2538 - custom_accuracy: 0.
7031 - val_loss: 0.2945 - val_custom_accuracy: 0.7734
Epoch 276/1000
4/4 [==========] - 2s 563ms/step - loss: 0.2528 - custom_accuracy: 0.
8203 - val_loss: 0.2915 - val_custom_accuracy: 0.7734
Epoch 277/1000
4/4 [==========] - 2s 442ms/step - loss: 0.2532 - custom_accuracy: 0.
8203 - val_loss: 0.2901 - val_custom_accuracy: 0.7734
Epoch 278/1000
4/4 [==========] - 1s 339ms/step - loss: 0.2537 - custom_accuracy: 0.
7656 - val_loss: 0.2897 - val_custom_accuracy: 0.7734
Epoch 279/1000
4/4 [==========] - 1s 342ms/step - loss: 0.2539 - custom_accuracy: 0.
8203 - val_loss: 0.2901 - val_custom_accuracy: 0.7734
Epoch 280/1000
4/4 [==========] - 1s 344ms/step - loss: 0.2538 - custom_accuracy: 0.
7656 - val_loss: 0.2907 - val_custom_accuracy: 0.7734
Epoch 281/1000
4/4 [==========] - 1s 339ms/step - loss: 0.2537 - custom_accuracy: 0.
7109 - val_loss: 0.2910 - val_custom_accuracy: 0.7734
Epoch 282/1000
4/4 [==========] - 1s 336ms/step - loss: 0.2537 - custom_accuracy: 0.
7656 - val_loss: 0.2911 - val_custom_accuracy: 0.7734
Epoch 283/1000
4/4 [==========] - 1s 337ms/step - loss: 0.2534 - custom_accuracy: 0.
7109 - val_loss: 0.2916 - val_custom_accuracy: 0.7734
Epoch 284/1000
4/4 [==========] - 1s 336ms/step - loss: 0.2533 - custom_accuracy: 0.
7109 - val_loss: 0.2913 - val_custom_accuracy: 0.7734
Epoch 285/1000
4/4 [==========] - 2s 501ms/step - loss: 0.2537 - custom_accuracy: 0.
7109 - val_loss: 0.2904 - val_custom_accuracy: 0.7734
Epoch 286/1000
4/4 [==========] - 2s 574ms/step - loss: 0.2535 - custom_accuracy: 0.
7656 - val_loss: 0.2904 - val_custom_accuracy: 0.7734
Epoch 287/1000
4/4 [==========] - 2s 557ms/step - loss: 0.2539 - custom_accuracy: 0.
8203 - val_loss: 0.2900 - val_custom_accuracy: 0.7734
Epoch 288/1000
4/4 [==========] - 2s 560ms/step - loss: 0.2537 - custom_accuracy: 0.
8203 - val_loss: 0.2906 - val_custom_accuracy: 0.7734
Epoch 289/1000
4/4 [==========] - 2s 459ms/step - loss: 0.2529 - custom_accuracy: 0.

4/4 [==========] - 2s 459ms/step - loss: 0.2529 - custom_accuracy: 0.
8203 - val_loss: 0.2922 - val_custom_accuracy: 0.7734
Epoch 290/1000
4/4 [==========] - 1s 331ms/step - loss: 0.2535 - custom_accuracy: 0.
7656 - val_loss: 0.2945 - val_custom_accuracy: 0.7734
Epoch 291/1000
4/4 [==========] - 1s 337ms/step - loss: 0.2531 - custom_accuracy: 0.
8203 - val_loss: 0.2953 - val_custom_accuracy: 0.7734
Epoch 292/1000
4/4 [==========] - 1s 340ms/step - loss: 0.2534 - custom_accuracy: 0.
7109 - val_loss: 0.2951 - val_custom_accuracy: 0.7734
Epoch 293/1000
4/4 [==========] - 1s 339ms/step - loss: 0.2531 - custom_accuracy: 0.
8203 - val_loss: 0.2929 - val_custom_accuracy: 0.7734
Epoch 294/1000
4/4 [==========] - 1s 336ms/step - loss: 0.2538 - custom_accuracy: 0.
8203 - val_loss: 0.2920 - val_custom_accuracy: 0.7734
Epoch 295/1000
4/4 [==========] - 1s 332ms/step - loss: 0.2538 - custom_accuracy: 0.
7656 - val_loss: 0.2924 - val_custom_accuracy: 0.7734
Epoch 296/1000
4/4 [==========] - 1s 336ms/step - loss: 0.2536 - custom_accuracy: 0.
8203 - val_loss: 0.2936 - val_custom_accuracy: 0.7734
Epoch 297/1000
4/4 [==========] - 2s 430ms/step - loss: 0.2538 - custom_accuracy: 0.
7656 - val_loss: 0.2947 - val_custom_accuracy: 0.7734
Epoch 298/1000
4/4 [==========] - 2s 577ms/step - loss: 0.2533 - custom_accuracy: 0.
7109 - val_loss: 0.2937 - val_custom_accuracy: 0.7734
Epoch 299/1000
4/4 [==========] - 2s 553ms/step - loss: 0.2544 - custom_accuracy: 0.
7109 - val_loss: 0.2926 - val_custom_accuracy: 0.7734
Epoch 300/1000
4/4 [==========] - 2s 549ms/step - loss: 0.2541 - custom_accuracy: 0.
7656 - val_loss: 0.2920 - val_custom_accuracy: 0.7734
Epoch 301/1000
4/4 [==========] - 2s 531ms/step - loss: 0.2543 - custom_accuracy: 0.
7656 - val_loss: 0.2926 - val_custom_accuracy: 0.7734
Epoch 302/1000
4/4 [==========] - 1s 326ms/step - loss: 0.2534 - custom_accuracy: 0.
7656 - val_loss: 0.2931 - val_custom_accuracy: 0.7734
Epoch 303/1000
4/4 [==========] - 1s 332ms/step - loss: 0.2534 - custom_accuracy: 0.
7656 - val_loss: 0.2933 - val_custom_accuracy: 0.7734
Epoch 304/1000
4/4 [==========] - 1s 329ms/step - loss: 0.2533 - custom_accuracy: 0.
8203 - val_loss: 0.2929 - val_custom_accuracy: 0.7734
Epoch 305/1000
4/4 [==========] - 1s 330ms/step - loss: 0.2536 - custom_accuracy: 0.
7656 - val_loss: 0.2926 - val_custom_accuracy: 0.7734
Epoch 306/1000
4/4 [==========] - 1s 330ms/step - loss: 0.2535 - custom_accuracy: 0.
8203 - val_loss: 0.2929 - val_custom_accuracy: 0.7734
Epoch 307/1000
4/4 [==========] - 1s 336ms/step - loss: 0.2533 - custom_accuracy: 0.
7656 - val_loss: 0.2938 - val_custom_accuracy: 0.7734
Epoch 308/1000
4/4 [==========] - 1s 349ms/step - loss: 0.2530 - custom_accuracy: 0.
7656 - val_loss: 0.2936 - val_custom_accuracy: 0.7734
Epoch 309/1000
4/4 [==========] - 1s 340ms/step - loss: 0.2531 - custom_accuracy: 0.
7656 - val_loss: 0.2933 - val_custom_accuracy: 0.7734
Epoch 310/1000
4/4 [==========] - 2s 580ms/step - loss: 0.2537 - custom_accuracy: 0.
8203 - val_loss: 0.2932 - val_custom_accuracy: 0.7734
Epoch 311/1000
4/4 [==========] - 2s 549ms/step - loss: 0.2539 - custom_accuracy: 0.
7109 - val_loss: 0.2932 - val_custom_accuracy: 0.7734
Epoch 312/1000
4/4 [==========] - 2s 551ms/step - loss: 0.2539 - custom_accuracy: 0.
8203 - val_loss: 0.2921 - val_custom_accuracy: 0.7734
Epoch 313/1000
4/4 [==========] - 3s 720ms/step - loss: 0.2541 - custom_accuracy: 0.

4/4 [==========] - 3s 720ms/step - loss: 0.2541 - custom_accuracy: 0.
7109 - val_loss: 0.2924 - val_custom_accuracy: 0.7734
Epoch 314/1000
4/4 [==========] - 1s 339ms/step - loss: 0.2540 - custom_accuracy: 0.
7656 - val_loss: 0.2927 - val_custom_accuracy: 0.7734
Epoch 315/1000
4/4 [==========] - 1s 333ms/step - loss: 0.2532 - custom_accuracy: 0.
8203 - val_loss: 0.2924 - val_custom_accuracy: 0.7734
Epoch 316/1000
4/4 [==========] - 1s 338ms/step - loss: 0.2531 - custom_accuracy: 0.
7656 - val_loss: 0.2920 - val_custom_accuracy: 0.7734
Epoch 317/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2530 - custom_accuracy: 0.
8203 - val_loss: 0.2919 - val_custom_accuracy: 0.7734
Epoch 318/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2526 - custom_accuracy: 0.
8203 - val_loss: 0.2925 - val_custom_accuracy: 0.7734
Epoch 319/1000
4/4 [==========] - 1s 332ms/step - loss: 0.2530 - custom_accuracy: 0.
7656 - val_loss: 0.2942 - val_custom_accuracy: 0.7734
Epoch 320/1000
4/4 [==========] - 1s 330ms/step - loss: 0.2528 - custom_accuracy: 0.
8203 - val_loss: 0.2960 - val_custom_accuracy: 0.7734
Epoch 321/1000
4/4 [==========] - 1s 352ms/step - loss: 0.2533 - custom_accuracy: 0.
8125 - val_loss: 0.2983 - val_custom_accuracy: 0.7734
Epoch 322/1000
4/4 [==========] - 2s 579ms/step - loss: 0.2536 - custom_accuracy: 0.
7578 - val_loss: 0.2988 - val_custom_accuracy: 0.7812
Epoch 323/1000
4/4 [==========] - 2s 540ms/step - loss: 0.2537 - custom_accuracy: 0.
7578 - val_loss: 0.2972 - val_custom_accuracy: 0.7734
Epoch 324/1000
4/4 [==========] - 2s 547ms/step - loss: 0.2531 - custom_accuracy: 0.
8125 - val_loss: 0.2945 - val_custom_accuracy: 0.7734
Epoch 325/1000
4/4 [==========] - 2s 548ms/step - loss: 0.2529 - custom_accuracy: 0.
7656 - val_loss: 0.2933 - val_custom_accuracy: 0.7734
Epoch 326/1000
4/4 [==========] - 1s 357ms/step - loss: 0.2532 - custom_accuracy: 0.
8203 - val_loss: 0.2926 - val_custom_accuracy: 0.7734
Epoch 327/1000
4/4 [==========] - 1s 337ms/step - loss: 0.2528 - custom_accuracy: 0.
8203 - val_loss: 0.2932 - val_custom_accuracy: 0.7734
Epoch 328/1000
4/4 [==========] - 1s 333ms/step - loss: 0.2534 - custom_accuracy: 0.
7656 - val_loss: 0.2945 - val_custom_accuracy: 0.7734
Epoch 329/1000
4/4 [==========] - 1s 338ms/step - loss: 0.2530 - custom_accuracy: 0.
8203 - val_loss: 0.2936 - val_custom_accuracy: 0.7734
Epoch 330/1000
4/4 [==========] - 1s 338ms/step - loss: 0.2530 - custom_accuracy: 0.
8203 - val_loss: 0.2934 - val_custom_accuracy: 0.7734
Epoch 331/1000
4/4 [==========] - 1s 340ms/step - loss: 0.2533 - custom_accuracy: 0.
7656 - val_loss: 0.2927 - val_custom_accuracy: 0.7734
Epoch 332/1000
4/4 [==========] - 1s 338ms/step - loss: 0.2533 - custom_accuracy: 0.
8203 - val_loss: 0.2917 - val_custom_accuracy: 0.7734
Epoch 333/1000
4/4 [==========] - 1s 338ms/step - loss: 0.2535 - custom_accuracy: 0.
8203 - val_loss: 0.2912 - val_custom_accuracy: 0.7734
Epoch 334/1000
4/4 [==========] - 2s 565ms/step - loss: 0.2538 - custom_accuracy: 0.
8203 - val_loss: 0.2919 - val_custom_accuracy: 0.7734
Epoch 335/1000
4/4 [==========] - 2s 567ms/step - loss: 0.2540 - custom_accuracy: 0.
7656 - val_loss: 0.2936 - val_custom_accuracy: 0.7734
Epoch 336/1000
4/4 [==========] - 2s 548ms/step - loss: 0.2539 - custom_accuracy: 0.
8203 - val_loss: 0.2944 - val_custom_accuracy: 0.7812
Epoch 337/1000
4/4 [==========] - 2s 547ms/step - loss: 0.2538 - custom_accuracy: 0.

4/4 [==============================] - 2s 547ms/step - loss: 0.2536 - custom_accuracy: 0.
8203 - val_loss: 0.2956 - val_custom_accuracy: 0.7812
Epoch 338/1000
4/4 [==============================] - 2s 431ms/step - loss: 0.2541 - custom_accuracy: 0.
8203 - val_loss: 0.2975 - val_custom_accuracy: 0.7812
Epoch 339/1000
4/4 [==============================] - 1s 336ms/step - loss: 0.2544 - custom_accuracy: 0.
7031 - val_loss: 0.2979 - val_custom_accuracy: 0.7812
Epoch 340/1000
4/4 [==============================] - 1s 338ms/step - loss: 0.2542 - custom_accuracy: 0.
8125 - val_loss: 0.2972 - val_custom_accuracy: 0.7812
Epoch 341/1000
4/4 [==============================] - 1s 332ms/step - loss: 0.2533 - custom_accuracy: 0.
7656 - val_loss: 0.2966 - val_custom_accuracy: 0.7734
Epoch 342/1000
4/4 [==============================] - 1s 330ms/step - loss: 0.2530 - custom_accuracy: 0.
8203 - val_loss: 0.2951 - val_custom_accuracy: 0.7734
Epoch 343/1000
4/4 [==============================] - 1s 331ms/step - loss: 0.2525 - custom_accuracy: 0.
8203 - val_loss: 0.2954 - val_custom_accuracy: 0.7734
Epoch 344/1000
4/4 [==============================] - 1s 338ms/step - loss: 0.2524 - custom_accuracy: 0.
8203 - val_loss: 0.2971 - val_custom_accuracy: 0.7734
Epoch 345/1000
4/4 [==============================] - 1s 331ms/step - loss: 0.2530 - custom_accuracy: 0.
8203 - val_loss: 0.3001 - val_custom_accuracy: 0.7812
Epoch 346/1000
4/4 [==============================] - 2s 451ms/step - loss: 0.2535 - custom_accuracy: 0.
8125 - val_loss: 0.3021 - val_custom_accuracy: 0.7812
Epoch 347/1000
4/4 [==============================] - 2s 583ms/step - loss: 0.2540 - custom_accuracy: 0.
7031 - val_loss: 0.3019 - val_custom_accuracy: 0.7812
Epoch 348/1000
4/4 [==============================] - 2s 545ms/step - loss: 0.2542 - custom_accuracy: 0.
7031 - val_loss: 0.3013 - val_custom_accuracy: 0.7812
Epoch 349/1000
4/4 [==============================] - 2s 534ms/step - loss: 0.2531 - custom_accuracy: 0.
8203 - val_loss: 0.2969 - val_custom_accuracy: 0.7734
Epoch 350/1000
4/4 [==============================] - 2s 550ms/step - loss: 0.2524 - custom_accuracy: 0.
8203 - val_loss: 0.2953 - val_custom_accuracy: 0.7734
Epoch 351/1000
4/4 [==============================] - 1s 330ms/step - loss: 0.2521 - custom_accuracy: 0.
8203 - val_loss: 0.2955 - val_custom_accuracy: 0.7734
Epoch 352/1000
4/4 [==============================] - 1s 334ms/step - loss: 0.2523 - custom_accuracy: 0.
7109 - val_loss: 0.2956 - val_custom_accuracy: 0.7734
Epoch 353/1000
4/4 [==============================] - 1s 335ms/step - loss: 0.2520 - custom_accuracy: 0.
8203 - val_loss: 0.2941 - val_custom_accuracy: 0.7734
Epoch 354/1000
4/4 [==============================] - 1s 335ms/step - loss: 0.2521 - custom_accuracy: 0.
8203 - val_loss: 0.2940 - val_custom_accuracy: 0.7734
Epoch 355/1000
4/4 [==============================] - 1s 336ms/step - loss: 0.2520 - custom_accuracy: 0.
7656 - val_loss: 0.2937 - val_custom_accuracy: 0.7734
Epoch 356/1000
4/4 [==============================] - 1s 334ms/step - loss: 0.2523 - custom_accuracy: 0.
8203 - val_loss: 0.2931 - val_custom_accuracy: 0.7734
Epoch 357/1000
4/4 [==============================] - 1s 334ms/step - loss: 0.2521 - custom_accuracy: 0.
8203 - val_loss: 0.2944 - val_custom_accuracy: 0.7734
Epoch 358/1000
4/4 [==============================] - 1s 336ms/step - loss: 0.2522 - custom_accuracy: 0.
7656 - val_loss: 0.2946 - val_custom_accuracy: 0.7734
Epoch 359/1000
4/4 [==============================] - 2s 570ms/step - loss: 0.2521 - custom_accuracy: 0.
7656 - val_loss: 0.2945 - val_custom_accuracy: 0.7734
Epoch 360/1000
4/4 [==============================] - 2s 552ms/step - loss: 0.2525 - custom_accuracy: 0.
7656 - val_loss: 0.2943 - val_custom_accuracy: 0.7734
Epoch 361/1000
4/4 [==============================] - 2s 571ms/step - loss: 0.2524 - custom_accuracy: 0.

4/4 [==========] - 2s 571ms/step - loss: 0.2524 - custom_accuracy: 0.
7656 - val_loss: 0.2953 - val_custom_accuracy: 0.7734
Epoch 362/1000
4/4 [==========] - 2s 550ms/step - loss: 0.2528 - custom_accuracy: 0.
8203 - val_loss: 0.2977 - val_custom_accuracy: 0.7734
Epoch 363/1000
4/4 [==========] - 2s 388ms/step - loss: 0.2523 - custom_accuracy: 0.
7109 - val_loss: 0.2988 - val_custom_accuracy: 0.7734
Epoch 364/1000
4/4 [==========] - 1s 334ms/step - loss: 0.2521 - custom_accuracy: 0.
7656 - val_loss: 0.3006 - val_custom_accuracy: 0.7734
Epoch 365/1000
4/4 [==========] - 1s 337ms/step - loss: 0.2532 - custom_accuracy: 0.
8125 - val_loss: 0.3031 - val_custom_accuracy: 0.7734
Epoch 366/1000
4/4 [==========] - 1s 342ms/step - loss: 0.2538 - custom_accuracy: 0.
7031 - val_loss: 0.3026 - val_custom_accuracy: 0.7734
Epoch 367/1000
4/4 [==========] - 1s 333ms/step - loss: 0.2528 - custom_accuracy: 0.
8203 - val_loss: 0.2965 - val_custom_accuracy: 0.7734
Epoch 368/1000
4/4 [==========] - 1s 337ms/step - loss: 0.2519 - custom_accuracy: 0.
7109 - val_loss: 0.2929 - val_custom_accuracy: 0.7734
Epoch 369/1000
4/4 [==========] - 1s 345ms/step - loss: 0.2515 - custom_accuracy: 0.
7656 - val_loss: 0.2910 - val_custom_accuracy: 0.7734
Epoch 370/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2517 - custom_accuracy: 0.
7109 - val_loss: 0.2901 - val_custom_accuracy: 0.7734
Epoch 371/1000
4/4 [==========] - 2s 524ms/step - loss: 0.2525 - custom_accuracy: 0.
7656 - val_loss: 0.2917 - val_custom_accuracy: 0.7734
Epoch 372/1000
4/4 [==========] - 2s 561ms/step - loss: 0.2521 - custom_accuracy: 0.
6562 - val_loss: 0.2917 - val_custom_accuracy: 0.7734
Epoch 373/1000
4/4 [==========] - 2s 554ms/step - loss: 0.2530 - custom_accuracy: 0.
7656 - val_loss: 0.2900 - val_custom_accuracy: 0.7734
Epoch 374/1000
4/4 [==========] - 2s 550ms/step - loss: 0.2519 - custom_accuracy: 0.
7656 - val_loss: 0.2883 - val_custom_accuracy: 0.7734
Epoch 375/1000
4/4 [==========] - 2s 480ms/step - loss: 0.2536 - custom_accuracy: 0.
8047 - val_loss: 0.2871 - val_custom_accuracy: 0.7734
Epoch 376/1000
4/4 [==========] - 1s 371ms/step - loss: 0.2536 - custom_accuracy: 0.
6953 - val_loss: 0.2872 - val_custom_accuracy: 0.7734
Epoch 377/1000
4/4 [==========] - 1s 342ms/step - loss: 0.2529 - custom_accuracy: 0.
7578 - val_loss: 0.2873 - val_custom_accuracy: 0.7734
Epoch 378/1000
4/4 [==========] - 1s 341ms/step - loss: 0.2526 - custom_accuracy: 0.
8203 - val_loss: 0.2869 - val_custom_accuracy: 0.7734
Epoch 379/1000
4/4 [==========] - 1s 337ms/step - loss: 0.2530 - custom_accuracy: 0.
7109 - val_loss: 0.2872 - val_custom_accuracy: 0.7734
Epoch 380/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2525 - custom_accuracy: 0.
7656 - val_loss: 0.2875 - val_custom_accuracy: 0.7734
Epoch 381/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2526 - custom_accuracy: 0.
8203 - val_loss: 0.2875 - val_custom_accuracy: 0.7734
Epoch 382/1000
4/4 [==========] - 1s 342ms/step - loss: 0.2521 - custom_accuracy: 0.
8203 - val_loss: 0.2888 - val_custom_accuracy: 0.7734
Epoch 383/1000
4/4 [==========] - 2s 462ms/step - loss: 0.2514 - custom_accuracy: 0.
7656 - val_loss: 0.2907 - val_custom_accuracy: 0.7734
Epoch 384/1000
4/4 [==========] - 2s 596ms/step - loss: 0.2525 - custom_accuracy: 0.
8203 - val_loss: 0.2943 - val_custom_accuracy: 0.7734
Epoch 385/1000
4/4 [==========] - 2s 559ms/step - loss: 0.2524 - custom_accuracy: 0.

4/4 [==========] - 2s 559ms/step - loss: 0.2524 - custom_accuracy: 0.
7656 - val_loss: 0.2955 - val_custom_accuracy: 0.7734
Epoch 386/1000
4/4 [==========] - 2s 561ms/step - loss: 0.2526 - custom_accuracy: 0.
7656 - val_loss: 0.2938 - val_custom_accuracy: 0.7734
Epoch 387/1000
4/4 [==========] - 2s 512ms/step - loss: 0.2523 - custom_accuracy: 0.
7656 - val_loss: 0.2934 - val_custom_accuracy: 0.7734
Epoch 388/1000
4/4 [==========] - 1s 345ms/step - loss: 0.2520 - custom_accuracy: 0.
8203 - val_loss: 0.2939 - val_custom_accuracy: 0.7734
Epoch 389/1000
4/4 [==========] - 1s 342ms/step - loss: 0.2522 - custom_accuracy: 0.
7109 - val_loss: 0.2941 - val_custom_accuracy: 0.7734
Epoch 390/1000
4/4 [==========] - 1s 347ms/step - loss: 0.2525 - custom_accuracy: 0.
8203 - val_loss: 0.2929 - val_custom_accuracy: 0.7734
Epoch 391/1000
4/4 [==========] - 1s 345ms/step - loss: 0.2520 - custom_accuracy: 0.
8203 - val_loss: 0.2918 - val_custom_accuracy: 0.7734
Epoch 392/1000
4/4 [==========] - 1s 334ms/step - loss: 0.2523 - custom_accuracy: 0.
8203 - val_loss: 0.2901 - val_custom_accuracy: 0.7734
Epoch 393/1000
4/4 [==========] - 1s 334ms/step - loss: 0.2516 - custom_accuracy: 0.
8203 - val_loss: 0.2899 - val_custom_accuracy: 0.7734
Epoch 394/1000
4/4 [==========] - 1s 339ms/step - loss: 0.2516 - custom_accuracy: 0.
8203 - val_loss: 0.2903 - val_custom_accuracy: 0.7734
Epoch 395/1000
4/4 [==========] - 1s 405ms/step - loss: 0.2524 - custom_accuracy: 0.
7109 - val_loss: 0.2908 - val_custom_accuracy: 0.7734
Epoch 396/1000
4/4 [==========] - 2s 573ms/step - loss: 0.2520 - custom_accuracy: 0.
8203 - val_loss: 0.2900 - val_custom_accuracy: 0.7734
Epoch 397/1000
4/4 [==========] - 2s 550ms/step - loss: 0.2518 - custom_accuracy: 0.
7109 - val_loss: 0.2909 - val_custom_accuracy: 0.7734
Epoch 398/1000
4/4 [==========] - 2s 553ms/step - loss: 0.2516 - custom_accuracy: 0.
7656 - val_loss: 0.2924 - val_custom_accuracy: 0.7734
Epoch 399/1000
4/4 [==========] - 2s 553ms/step - loss: 0.2515 - custom_accuracy: 0.
7656 - val_loss: 0.2921 - val_custom_accuracy: 0.7734
Epoch 400/1000
4/4 [==========] - 1s 330ms/step - loss: 0.2509 - custom_accuracy: 0.
6562 - val_loss: 0.2918 - val_custom_accuracy: 0.7734
Epoch 401/1000
4/4 [==========] - 1s 325ms/step - loss: 0.2514 - custom_accuracy: 0.
7656 - val_loss: 0.2909 - val_custom_accuracy: 0.7734
Epoch 402/1000
4/4 [==========] - 1s 328ms/step - loss: 0.2509 - custom_accuracy: 0.
7656 - val_loss: 0.2895 - val_custom_accuracy: 0.7734
Epoch 403/1000
4/4 [==========] - 1s 333ms/step - loss: 0.2522 - custom_accuracy: 0.
8125 - val_loss: 0.2891 - val_custom_accuracy: 0.7734
Epoch 404/1000
4/4 [==========] - 1s 332ms/step - loss: 0.2516 - custom_accuracy: 0.
7578 - val_loss: 0.2896 - val_custom_accuracy: 0.7734
Epoch 405/1000
4/4 [==========] - 1s 342ms/step - loss: 0.2513 - custom_accuracy: 0.
8125 - val_loss: 0.2896 - val_custom_accuracy: 0.7734
Epoch 406/1000
4/4 [==========] - 1s 333ms/step - loss: 0.2509 - custom_accuracy: 0.
7656 - val_loss: 0.2907 - val_custom_accuracy: 0.7734
Epoch 407/1000
4/4 [==========] - 1s 337ms/step - loss: 0.2510 - custom_accuracy: 0.
7656 - val_loss: 0.2918 - val_custom_accuracy: 0.7734
Epoch 408/1000
4/4 [==========] - 2s 572ms/step - loss: 0.2510 - custom_accuracy: 0.
7656 - val_loss: 0.2914 - val_custom_accuracy: 0.7734
Epoch 409/1000
4/4 [==========] - 2s 567ms/step - loss: 0.2509 - custom_accuracy: 0.

4/4 [==========] - 2s 567ms/step - loss: 0.2509 - custom_accuracy: 0.
7656 - val_loss: 0.2900 - val_custom_accuracy: 0.7734
Epoch 410/1000
4/4 [==========] - 2s 553ms/step - loss: 0.2508 - custom_accuracy: 0.
8203 - val_loss: 0.2900 - val_custom_accuracy: 0.7734
Epoch 411/1000
4/4 [==========] - 2s 542ms/step - loss: 0.2507 - custom_accuracy: 0.
7656 - val_loss: 0.2905 - val_custom_accuracy: 0.7734
Epoch 412/1000
4/4 [==========] - 2s 420ms/step - loss: 0.2511 - custom_accuracy: 0.
7656 - val_loss: 0.2890 - val_custom_accuracy: 0.7734
Epoch 413/1000
4/4 [==========] - 1s 338ms/step - loss: 0.2512 - custom_accuracy: 0.
7656 - val_loss: 0.2881 - val_custom_accuracy: 0.7734
Epoch 414/1000
4/4 [==========] - 1s 330ms/step - loss: 0.2520 - custom_accuracy: 0.
8203 - val_loss: 0.2871 - val_custom_accuracy: 0.7734
Epoch 415/1000
4/4 [==========] - 1s 330ms/step - loss: 0.2526 - custom_accuracy: 0.
7031 - val_loss: 0.2868 - val_custom_accuracy: 0.7734
Epoch 416/1000
4/4 [==========] - 1s 332ms/step - loss: 0.2527 - custom_accuracy: 0.
8125 - val_loss: 0.2869 - val_custom_accuracy: 0.7734
Epoch 417/1000
4/4 [==========] - 1s 327ms/step - loss: 0.2520 - custom_accuracy: 0.
7656 - val_loss: 0.2885 - val_custom_accuracy: 0.7734
Epoch 418/1000
4/4 [==========] - 1s 334ms/step - loss: 0.2511 - custom_accuracy: 0.
7656 - val_loss: 0.2904 - val_custom_accuracy: 0.7734
Epoch 419/1000
4/4 [==========] - 1s 331ms/step - loss: 0.2510 - custom_accuracy: 0.
6562 - val_loss: 0.2917 - val_custom_accuracy: 0.7734
Epoch 420/1000
4/4 [==========] - 2s 446ms/step - loss: 0.2506 - custom_accuracy: 0.
7656 - val_loss: 0.2916 - val_custom_accuracy: 0.7734
Epoch 421/1000
4/4 [==========] - 2s 563ms/step - loss: 0.2513 - custom_accuracy: 0.
8203 - val_loss: 0.2914 - val_custom_accuracy: 0.7734
Epoch 422/1000
4/4 [==========] - 2s 551ms/step - loss: 0.2505 - custom_accuracy: 0.
7656 - val_loss: 0.2919 - val_custom_accuracy: 0.7734
Epoch 423/1000
4/4 [==========] - 2s 560ms/step - loss: 0.2503 - custom_accuracy: 0.
8203 - val_loss: 0.2926 - val_custom_accuracy: 0.7734
Epoch 424/1000
4/4 [==========] - 2s 531ms/step - loss: 0.2504 - custom_accuracy: 0.
8203 - val_loss: 0.2931 - val_custom_accuracy: 0.7734
Epoch 425/1000
4/4 [==========] - 1s 329ms/step - loss: 0.2503 - custom_accuracy: 0.
7656 - val_loss: 0.2945 - val_custom_accuracy: 0.7734
Epoch 426/1000
4/4 [==========] - 1s 321ms/step - loss: 0.2505 - custom_accuracy: 0.
7656 - val_loss: 0.2950 - val_custom_accuracy: 0.7734
Epoch 427/1000
4/4 [==========] - 1s 327ms/step - loss: 0.2505 - custom_accuracy: 0.
8203 - val_loss: 0.2969 - val_custom_accuracy: 0.7734
Epoch 428/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2506 - custom_accuracy: 0.
7109 - val_loss: 0.2972 - val_custom_accuracy: 0.7734
Epoch 429/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2507 - custom_accuracy: 0.
8203 - val_loss: 0.2957 - val_custom_accuracy: 0.7734
Epoch 430/1000
4/4 [==========] - 1s 340ms/step - loss: 0.2503 - custom_accuracy: 0.
8203 - val_loss: 0.2941 - val_custom_accuracy: 0.7734
Epoch 431/1000
4/4 [==========] - 1s 331ms/step - loss: 0.2499 - custom_accuracy: 0.
7656 - val_loss: 0.2918 - val_custom_accuracy: 0.7734
Epoch 432/1000
4/4 [==========] - 1s 331ms/step - loss: 0.2497 - custom_accuracy: 0.
7656 - val_loss: 0.2899 - val_custom_accuracy: 0.7734
Epoch 433/1000
4/4 [==========] - 2s 579ms/step - loss: 0.2508 - custom_accuracy: 0.

4/4 [==============================] - 2s 379ms/step - loss: 0.2506 - custom_accuracy: 0.
8203 - val_loss: 0.2886 - val_custom_accuracy: 0.7734
Epoch 434/1000
4/4 [==============================] - 2s 560ms/step - loss: 0.2508 - custom_accuracy: 0.
7656 - val_loss: 0.2891 - val_custom_accuracy: 0.7734
Epoch 435/1000
4/4 [==============================] - 2s 546ms/step - loss: 0.2510 - custom_accuracy: 0.
7656 - val_loss: 0.2907 - val_custom_accuracy: 0.7734
Epoch 436/1000
4/4 [==============================] - 2s 547ms/step - loss: 0.2503 - custom_accuracy: 0.
7109 - val_loss: 0.2912 - val_custom_accuracy: 0.7734
Epoch 437/1000
4/4 [==============================] - 2s 392ms/step - loss: 0.2501 - custom_accuracy: 0.
7656 - val_loss: 0.2909 - val_custom_accuracy: 0.7734
Epoch 438/1000
4/4 [==============================] - 1s 333ms/step - loss: 0.2505 - custom_accuracy: 0.
8203 - val_loss: 0.2898 - val_custom_accuracy: 0.7734
Epoch 439/1000
4/4 [==============================] - 1s 391ms/step - loss: 0.2506 - custom_accuracy: 0.
8125 - val_loss: 0.2902 - val_custom_accuracy: 0.7734
Epoch 440/1000
4/4 [==============================] - 1s 337ms/step - loss: 0.2504 - custom_accuracy: 0.
7578 - val_loss: 0.2903 - val_custom_accuracy: 0.7734
Epoch 441/1000
4/4 [==============================] - 1s 326ms/step - loss: 0.2503 - custom_accuracy: 0.
8203 - val_loss: 0.2911 - val_custom_accuracy: 0.7734
Epoch 442/1000
4/4 [==============================] - 1s 326ms/step - loss: 0.2502 - custom_accuracy: 0.
7109 - val_loss: 0.2919 - val_custom_accuracy: 0.7734
Epoch 443/1000
4/4 [==============================] - 1s 335ms/step - loss: 0.2497 - custom_accuracy: 0.
7109 - val_loss: 0.2889 - val_custom_accuracy: 0.7734
Epoch 444/1000
4/4 [==============================] - 1s 330ms/step - loss: 0.2507 - custom_accuracy: 0.
8047 - val_loss: 0.2866 - val_custom_accuracy: 0.7734
Epoch 445/1000
4/4 [==============================] - 2s 550ms/step - loss: 0.2532 - custom_accuracy: 0.
7500 - val_loss: 0.2863 - val_custom_accuracy: 0.7734
Epoch 446/1000
4/4 [==============================] - 2s 557ms/step - loss: 0.2522 - custom_accuracy: 0.
8047 - val_loss: 0.2874 - val_custom_accuracy: 0.7734
Epoch 447/1000
4/4 [==============================] - 2s 554ms/step - loss: 0.2509 - custom_accuracy: 0.
7656 - val_loss: 0.2905 - val_custom_accuracy: 0.7734
Epoch 448/1000
4/4 [==============================] - 2s 542ms/step - loss: 0.2512 - custom_accuracy: 0.
7656 - val_loss: 0.2941 - val_custom_accuracy: 0.7734
Epoch 449/1000
4/4 [==============================] - 2s 465ms/step - loss: 0.2518 - custom_accuracy: 0.
7656 - val_loss: 0.2955 - val_custom_accuracy: 0.7734
Epoch 450/1000
4/4 [==============================] - 1s 334ms/step - loss: 0.2507 - custom_accuracy: 0.
8203 - val_loss: 0.2936 - val_custom_accuracy: 0.7734
Epoch 451/1000
4/4 [==============================] - 1s 328ms/step - loss: 0.2507 - custom_accuracy: 0.
8203 - val_loss: 0.2941 - val_custom_accuracy: 0.7734
Epoch 452/1000
4/4 [==============================] - 1s 337ms/step - loss: 0.2504 - custom_accuracy: 0.
8203 - val_loss: 0.2945 - val_custom_accuracy: 0.7734
Epoch 453/1000
4/4 [==============================] - 1s 329ms/step - loss: 0.2501 - custom_accuracy: 0.
8203 - val_loss: 0.2946 - val_custom_accuracy: 0.7734
Epoch 454/1000
4/4 [==============================] - 1s 330ms/step - loss: 0.2502 - custom_accuracy: 0.
7109 - val_loss: 0.2940 - val_custom_accuracy: 0.7734
Epoch 455/1000
4/4 [==============================] - 1s 331ms/step - loss: 0.2501 - custom_accuracy: 0.
7656 - val_loss: 0.2907 - val_custom_accuracy: 0.7734
Epoch 456/1000
4/4 [==============================] - 1s 334ms/step - loss: 0.2501 - custom_accuracy: 0.
7656 - val_loss: 0.2893 - val_custom_accuracy: 0.7734
Epoch 457/1000
4/4 [==============================] - 1s 397ms/step - loss: 0.2502 - custom_accuracy: 0.

4/4 [==============================] - 1s 397ms/step - loss: 0.2502 - custom_accuracy: 0.
8203 - val_loss: 0.2882 - val_custom_accuracy: 0.7734
Epoch 458/1000
4/4 [==============================] - 2s 576ms/step - loss: 0.2507 - custom_accuracy: 0.
7578 - val_loss: 0.2877 - val_custom_accuracy: 0.7734
Epoch 459/1000
4/4 [==============================] - 2s 575ms/step - loss: 0.2508 - custom_accuracy: 0.
8047 - val_loss: 0.2877 - val_custom_accuracy: 0.7734
Epoch 460/1000
4/4 [==============================] - 2s 553ms/step - loss: 0.2506 - custom_accuracy: 0.
7500 - val_loss: 0.2884 - val_custom_accuracy: 0.7734
Epoch 461/1000
4/4 [==============================] - 2s 542ms/step - loss: 0.2500 - custom_accuracy: 0.
7656 - val_loss: 0.2890 - val_custom_accuracy: 0.7734
Epoch 462/1000
4/4 [==============================] - 1s 344ms/step - loss: 0.2501 - custom_accuracy: 0.
7031 - val_loss: 0.2896 - val_custom_accuracy: 0.7734
Epoch 463/1000
4/4 [==============================] - 1s 341ms/step - loss: 0.2499 - custom_accuracy: 0.
7578 - val_loss: 0.2907 - val_custom_accuracy: 0.7734
Epoch 464/1000
4/4 [==============================] - 1s 330ms/step - loss: 0.2498 - custom_accuracy: 0.
7109 - val_loss: 0.2919 - val_custom_accuracy: 0.7734
Epoch 465/1000
4/4 [==============================] - 1s 335ms/step - loss: 0.2497 - custom_accuracy: 0.
8203 - val_loss: 0.2929 - val_custom_accuracy: 0.7734
Epoch 466/1000
4/4 [==============================] - 1s 331ms/step - loss: 0.2496 - custom_accuracy: 0.
7656 - val_loss: 0.2951 - val_custom_accuracy: 0.7734
Epoch 467/1000
4/4 [==============================] - 1s 337ms/step - loss: 0.2498 - custom_accuracy: 0.
8203 - val_loss: 0.2985 - val_custom_accuracy: 0.7734
Epoch 468/1000
4/4 [==============================] - 1s 334ms/step - loss: 0.2503 - custom_accuracy: 0.
7656 - val_loss: 0.3009 - val_custom_accuracy: 0.7734
Epoch 469/1000
4/4 [==============================] - 1s 333ms/step - loss: 0.2509 - custom_accuracy: 0.
7656 - val_loss: 0.3007 - val_custom_accuracy: 0.7734
Epoch 470/1000
4/4 [==============================] - 2s 587ms/step - loss: 0.2506 - custom_accuracy: 0.
7656 - val_loss: 0.2998 - val_custom_accuracy: 0.7734
Epoch 471/1000
4/4 [==============================] - 2s 549ms/step - loss: 0.2506 - custom_accuracy: 0.
7656 - val_loss: 0.2970 - val_custom_accuracy: 0.7734
Epoch 472/1000
4/4 [==============================] - 2s 555ms/step - loss: 0.2500 - custom_accuracy: 0.
7109 - val_loss: 0.2949 - val_custom_accuracy: 0.7734
Epoch 473/1000
4/4 [==============================] - 2s 556ms/step - loss: 0.2498 - custom_accuracy: 0.
7578 - val_loss: 0.2939 - val_custom_accuracy: 0.7734
Epoch 474/1000
4/4 [==============================] - 2s 394ms/step - loss: 0.2498 - custom_accuracy: 0.
7578 - val_loss: 0.2958 - val_custom_accuracy: 0.7734
Epoch 475/1000
4/4 [==============================] - 1s 329ms/step - loss: 0.2496 - custom_accuracy: 0.
7578 - val_loss: 0.2959 - val_custom_accuracy: 0.7734
Epoch 476/1000
4/4 [==============================] - 1s 331ms/step - loss: 0.2493 - custom_accuracy: 0.
7578 - val_loss: 0.2969 - val_custom_accuracy: 0.7734
Epoch 477/1000
4/4 [==============================] - 1s 334ms/step - loss: 0.2497 - custom_accuracy: 0.
7656 - val_loss: 0.2971 - val_custom_accuracy: 0.7734
Epoch 478/1000
4/4 [==============================] - 1s 332ms/step - loss: 0.2496 - custom_accuracy: 0.
6562 - val_loss: 0.2941 - val_custom_accuracy: 0.7734
Epoch 479/1000
4/4 [==============================] - 1s 333ms/step - loss: 0.2497 - custom_accuracy: 0.
7031 - val_loss: 0.2921 - val_custom_accuracy: 0.7734
Epoch 480/1000
4/4 [==============================] - 1s 342ms/step - loss: 0.2509 - custom_accuracy: 0.
7031 - val_loss: 0.2926 - val_custom_accuracy: 0.7734
Epoch 481/1000
4/4 [==============================] - 1s 334ms/step - loss: 0.2514 - custom_accuracy: 0.

4/4 [==========] - 1s 334ms/step - loss: 0.2514 - custom_accuracy: 0.
7578 - val_loss: 0.2949 - val_custom_accuracy: 0.7734
Epoch 482/1000
4/4 [==========] - 2s 499ms/step - loss: 0.2511 - custom_accuracy: 0.
8125 - val_loss: 0.2957 - val_custom_accuracy: 0.7734
Epoch 483/1000
4/4 [==========] - 2s 566ms/step - loss: 0.2507 - custom_accuracy: 0.
8125 - val_loss: 0.2958 - val_custom_accuracy: 0.7734
Epoch 484/1000
4/4 [==========] - 2s 556ms/step - loss: 0.2498 - custom_accuracy: 0.
7578 - val_loss: 0.2972 - val_custom_accuracy: 0.7734
Epoch 485/1000
4/4 [==========] - 2s 544ms/step - loss: 0.2496 - custom_accuracy: 0.
7578 - val_loss: 0.2955 - val_custom_accuracy: 0.7734
Epoch 486/1000
4/4 [==========] - 2s 519ms/step - loss: 0.2490 - custom_accuracy: 0.
8125 - val_loss: 0.2916 - val_custom_accuracy: 0.7734
Epoch 487/1000
4/4 [==========] - 1s 336ms/step - loss: 0.2497 - custom_accuracy: 0.
7578 - val_loss: 0.2901 - val_custom_accuracy: 0.7734
Epoch 488/1000
4/4 [==========] - 1s 340ms/step - loss: 0.2488 - custom_accuracy: 0.
8125 - val_loss: 0.2924 - val_custom_accuracy: 0.7734
Epoch 489/1000
4/4 [==========] - 1s 343ms/step - loss: 0.2497 - custom_accuracy: 0.
6562 - val_loss: 0.2951 - val_custom_accuracy: 0.7734
Epoch 490/1000
4/4 [==========] - 1s 330ms/step - loss: 0.2483 - custom_accuracy: 0.
7031 - val_loss: 0.2925 - val_custom_accuracy: 0.7734
Epoch 491/1000
4/4 [==========] - 1s 344ms/step - loss: 0.2487 - custom_accuracy: 0.
7578 - val_loss: 0.2916 - val_custom_accuracy: 0.7734
Epoch 492/1000
4/4 [==========] - 1s 336ms/step - loss: 0.2489 - custom_accuracy: 0.
8125 - val_loss: 0.2922 - val_custom_accuracy: 0.7734
Epoch 493/1000
4/4 [==========] - 1s 333ms/step - loss: 0.2485 - custom_accuracy: 0.
7578 - val_loss: 0.2932 - val_custom_accuracy: 0.7734
Epoch 494/1000
4/4 [==========] - 1s 369ms/step - loss: 0.2488 - custom_accuracy: 0.
7578 - val_loss: 0.2939 - val_custom_accuracy: 0.7734
Epoch 495/1000
4/4 [==========] - 2s 574ms/step - loss: 0.2486 - custom_accuracy: 0.
7031 - val_loss: 0.2910 - val_custom_accuracy: 0.7734
Epoch 496/1000
4/4 [==========] - 2s 551ms/step - loss: 0.2486 - custom_accuracy: 0.
8047 - val_loss: 0.2894 - val_custom_accuracy: 0.7734
Epoch 497/1000
4/4 [==========] - 2s 540ms/step - loss: 0.2489 - custom_accuracy: 0.
6406 - val_loss: 0.2880 - val_custom_accuracy: 0.7734
Epoch 498/1000
4/4 [==========] - 2s 550ms/step - loss: 0.2495 - custom_accuracy: 0.
6406 - val_loss: 0.2870 - val_custom_accuracy: 0.7656
Epoch 499/1000
4/4 [==========] - 1s 333ms/step - loss: 0.2572 - custom_accuracy: 0.
7656 - val_loss: 0.2892 - val_custom_accuracy: 0.7578
Epoch 500/1000
4/4 [==========] - 1s 332ms/step - loss: 0.2587 - custom_accuracy: 0.
8203 - val_loss: 0.2887 - val_custom_accuracy: 0.7656
Epoch 501/1000
4/4 [==========] - 1s 334ms/step - loss: 0.2545 - custom_accuracy: 0.
7578 - val_loss: 0.2901 - val_custom_accuracy: 0.7734
Epoch 502/1000
4/4 [==========] - 1s 339ms/step - loss: 0.2507 - custom_accuracy: 0.
6953 - val_loss: 0.2920 - val_custom_accuracy: 0.7734
Epoch 503/1000
4/4 [==========] - 1s 346ms/step - loss: 0.2489 - custom_accuracy: 0.
7578 - val_loss: 0.2952 - val_custom_accuracy: 0.7734
Epoch 504/1000
4/4 [==========] - 1s 336ms/step - loss: 0.2505 - custom_accuracy: 0.
6562 - val_loss: 0.2981 - val_custom_accuracy: 0.7734
Epoch 505/1000
4/4 [==========] - 1s 324ms/step - loss: 0.2495 - custom_accuracy: 0.

4/4 [==============================] - 1s 324ms/step - loss: 0.2499 - custom_accuracy: 0.
7109 - val_loss: 0.2976 - val_custom_accuracy: 0.7734
Epoch 506/1000
4/4 [==============================] - 1s 328ms/step - loss: 0.2503 - custom_accuracy: 0.
7109 - val_loss: 0.2995 - val_custom_accuracy: 0.7734
Epoch 507/1000
4/4 [==============================] - 2s 557ms/step - loss: 0.2507 - custom_accuracy: 0.
7656 - val_loss: 0.2996 - val_custom_accuracy: 0.7734
Epoch 508/1000
4/4 [==============================] - 2s 557ms/step - loss: 0.2512 - custom_accuracy: 0.
7656 - val_loss: 0.3006 - val_custom_accuracy: 0.7734
Epoch 509/1000
4/4 [==============================] - 2s 558ms/step - loss: 0.2515 - custom_accuracy: 0.
7109 - val_loss: 0.2989 - val_custom_accuracy: 0.7734
Epoch 510/1000
4/4 [==============================] - 2s 558ms/step - loss: 0.2508 - custom_accuracy: 0.
7656 - val_loss: 0.2952 - val_custom_accuracy: 0.7734
Epoch 511/1000
4/4 [==============================] - 2s 412ms/step - loss: 0.2507 - custom_accuracy: 0.
7578 - val_loss: 0.2942 - val_custom_accuracy: 0.7734
Epoch 512/1000
4/4 [==============================] - 1s 330ms/step - loss: 0.2506 - custom_accuracy: 0.
7578 - val_loss: 0.2934 - val_custom_accuracy: 0.7734
Epoch 513/1000
4/4 [==============================] - 1s 333ms/step - loss: 0.2500 - custom_accuracy: 0.
8047 - val_loss: 0.2920 - val_custom_accuracy: 0.7734
Epoch 514/1000
4/4 [==============================] - 1s 332ms/step - loss: 0.2496 - custom_accuracy: 0.
7500 - val_loss: 0.2900 - val_custom_accuracy: 0.7734
Epoch 515/1000
4/4 [==============================] - 1s 332ms/step - loss: 0.2494 - custom_accuracy: 0.
7500 - val_loss: 0.2882 - val_custom_accuracy: 0.7734
Epoch 516/1000
4/4 [==============================] - 1s 340ms/step - loss: 0.2495 - custom_accuracy: 0.
7500 - val_loss: 0.2876 - val_custom_accuracy: 0.7734
Epoch 517/1000
4/4 [==============================] - 1s 341ms/step - loss: 0.2490 - custom_accuracy: 0.
8047 - val_loss: 0.2875 - val_custom_accuracy: 0.7734
Epoch 518/1000
4/4 [==============================] - 1s 332ms/step - loss: 0.2489 - custom_accuracy: 0.
8047 - val_loss: 0.2884 - val_custom_accuracy: 0.7734
Epoch 519/1000
4/4 [==============================] - 2s 475ms/step - loss: 0.2489 - custom_accuracy: 0.
7031 - val_loss: 0.2894 - val_custom_accuracy: 0.7734
Epoch 520/1000
4/4 [==============================] - 2s 569ms/step - loss: 0.2486 - custom_accuracy: 0.
8125 - val_loss: 0.2915 - val_custom_accuracy: 0.7734
Epoch 521/1000
4/4 [==============================] - 2s 559ms/step - loss: 0.2486 - custom_accuracy: 0.
7656 - val_loss: 0.2933 - val_custom_accuracy: 0.7734
Epoch 522/1000
4/4 [==============================] - 2s 557ms/step - loss: 0.2488 - custom_accuracy: 0.
8203 - val_loss: 0.2926 - val_custom_accuracy: 0.7734
Epoch 523/1000
4/4 [==============================] - 2s 503ms/step - loss: 0.2486 - custom_accuracy: 0.
7656 - val_loss: 0.2925 - val_custom_accuracy: 0.7734
Epoch 524/1000
4/4 [==============================] - 1s 335ms/step - loss: 0.2483 - custom_accuracy: 0.
8203 - val_loss: 0.2937 - val_custom_accuracy: 0.7734
Epoch 525/1000
4/4 [==============================] - 1s 347ms/step - loss: 0.2484 - custom_accuracy: 0.
7656 - val_loss: 0.2942 - val_custom_accuracy: 0.7734
Epoch 526/1000
4/4 [==============================] - 1s 338ms/step - loss: 0.2484 - custom_accuracy: 0.
7656 - val_loss: 0.2928 - val_custom_accuracy: 0.7734
Epoch 527/1000
4/4 [==============================] - 1s 330ms/step - loss: 0.2484 - custom_accuracy: 0.
7656 - val_loss: 0.2933 - val_custom_accuracy: 0.7734
Epoch 528/1000
4/4 [==============================] - 1s 342ms/step - loss: 0.2481 - custom_accuracy: 0.
6562 - val_loss: 0.2944 - val_custom_accuracy: 0.7734
Epoch 529/1000
4/4 [==============================] - 1s 334ms/step - loss: 0.2482 - custom_accuracy: 0.

4/4 [==============================] - 1s 334ms/step - loss: 0.2482 - custom_accuracy: 0.
8203 - val_loss: 0.2915 - val_custom_accuracy: 0.7734
Epoch 530/1000
4/4 [==============================] - 1s 331ms/step - loss: 0.2478 - custom_accuracy: 0.
8047 - val_loss: 0.2918 - val_custom_accuracy: 0.7734
Epoch 531/1000
4/4 [==============================] - 1s 386ms/step - loss: 0.2477 - custom_accuracy: 0.
7031 - val_loss: 0.2961 - val_custom_accuracy: 0.7734
Epoch 532/1000
4/4 [==============================] - 2s 594ms/step - loss: 0.2476 - custom_accuracy: 0.
7578 - val_loss: 0.2986 - val_custom_accuracy: 0.7734
Epoch 533/1000
4/4 [==============================] - 2s 629ms/step - loss: 0.2478 - custom_accuracy: 0.
7031 - val_loss: 0.2996 - val_custom_accuracy: 0.7734
Epoch 534/1000
4/4 [==============================] - 2s 560ms/step - loss: 0.2481 - custom_accuracy: 0.
7578 - val_loss: 0.3001 - val_custom_accuracy: 0.7734
Epoch 535/1000
4/4 [==============================] - 2s 555ms/step - loss: 0.2484 - custom_accuracy: 0.
7031 - val_loss: 0.2967 - val_custom_accuracy: 0.7734
Epoch 536/1000
4/4 [==============================] - 1s 330ms/step - loss: 0.2474 - custom_accuracy: 0.
8125 - val_loss: 0.2956 - val_custom_accuracy: 0.7734
Epoch 537/1000
4/4 [==============================] - 1s 327ms/step - loss: 0.2479 - custom_accuracy: 0.
7578 - val_loss: 0.2974 - val_custom_accuracy: 0.7734
Epoch 538/1000
4/4 [==============================] - 1s 330ms/step - loss: 0.2475 - custom_accuracy: 0.
8125 - val_loss: 0.2988 - val_custom_accuracy: 0.7734
Epoch 539/1000
4/4 [==============================] - 1s 327ms/step - loss: 0.2480 - custom_accuracy: 0.
6484 - val_loss: 0.2987 - val_custom_accuracy: 0.7734
Epoch 540/1000
4/4 [==============================] - 1s 331ms/step - loss: 0.2474 - custom_accuracy: 0.
8125 - val_loss: 0.2981 - val_custom_accuracy: 0.7734
Epoch 541/1000
4/4 [==============================] - 1s 341ms/step - loss: 0.2475 - custom_accuracy: 0.
7578 - val_loss: 0.2975 - val_custom_accuracy: 0.7734
Epoch 542/1000
4/4 [==============================] - 1s 336ms/step - loss: 0.2474 - custom_accuracy: 0.
7031 - val_loss: 0.2930 - val_custom_accuracy: 0.7734
Epoch 543/1000
4/4 [==============================] - 1s 336ms/step - loss: 0.2474 - custom_accuracy: 0.
6406 - val_loss: 0.2901 - val_custom_accuracy: 0.7734
Epoch 544/1000
4/4 [==============================] - 2s 567ms/step - loss: 0.2487 - custom_accuracy: 0.
6953 - val_loss: 0.2894 - val_custom_accuracy: 0.7812
Epoch 545/1000
4/4 [==============================] - 2s 560ms/step - loss: 0.2499 - custom_accuracy: 0.
7031 - val_loss: 0.2916 - val_custom_accuracy: 0.7734
Epoch 546/1000
4/4 [==============================] - 2s 554ms/step - loss: 0.2485 - custom_accuracy: 0.
8047 - val_loss: 0.2918 - val_custom_accuracy: 0.7734
Epoch 547/1000
4/4 [==============================] - 2s 551ms/step - loss: 0.2481 - custom_accuracy: 0.
6953 - val_loss: 0.2913 - val_custom_accuracy: 0.7734
Epoch 548/1000
4/4 [==============================] - 2s 409ms/step - loss: 0.2477 - custom_accuracy: 0.
8047 - val_loss: 0.2916 - val_custom_accuracy: 0.7734
Epoch 549/1000
4/4 [==============================] - 1s 335ms/step - loss: 0.2472 - custom_accuracy: 0.
7500 - val_loss: 0.2940 - val_custom_accuracy: 0.7734
Epoch 550/1000
4/4 [==============================] - 1s 332ms/step - loss: 0.2478 - custom_accuracy: 0.
6406 - val_loss: 0.3018 - val_custom_accuracy: 0.7734
Epoch 551/1000
4/4 [==============================] - 1s 331ms/step - loss: 0.2478 - custom_accuracy: 0.
7578 - val_loss: 0.2989 - val_custom_accuracy: 0.7734
Epoch 552/1000
4/4 [==============================] - 1s 335ms/step - loss: 0.2482 - custom_accuracy: 0.
7578 - val_loss: 0.2963 - val_custom_accuracy: 0.7734
Epoch 553/1000
4/4 [==============================] - 1s 332ms/step - loss: 0.2477 - custom_accuracy: 0.

4/4 [==========] - 1s 352ms/step - loss: 0.2477 - custom_accuracy: 0.
8125 - val_loss: 0.2986 - val_custom_accuracy: 0.7734
Epoch 554/1000
4/4 [==========] - 1s 395ms/step - loss: 0.2474 - custom_accuracy: 0.
7578 - val_loss: 0.3021 - val_custom_accuracy: 0.7734
Epoch 555/1000
4/4 [==========] - 1s 339ms/step - loss: 0.2479 - custom_accuracy: 0.
8203 - val_loss: 0.3069 - val_custom_accuracy: 0.7734
Epoch 556/1000
4/4 [==========] - 2s 519ms/step - loss: 0.2492 - custom_accuracy: 0.
7109 - val_loss: 0.3105 - val_custom_accuracy: 0.7734
Epoch 557/1000
4/4 [==========] - 2s 558ms/step - loss: 0.2496 - custom_accuracy: 0.
6562 - val_loss: 0.3066 - val_custom_accuracy: 0.7734
Epoch 558/1000
4/4 [==========] - 2s 548ms/step - loss: 0.2474 - custom_accuracy: 0.
8203 - val_loss: 0.2989 - val_custom_accuracy: 0.7734
Epoch 559/1000
4/4 [==========] - 2s 548ms/step - loss: 0.2473 - custom_accuracy: 0.
8203 - val_loss: 0.2940 - val_custom_accuracy: 0.7734
Epoch 560/1000
4/4 [==========] - 2s 450ms/step - loss: 0.2474 - custom_accuracy: 0.
6953 - val_loss: 0.2948 - val_custom_accuracy: 0.7734
Epoch 561/1000
4/4 [==========] - 1s 329ms/step - loss: 0.2470 - custom_accuracy: 0.
7031 - val_loss: 0.2944 - val_custom_accuracy: 0.7734
Epoch 562/1000
4/4 [==========] - 1s 330ms/step - loss: 0.2473 - custom_accuracy: 0.
7500 - val_loss: 0.2904 - val_custom_accuracy: 0.7734
Epoch 563/1000
4/4 [==========] - 1s 331ms/step - loss: 0.2469 - custom_accuracy: 0.
6953 - val_loss: 0.2906 - val_custom_accuracy: 0.7734
Epoch 564/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2468 - custom_accuracy: 0.
7500 - val_loss: 0.2939 - val_custom_accuracy: 0.7734
Epoch 565/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2461 - custom_accuracy: 0.
7578 - val_loss: 0.2983 - val_custom_accuracy: 0.7734
Epoch 566/1000
4/4 [==========] - 1s 333ms/step - loss: 0.2467 - custom_accuracy: 0.
8203 - val_loss: 0.3061 - val_custom_accuracy: 0.7734
Epoch 567/1000
4/4 [==========] - 1s 333ms/step - loss: 0.2492 - custom_accuracy: 0.
7656 - val_loss: 0.3117 - val_custom_accuracy: 0.7734
Epoch 568/1000
4/4 [==========] - 1s 422ms/step - loss: 0.2494 - custom_accuracy: 0.
7656 - val_loss: 0.3047 - val_custom_accuracy: 0.7734
Epoch 569/1000
4/4 [==========] - 2s 575ms/step - loss: 0.2481 - custom_accuracy: 0.
7109 - val_loss: 0.3020 - val_custom_accuracy: 0.7734
Epoch 570/1000
4/4 [==========] - 2s 542ms/step - loss: 0.2471 - custom_accuracy: 0.
6562 - val_loss: 0.3064 - val_custom_accuracy: 0.7734
Epoch 571/1000
4/4 [==========] - 2s 543ms/step - loss: 0.2485 - custom_accuracy: 0.
7109 - val_loss: 0.3073 - val_custom_accuracy: 0.7734
Epoch 572/1000
4/4 [==========] - 2s 544ms/step - loss: 0.2486 - custom_accuracy: 0.
7109 - val_loss: 0.3044 - val_custom_accuracy: 0.7734
Epoch 573/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2497 - custom_accuracy: 0.
8203 - val_loss: 0.2996 - val_custom_accuracy: 0.7734
Epoch 574/1000
4/4 [==========] - 1s 341ms/step - loss: 0.2491 - custom_accuracy: 0.
8125 - val_loss: 0.3030 - val_custom_accuracy: 0.7734
Epoch 575/1000
4/4 [==========] - 1s 334ms/step - loss: 0.2484 - custom_accuracy: 0.
7031 - val_loss: 0.3033 - val_custom_accuracy: 0.7734
Epoch 576/1000
4/4 [==========] - 1s 332ms/step - loss: 0.2480 - custom_accuracy: 0.
7578 - val_loss: 0.2974 - val_custom_accuracy: 0.7734
Epoch 577/1000
4/4 [==========] - 1s 329ms/step - loss: 0.2473 - custom_accuracy: 0.

4/4 [==============================] - 1s 329ms/step - loss: 0.2479 - custom_accuracy: 0.
8047 - val_loss: 0.2912 - val_custom_accuracy: 0.7734
Epoch 578/1000
4/4 [==============================] - 1s 331ms/step - loss: 0.2465 - custom_accuracy: 0.
7500 - val_loss: 0.2904 - val_custom_accuracy: 0.7812
Epoch 579/1000
4/4 [==============================] - 1s 327ms/step - loss: 0.2474 - custom_accuracy: 0.
6406 - val_loss: 0.2875 - val_custom_accuracy: 0.7734
Epoch 580/1000
4/4 [==============================] - 1s 325ms/step - loss: 0.2479 - custom_accuracy: 0.
6562 - val_loss: 0.2865 - val_custom_accuracy: 0.7656
Epoch 581/1000
4/4 [==============================] - 2s 574ms/step - loss: 0.2490 - custom_accuracy: 0.
7734 - val_loss: 0.2887 - val_custom_accuracy: 0.7656
Epoch 582/1000
4/4 [==============================] - 2s 552ms/step - loss: 0.2469 - custom_accuracy: 0.
7500 - val_loss: 0.2942 - val_custom_accuracy: 0.7734
Epoch 583/1000
4/4 [==============================] - 2s 545ms/step - loss: 0.2468 - custom_accuracy: 0.
8047 - val_loss: 0.3027 - val_custom_accuracy: 0.7734
Epoch 584/1000
4/4 [==============================] - 2s 550ms/step - loss: 0.2464 - custom_accuracy: 0.
7578 - val_loss: 0.3046 - val_custom_accuracy: 0.7734
Epoch 585/1000
4/4 [==============================] - 2s 425ms/step - loss: 0.2469 - custom_accuracy: 0.
7578 - val_loss: 0.3080 - val_custom_accuracy: 0.7734
Epoch 586/1000
4/4 [==============================] - 1s 320ms/step - loss: 0.2469 - custom_accuracy: 0.
7578 - val_loss: 0.3059 - val_custom_accuracy: 0.7734
Epoch 587/1000
4/4 [==============================] - 1s 323ms/step - loss: 0.2460 - custom_accuracy: 0.
7578 - val_loss: 0.3016 - val_custom_accuracy: 0.7734
Epoch 588/1000
4/4 [==============================] - 1s 325ms/step - loss: 0.2456 - custom_accuracy: 0.
7578 - val_loss: 0.2980 - val_custom_accuracy: 0.7734
Epoch 589/1000
4/4 [==============================] - 1s 329ms/step - loss: 0.2444 - custom_accuracy: 0.
7500 - val_loss: 0.2901 - val_custom_accuracy: 0.7812
Epoch 590/1000
4/4 [==============================] - 1s 329ms/step - loss: 0.2482 - custom_accuracy: 0.
7734 - val_loss: 0.2861 - val_custom_accuracy: 0.7578
Epoch 591/1000
4/4 [==============================] - 1s 334ms/step - loss: 0.2502 - custom_accuracy: 0.
7188 - val_loss: 0.2858 - val_custom_accuracy: 0.7578
Epoch 592/1000
4/4 [==============================] - 1s 324ms/step - loss: 0.2506 - custom_accuracy: 0.
7188 - val_loss: 0.2857 - val_custom_accuracy: 0.7578
Epoch 593/1000
4/4 [==============================] - 1s 388ms/step - loss: 0.2496 - custom_accuracy: 0.
7734 - val_loss: 0.2878 - val_custom_accuracy: 0.7656
Epoch 594/1000
4/4 [==============================] - 2s 593ms/step - loss: 0.2463 - custom_accuracy: 0.
7188 - val_loss: 0.2940 - val_custom_accuracy: 0.7734
Epoch 595/1000
4/4 [==============================] - 2s 567ms/step - loss: 0.2451 - custom_accuracy: 0.
8203 - val_loss: 0.3048 - val_custom_accuracy: 0.7734
Epoch 596/1000
4/4 [==============================] - 2s 548ms/step - loss: 0.2483 - custom_accuracy: 0.
8203 - val_loss: 0.3129 - val_custom_accuracy: 0.7734
Epoch 597/1000
4/4 [==============================] - 2s 552ms/step - loss: 0.2497 - custom_accuracy: 0.
8203 - val_loss: 0.3178 - val_custom_accuracy: 0.7734
Epoch 598/1000
4/4 [==============================] - 1s 339ms/step - loss: 0.2502 - custom_accuracy: 0.
7656 - val_loss: 0.3142 - val_custom_accuracy: 0.7734
Epoch 599/1000
4/4 [==============================] - 1s 345ms/step - loss: 0.2490 - custom_accuracy: 0.
7656 - val_loss: 0.3009 - val_custom_accuracy: 0.7734
Epoch 600/1000
4/4 [==============================] - 1s 345ms/step - loss: 0.2470 - custom_accuracy: 0.
7109 - val_loss: 0.2976 - val_custom_accuracy: 0.7734
Epoch 601/1000
4/4 [==============================] - 1s 334ms/step - loss: 0.2459 - custom_accuracy: 0.

4/4 [==========] - 1s 334ms/step - loss: 0.2459 - custom_accuracy: 0.
7578 - val_loss: 0.2961 - val_custom_accuracy: 0.7734
Epoch 602/1000
4/4 [==========] - 1s 340ms/step - loss: 0.2456 - custom_accuracy: 0.
8047 - val_loss: 0.2955 - val_custom_accuracy: 0.7734
Epoch 603/1000
4/4 [==========] - 1s 325ms/step - loss: 0.2456 - custom_accuracy: 0.
7500 - val_loss: 0.2961 - val_custom_accuracy: 0.7734
Epoch 604/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2461 - custom_accuracy: 0.
8125 - val_loss: 0.2995 - val_custom_accuracy: 0.7734
Epoch 605/1000
4/4 [==========] - 1s 336ms/step - loss: 0.2450 - custom_accuracy: 0.
7031 - val_loss: 0.2982 - val_custom_accuracy: 0.7734
Epoch 606/1000
4/4 [==========] - 2s 579ms/step - loss: 0.2457 - custom_accuracy: 0.
6953 - val_loss: 0.2922 - val_custom_accuracy: 0.7812
Epoch 607/1000
4/4 [==========] - 2s 543ms/step - loss: 0.2470 - custom_accuracy: 0.
7734 - val_loss: 0.2910 - val_custom_accuracy: 0.7656
Epoch 608/1000
4/4 [==========] - 2s 548ms/step - loss: 0.2451 - custom_accuracy: 0.
8125 - val_loss: 0.2978 - val_custom_accuracy: 0.7734
Epoch 609/1000
4/4 [==========] - 2s 540ms/step - loss: 0.2453 - custom_accuracy: 0.
7578 - val_loss: 0.3055 - val_custom_accuracy: 0.7734
Epoch 610/1000
4/4 [==========] - 2s 404ms/step - loss: 0.2452 - custom_accuracy: 0.
7109 - val_loss: 0.3008 - val_custom_accuracy: 0.7656
Epoch 611/1000
4/4 [==========] - 1s 334ms/step - loss: 0.2447 - custom_accuracy: 0.
8203 - val_loss: 0.2956 - val_custom_accuracy: 0.7656
Epoch 612/1000
4/4 [==========] - 1s 329ms/step - loss: 0.2451 - custom_accuracy: 0.
8047 - val_loss: 0.2958 - val_custom_accuracy: 0.7656
Epoch 613/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2436 - custom_accuracy: 0.
8047 - val_loss: 0.3012 - val_custom_accuracy: 0.7656
Epoch 614/1000
4/4 [==========] - 1s 336ms/step - loss: 0.2445 - custom_accuracy: 0.
8125 - val_loss: 0.3062 - val_custom_accuracy: 0.7656
Epoch 615/1000
4/4 [==========] - 1s 333ms/step - loss: 0.2453 - custom_accuracy: 0.
6562 - val_loss: 0.3067 - val_custom_accuracy: 0.7656
Epoch 616/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2447 - custom_accuracy: 0.
7031 - val_loss: 0.3024 - val_custom_accuracy: 0.7656
Epoch 617/1000
4/4 [==========] - 1s 326ms/step - loss: 0.2440 - custom_accuracy: 0.
8125 - val_loss: 0.2975 - val_custom_accuracy: 0.7656
Epoch 618/1000
4/4 [==========] - 2s 471ms/step - loss: 0.2444 - custom_accuracy: 0.
7500 - val_loss: 0.2941 - val_custom_accuracy: 0.7734
Epoch 619/1000
4/4 [==========] - 2s 563ms/step - loss: 0.2443 - custom_accuracy: 0.
7500 - val_loss: 0.2905 - val_custom_accuracy: 0.7656
Epoch 620/1000
4/4 [==========] - 2s 538ms/step - loss: 0.2445 - custom_accuracy: 0.
7188 - val_loss: 0.2913 - val_custom_accuracy: 0.7656
Epoch 621/1000
4/4 [==========] - 2s 555ms/step - loss: 0.2443 - custom_accuracy: 0.
7734 - val_loss: 0.2955 - val_custom_accuracy: 0.7734
Epoch 622/1000
4/4 [==========] - 2s 512ms/step - loss: 0.2465 - custom_accuracy: 0.
8203 - val_loss: 0.3090 - val_custom_accuracy: 0.7656
Epoch 623/1000
4/4 [==========] - 1s 337ms/step - loss: 0.2458 - custom_accuracy: 0.
7109 - val_loss: 0.3059 - val_custom_accuracy: 0.7656
Epoch 624/1000
4/4 [==========] - 1s 337ms/step - loss: 0.2429 - custom_accuracy: 0.
8203 - val_loss: 0.2906 - val_custom_accuracy: 0.7578
Epoch 625/1000
4/4 [==========] - 1s 341ms/step - loss: 0.2460 - custom_accuracy: 0.

4/4 [==========] - 1s 341ms/step - loss: 0.2460 - custom_accuracy: 0.
7812 - val_loss: 0.2877 - val_custom_accuracy: 0.7500
Epoch 626/1000
4/4 [==========] - 1s 340ms/step - loss: 0.2463 - custom_accuracy: 0.
8359 - val_loss: 0.2914 - val_custom_accuracy: 0.7656
Epoch 627/1000
4/4 [==========] - 1s 330ms/step - loss: 0.2424 - custom_accuracy: 0.
7891 - val_loss: 0.2997 - val_custom_accuracy: 0.7656
Epoch 628/1000
4/4 [==========] - 1s 337ms/step - loss: 0.2464 - custom_accuracy: 0.
7109 - val_loss: 0.3063 - val_custom_accuracy: 0.7656
Epoch 629/1000
4/4 [==========] - 1s 341ms/step - loss: 0.2442 - custom_accuracy: 0.
8203 - val_loss: 0.2937 - val_custom_accuracy: 0.7656
Epoch 630/1000
4/4 [==========] - 1s 370ms/step - loss: 0.2434 - custom_accuracy: 0.
7812 - val_loss: 0.2889 - val_custom_accuracy: 0.7578
Epoch 631/1000
4/4 [==========] - 2s 575ms/step - loss: 0.2445 - custom_accuracy: 0.
8359 - val_loss: 0.2890 - val_custom_accuracy: 0.7578
Epoch 632/1000
4/4 [==========] - 2s 552ms/step - loss: 0.2443 - custom_accuracy: 0.
7812 - val_loss: 0.2919 - val_custom_accuracy: 0.7656
Epoch 633/1000
4/4 [==========] - 2s 560ms/step - loss: 0.2434 - custom_accuracy: 0.
8359 - val_loss: 0.2910 - val_custom_accuracy: 0.7656
Epoch 634/1000
4/4 [==========] - 2s 559ms/step - loss: 0.2434 - custom_accuracy: 0.
7812 - val_loss: 0.2963 - val_custom_accuracy: 0.7734
Epoch 635/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2435 - custom_accuracy: 0.
8203 - val_loss: 0.3028 - val_custom_accuracy: 0.7734
Epoch 636/1000
4/4 [==========] - 1s 341ms/step - loss: 0.2436 - custom_accuracy: 0.
6562 - val_loss: 0.2980 - val_custom_accuracy: 0.7812
Epoch 637/1000
4/4 [==========] - 1s 339ms/step - loss: 0.2426 - custom_accuracy: 0.
7266 - val_loss: 0.2881 - val_custom_accuracy: 0.7500
Epoch 638/1000
4/4 [==========] - 1s 340ms/step - loss: 0.2479 - custom_accuracy: 0.
7812 - val_loss: 0.2862 - val_custom_accuracy: 0.7500
Epoch 639/1000
4/4 [==========] - 1s 333ms/step - loss: 0.2486 - custom_accuracy: 0.
8359 - val_loss: 0.2915 - val_custom_accuracy: 0.7578
Epoch 640/1000
4/4 [==========] - 1s 347ms/step - loss: 0.2437 - custom_accuracy: 0.
7812 - val_loss: 0.3041 - val_custom_accuracy: 0.7578
Epoch 641/1000
4/4 [==========] - 1s 338ms/step - loss: 0.2432 - custom_accuracy: 0.
8203 - val_loss: 0.3095 - val_custom_accuracy: 0.7656
Epoch 642/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2443 - custom_accuracy: 0.
8203 - val_loss: 0.3084 - val_custom_accuracy: 0.7656
Epoch 643/1000
4/4 [==========] - 2s 581ms/step - loss: 0.2425 - custom_accuracy: 0.
7656 - val_loss: 0.3000 - val_custom_accuracy: 0.7734
Epoch 644/1000
4/4 [==========] - 2s 556ms/step - loss: 0.2416 - custom_accuracy: 0.
8203 - val_loss: 0.2975 - val_custom_accuracy: 0.7734
Epoch 645/1000
4/4 [==========] - 2s 553ms/step - loss: 0.2413 - custom_accuracy: 0.
8125 - val_loss: 0.3007 - val_custom_accuracy: 0.7734
Epoch 646/1000
4/4 [==========] - 2s 548ms/step - loss: 0.2415 - custom_accuracy: 0.
8203 - val_loss: 0.3027 - val_custom_accuracy: 0.7734
Epoch 647/1000
4/4 [==========] - 2s 382ms/step - loss: 0.2419 - custom_accuracy: 0.
7656 - val_loss: 0.3028 - val_custom_accuracy: 0.7734
Epoch 648/1000
4/4 [==========] - 1s 333ms/step - loss: 0.2424 - custom_accuracy: 0.
8281 - val_loss: 0.2986 - val_custom_accuracy: 0.7734
Epoch 649/1000
4/4 [==========] - 1s 341ms/step - loss: 0.2417 - custom_accuracy: 0.

8359 - val_loss: 0.3028 - val_custom_accuracy: 0.7656
Epoch 650/1000
4/4 [==============================] - 1s 336ms/step - loss: 0.2424 - custom_accuracy: 0.
8203 - val_loss: 0.3028 - val_custom_accuracy: 0.7656
Epoch 651/1000
4/4 [==============================] - 1s 321ms/step - loss: 0.2418 - custom_accuracy: 0.
7656 - val_loss: 0.3028 - val_custom_accuracy: 0.7656
Epoch 652/1000
4/4 [==============================] - 1s 332ms/step - loss: 0.2416 - custom_accuracy: 0.
7188 - val_loss: 0.3004 - val_custom_accuracy: 0.7734
Epoch 653/1000
4/4 [==============================] - 1s 339ms/step - loss: 0.2411 - custom_accuracy: 0.
7734 - val_loss: 0.3017 - val_custom_accuracy: 0.7734
Epoch 654/1000
4/4 [==============================] - 1s 327ms/step - loss: 0.2411 - custom_accuracy: 0.
7578 - val_loss: 0.3087 - val_custom_accuracy: 0.7734
Epoch 655/1000
4/4 [==============================] - 2s 502ms/step - loss: 0.2411 - custom_accuracy: 0.
7578 - val_loss: 0.3131 - val_custom_accuracy: 0.7734
Epoch 656/1000
4/4 [==============================] - 2s 566ms/step - loss: 0.2414 - custom_accuracy: 0.
7578 - val_loss: 0.3132 - val_custom_accuracy: 0.7734
Epoch 657/1000
4/4 [==============================] - 2s 566ms/step - loss: 0.2409 - custom_accuracy: 0.
8125 - val_loss: 0.3094 - val_custom_accuracy: 0.7656
Epoch 658/1000
4/4 [==============================] - 2s 564ms/step - loss: 0.2398 - custom_accuracy: 0.
7031 - val_loss: 0.2931 - val_custom_accuracy: 0.7578
Epoch 659/1000
4/4 [==============================] - 2s 464ms/step - loss: 0.2516 - custom_accuracy: 0.
8281 - val_loss: 0.2877 - val_custom_accuracy: 0.7734
Epoch 660/1000
4/4 [==============================] - 1s 330ms/step - loss: 0.2618 - custom_accuracy: 0.
8125 - val_loss: 0.2870 - val_custom_accuracy: 0.7500
Epoch 661/1000
4/4 [==============================] - 1s 333ms/step - loss: 0.2512 - custom_accuracy: 0.
7656 - val_loss: 0.2947 - val_custom_accuracy: 0.7734
Epoch 662/1000
4/4 [==============================] - 1s 331ms/step - loss: 0.2456 - custom_accuracy: 0.
7031 - val_loss: 0.2994 - val_custom_accuracy: 0.7656
Epoch 663/1000
4/4 [==============================] - 1s 329ms/step - loss: 0.2438 - custom_accuracy: 0.
8203 - val_loss: 0.3055 - val_custom_accuracy: 0.7734
Epoch 664/1000
4/4 [==============================] - 1s 324ms/step - loss: 0.2463 - custom_accuracy: 0.
7031 - val_loss: 0.3103 - val_custom_accuracy: 0.7734
Epoch 665/1000
4/4 [==============================] - 1s 332ms/step - loss: 0.2451 - custom_accuracy: 0.
8203 - val_loss: 0.3063 - val_custom_accuracy: 0.7656
Epoch 666/1000
4/4 [==============================] - 1s 330ms/step - loss: 0.2437 - custom_accuracy: 0.
8203 - val_loss: 0.3028 - val_custom_accuracy: 0.7656
Epoch 667/1000
4/4 [==============================] - 1s 390ms/step - loss: 0.2428 - custom_accuracy: 0.
8203 - val_loss: 0.3065 - val_custom_accuracy: 0.7656
Epoch 668/1000
4/4 [==============================] - 2s 580ms/step - loss: 0.2423 - custom_accuracy: 0.
7109 - val_loss: 0.3071 - val_custom_accuracy: 0.7656
Epoch 669/1000
4/4 [==============================] - 2s 532ms/step - loss: 0.2414 - custom_accuracy: 0.
6562 - val_loss: 0.2988 - val_custom_accuracy: 0.7734
Epoch 670/1000
4/4 [==============================] - 2s 541ms/step - loss: 0.2433 - custom_accuracy: 0.
8281 - val_loss: 0.2882 - val_custom_accuracy: 0.7500
Epoch 671/1000
4/4 [==============================] - 3s 723ms/step - loss: 0.2474 - custom_accuracy: 0.
7734 - val_loss: 0.2895 - val_custom_accuracy: 0.7500
Epoch 672/1000
4/4 [==============================] - 1s 341ms/step - loss: 0.2443 - custom_accuracy: 0.
7188 - val_loss: 0.2951 - val_custom_accuracy: 0.7656
Epoch 673/1000

4/4 [==============================] - 1s 351ms/step - loss: 0.2415 - custom_accuracy: 0.
7266 - val_loss: 0.3025 - val_custom_accuracy: 0.7656
Epoch 674/1000
4/4 [==============================] - 1s 323ms/step - loss: 0.2409 - custom_accuracy: 0.
7656 - val_loss: 0.3087 - val_custom_accuracy: 0.7578
Epoch 675/1000
4/4 [==============================] - 1s 333ms/step - loss: 0.2407 - custom_accuracy: 0.
7188 - val_loss: 0.3080 - val_custom_accuracy: 0.7656
Epoch 676/1000
4/4 [==============================] - 1s 338ms/step - loss: 0.2399 - custom_accuracy: 0.
7734 - val_loss: 0.3060 - val_custom_accuracy: 0.7656
Epoch 677/1000
4/4 [==============================] - 1s 335ms/step - loss: 0.2393 - custom_accuracy: 0.
7188 - val_loss: 0.3037 - val_custom_accuracy: 0.7656
Epoch 678/1000
4/4 [==============================] - 1s 333ms/step - loss: 0.2399 - custom_accuracy: 0.
8359 - val_loss: 0.2987 - val_custom_accuracy: 0.7734
Epoch 679/1000
4/4 [==============================] - 1s 378ms/step - loss: 0.2397 - custom_accuracy: 0.
6641 - val_loss: 0.3017 - val_custom_accuracy: 0.7734
Epoch 680/1000
4/4 [==============================] - 2s 570ms/step - loss: 0.2397 - custom_accuracy: 0.
8281 - val_loss: 0.3029 - val_custom_accuracy: 0.7734
Epoch 681/1000
4/4 [==============================] - 2s 554ms/step - loss: 0.2413 - custom_accuracy: 0.
8281 - val_loss: 0.3059 - val_custom_accuracy: 0.7656
Epoch 682/1000
4/4 [==============================] - 2s 549ms/step - loss: 0.2408 - custom_accuracy: 0.
7734 - val_loss: 0.2973 - val_custom_accuracy: 0.7656
Epoch 683/1000
4/4 [==============================] - 2s 551ms/step - loss: 0.2404 - custom_accuracy: 0.
7812 - val_loss: 0.2993 - val_custom_accuracy: 0.7656
Epoch 684/1000
4/4 [==============================] - 1s 340ms/step - loss: 0.2385 - custom_accuracy: 0.
7266 - val_loss: 0.3015 - val_custom_accuracy: 0.7656
Epoch 685/1000
4/4 [==============================] - 1s 332ms/step - loss: 0.2374 - custom_accuracy: 0.
7266 - val_loss: 0.3071 - val_custom_accuracy: 0.7656
Epoch 686/1000
4/4 [==============================] - 1s 339ms/step - loss: 0.2379 - custom_accuracy: 0.
7656 - val_loss: 0.3174 - val_custom_accuracy: 0.7578
Epoch 687/1000
4/4 [==============================] - 1s 336ms/step - loss: 0.2424 - custom_accuracy: 0.
7656 - val_loss: 0.3182 - val_custom_accuracy: 0.7578
Epoch 688/1000
4/4 [==============================] - 1s 329ms/step - loss: 0.2419 - custom_accuracy: 0.
7656 - val_loss: 0.3097 - val_custom_accuracy: 0.7656
Epoch 689/1000
4/4 [==============================] - 1s 328ms/step - loss: 0.2412 - custom_accuracy: 0.
7656 - val_loss: 0.3116 - val_custom_accuracy: 0.7656
Epoch 690/1000
4/4 [==============================] - 1s 364ms/step - loss: 0.2399 - custom_accuracy: 0.
7656 - val_loss: 0.3020 - val_custom_accuracy: 0.7578
Epoch 691/1000
4/4 [==============================] - 1s 335ms/step - loss: 0.2390 - custom_accuracy: 0.
8438 - val_loss: 0.2912 - val_custom_accuracy: 0.7344
Epoch 692/1000
4/4 [==============================] - 2s 588ms/step - loss: 0.2459 - custom_accuracy: 0.
8438 - val_loss: 0.2920 - val_custom_accuracy: 0.7266
Epoch 693/1000
4/4 [==============================] - 2s 546ms/step - loss: 0.2405 - custom_accuracy: 0.
8516 - val_loss: 0.3007 - val_custom_accuracy: 0.7656
Epoch 694/1000
4/4 [==============================] - 2s 553ms/step - loss: 0.2383 - custom_accuracy: 0.
7734 - val_loss: 0.3173 - val_custom_accuracy: 0.7656
Epoch 695/1000
4/4 [==============================] - 2s 551ms/step - loss: 0.2396 - custom_accuracy: 0.
7188 - val_loss: 0.3123 - val_custom_accuracy: 0.7656
Epoch 696/1000
4/4 [==============================] - 2s 414ms/step - loss: 0.2377 - custom_accuracy: 0.
7734 - val_loss: 0.3001 - val_custom_accuracy: 0.7734
Epoch 697/1000
4/4 [==============================] - 1s 337ms/step - loss: 0.2406 - custom_accuracy: 0.

4/4 [==========] - 1s 337ms/step - loss: 0.2406 - custom_accuracy: 0.
7812 - val_loss: 0.2955 - val_custom_accuracy: 0.7578
Epoch 698/1000
4/4 [==========] - 1s 331ms/step - loss: 0.2421 - custom_accuracy: 0.
8516 - val_loss: 0.2986 - val_custom_accuracy: 0.7656
Epoch 699/1000
4/4 [==========] - 1s 328ms/step - loss: 0.2377 - custom_accuracy: 0.
8281 - val_loss: 0.3036 - val_custom_accuracy: 0.7734
Epoch 700/1000
4/4 [==========] - 1s 334ms/step - loss: 0.2384 - custom_accuracy: 0.
8281 - val_loss: 0.3041 - val_custom_accuracy: 0.7656
Epoch 701/1000
4/4 [==========] - 1s 336ms/step - loss: 0.2380 - custom_accuracy: 0.
7188 - val_loss: 0.3093 - val_custom_accuracy: 0.7656
Epoch 702/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2380 - custom_accuracy: 0.
8281 - val_loss: 0.3157 - val_custom_accuracy: 0.7656
Epoch 703/1000
4/4 [==========] - 1s 326ms/step - loss: 0.2369 - custom_accuracy: 0.
7734 - val_loss: 0.3091 - val_custom_accuracy: 0.7656
Epoch 704/1000
4/4 [==========] - 2s 485ms/step - loss: 0.2362 - custom_accuracy: 0.
8359 - val_loss: 0.3079 - val_custom_accuracy: 0.7656
Epoch 705/1000
4/4 [==========] - 2s 557ms/step - loss: 0.2359 - custom_accuracy: 0.
7812 - val_loss: 0.3067 - val_custom_accuracy: 0.7656
Epoch 706/1000
4/4 [==========] - 2s 562ms/step - loss: 0.2356 - custom_accuracy: 0.
8359 - val_loss: 0.3024 - val_custom_accuracy: 0.7500
Epoch 707/1000
4/4 [==========] - 2s 549ms/step - loss: 0.2349 - custom_accuracy: 0.
8359 - val_loss: 0.3029 - val_custom_accuracy: 0.7578
Epoch 708/1000
4/4 [==========] - 2s 500ms/step - loss: 0.2349 - custom_accuracy: 0.
7812 - val_loss: 0.3085 - val_custom_accuracy: 0.7656
Epoch 709/1000
4/4 [==========] - 1s 332ms/step - loss: 0.2356 - custom_accuracy: 0.
7734 - val_loss: 0.3119 - val_custom_accuracy: 0.7734
Epoch 710/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2356 - custom_accuracy: 0.
7734 - val_loss: 0.3075 - val_custom_accuracy: 0.7734
Epoch 711/1000
4/4 [==========] - 1s 330ms/step - loss: 0.2348 - custom_accuracy: 0.
7734 - val_loss: 0.3047 - val_custom_accuracy: 0.7734
Epoch 712/1000
4/4 [==========] - 1s 327ms/step - loss: 0.2355 - custom_accuracy: 0.
7734 - val_loss: 0.3076 - val_custom_accuracy: 0.7734
Epoch 713/1000
4/4 [==========] - 1s 330ms/step - loss: 0.2348 - custom_accuracy: 0.
7734 - val_loss: 0.3292 - val_custom_accuracy: 0.7656
Epoch 714/1000
4/4 [==========] - 1s 333ms/step - loss: 0.2383 - custom_accuracy: 0.
7734 - val_loss: 0.3372 - val_custom_accuracy: 0.7656
Epoch 715/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2393 - custom_accuracy: 0.
8281 - val_loss: 0.3182 - val_custom_accuracy: 0.7656
Epoch 716/1000
4/4 [==========] - 1s 363ms/step - loss: 0.2375 - custom_accuracy: 0.
7734 - val_loss: 0.2961 - val_custom_accuracy: 0.7578
Epoch 717/1000
4/4 [==========] - 2s 604ms/step - loss: 0.2384 - custom_accuracy: 0.
6875 - val_loss: 0.2981 - val_custom_accuracy: 0.7656
Epoch 718/1000
4/4 [==========] - 2s 566ms/step - loss: 0.2368 - custom_accuracy: 0.
7812 - val_loss: 0.3077 - val_custom_accuracy: 0.7734
Epoch 719/1000
4/4 [==========] - 2s 566ms/step - loss: 0.2354 - custom_accuracy: 0.
7734 - val_loss: 0.3178 - val_custom_accuracy: 0.7734
Epoch 720/1000
4/4 [==========] - 2s 573ms/step - loss: 0.2355 - custom_accuracy: 0.
7188 - val_loss: 0.3166 - val_custom_accuracy: 0.7734
Epoch 721/1000
4/4 [==========] - 1s 332ms/step - loss: 0.2353 - custom_accuracy: 0.

4/4 [==============================] - 1s 332ms/step - loss: 0.2359 - custom_accuracy: 0.
8281 - val_loss: 0.3250 - val_custom_accuracy: 0.7656
Epoch 722/1000
4/4 [==============================] - 1s 339ms/step - loss: 0.2362 - custom_accuracy: 0.
8281 - val_loss: 0.3272 - val_custom_accuracy: 0.7656
Epoch 723/1000
4/4 [==============================] - 1s 335ms/step - loss: 0.2364 - custom_accuracy: 0.
7188 - val_loss: 0.3272 - val_custom_accuracy: 0.7734
Epoch 724/1000
4/4 [==============================] - 1s 331ms/step - loss: 0.2350 - custom_accuracy: 0.
8281 - val_loss: 0.3207 - val_custom_accuracy: 0.7734
Epoch 725/1000
4/4 [==============================] - 1s 337ms/step - loss: 0.2344 - custom_accuracy: 0.
7734 - val_loss: 0.3171 - val_custom_accuracy: 0.7734
Epoch 726/1000
4/4 [==============================] - 1s 334ms/step - loss: 0.2338 - custom_accuracy: 0.
8359 - val_loss: 0.3115 - val_custom_accuracy: 0.7656
Epoch 727/1000
4/4 [==============================] - 1s 333ms/step - loss: 0.2333 - custom_accuracy: 0.
7266 - val_loss: 0.3107 - val_custom_accuracy: 0.7656
Epoch 728/1000
4/4 [==============================] - 1s 330ms/step - loss: 0.2339 - custom_accuracy: 0.
8359 - val_loss: 0.3077 - val_custom_accuracy: 0.7656
Epoch 729/1000
4/4 [==============================] - 2s 579ms/step - loss: 0.2336 - custom_accuracy: 0.
7812 - val_loss: 0.3039 - val_custom_accuracy: 0.7656
Epoch 730/1000
4/4 [==============================] - 2s 559ms/step - loss: 0.2373 - custom_accuracy: 0.
7891 - val_loss: 0.2945 - val_custom_accuracy: 0.7422
Epoch 731/1000
4/4 [==============================] - 2s 548ms/step - loss: 0.2371 - custom_accuracy: 0.
7969 - val_loss: 0.3046 - val_custom_accuracy: 0.7656
Epoch 732/1000
4/4 [==============================] - 2s 535ms/step - loss: 0.2343 - custom_accuracy: 0.
7812 - val_loss: 0.3233 - val_custom_accuracy: 0.7656
Epoch 733/1000
4/4 [==============================] - 2s 418ms/step - loss: 0.2365 - custom_accuracy: 0.
8281 - val_loss: 0.3334 - val_custom_accuracy: 0.7656
Epoch 734/1000
4/4 [==============================] - 1s 328ms/step - loss: 0.2379 - custom_accuracy: 0.
7734 - val_loss: 0.3097 - val_custom_accuracy: 0.7734
Epoch 735/1000
4/4 [==============================] - 1s 332ms/step - loss: 0.2366 - custom_accuracy: 0.
8516 - val_loss: 0.2906 - val_custom_accuracy: 0.7422
Epoch 736/1000
4/4 [==============================] - 1s 338ms/step - loss: 0.2441 - custom_accuracy: 0.
7344 - val_loss: 0.2955 - val_custom_accuracy: 0.7422
Epoch 737/1000
4/4 [==============================] - 1s 349ms/step - loss: 0.2358 - custom_accuracy: 0.
7891 - val_loss: 0.3024 - val_custom_accuracy: 0.7656
Epoch 738/1000
4/4 [==============================] - 1s 330ms/step - loss: 0.2360 - custom_accuracy: 0.
7969 - val_loss: 0.2951 - val_custom_accuracy: 0.7656
Epoch 739/1000
4/4 [==============================] - 1s 329ms/step - loss: 0.2367 - custom_accuracy: 0.
8516 - val_loss: 0.3126 - val_custom_accuracy: 0.7734
Epoch 740/1000
4/4 [==============================] - 1s 342ms/step - loss: 0.2354 - custom_accuracy: 0.
7188 - val_loss: 0.3189 - val_custom_accuracy: 0.7656
Epoch 741/1000
4/4 [==============================] - 2s 503ms/step - loss: 0.2380 - custom_accuracy: 0.
7188 - val_loss: 0.3005 - val_custom_accuracy: 0.7734
Epoch 742/1000
4/4 [==============================] - 2s 564ms/step - loss: 0.2412 - custom_accuracy: 0.
7891 - val_loss: 0.2918 - val_custom_accuracy: 0.7656
Epoch 743/1000
4/4 [==============================] - 2s 538ms/step - loss: 0.2620 - custom_accuracy: 0.
6406 - val_loss: 0.2981 - val_custom_accuracy: 0.7734
Epoch 744/1000
4/4 [==============================] - 2s 558ms/step - loss: 0.2665 - custom_accuracy: 0.
7891 - val_loss: 0.2929 - val_custom_accuracy: 0.7734
Epoch 745/1000
4/4 [==============================] - 2s 500ms/step - loss: 0.2485 - custom_accuracy: 0.

4/4 [==========] - 2s 506ms/step - loss: 0.2469 - custom_accuracy: 0.
7578 - val_loss: 0.3221 - val_custom_accuracy: 0.7734
Epoch 746/1000
4/4 [==========] - 1s 338ms/step - loss: 0.2463 - custom_accuracy: 0.
7578 - val_loss: 0.3062 - val_custom_accuracy: 0.7578
Epoch 747/1000
4/4 [==========] - 1s 338ms/step - loss: 0.2417 - custom_accuracy: 0.
7812 - val_loss: 0.2951 - val_custom_accuracy: 0.7656
Epoch 748/1000
4/4 [==========] - 1s 334ms/step - loss: 0.2435 - custom_accuracy: 0.
7812 - val_loss: 0.2965 - val_custom_accuracy: 0.7656
Epoch 749/1000
4/4 [==========] - 1s 344ms/step - loss: 0.2432 - custom_accuracy: 0.
7812 - val_loss: 0.3001 - val_custom_accuracy: 0.7656
Epoch 750/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2421 - custom_accuracy: 0.
8359 - val_loss: 0.2955 - val_custom_accuracy: 0.7656
Epoch 751/1000
4/4 [==========] - 1s 331ms/step - loss: 0.2413 - custom_accuracy: 0.
8438 - val_loss: 0.2956 - val_custom_accuracy: 0.7656
Epoch 752/1000
4/4 [==========] - 1s 344ms/step - loss: 0.2411 - custom_accuracy: 0.
7812 - val_loss: 0.2917 - val_custom_accuracy: 0.7578
Epoch 753/1000
4/4 [==========] - 1s 398ms/step - loss: 0.2418 - custom_accuracy: 0.
8359 - val_loss: 0.2974 - val_custom_accuracy: 0.7656
Epoch 754/1000
4/4 [==========] - 2s 586ms/step - loss: 0.2396 - custom_accuracy: 0.
8359 - val_loss: 0.3233 - val_custom_accuracy: 0.7656
Epoch 755/1000
4/4 [==========] - 2s 541ms/step - loss: 0.2444 - custom_accuracy: 0.
8203 - val_loss: 0.3460 - val_custom_accuracy: 0.7734
Epoch 756/1000
4/4 [==========] - 2s 543ms/step - loss: 0.2478 - custom_accuracy: 0.
8203 - val_loss: 0.3350 - val_custom_accuracy: 0.7734
Epoch 757/1000
4/4 [==========] - 2s 549ms/step - loss: 0.2437 - custom_accuracy: 0.
7656 - val_loss: 0.3192 - val_custom_accuracy: 0.7734
Epoch 758/1000
4/4 [==========] - 1s 339ms/step - loss: 0.2404 - custom_accuracy: 0.
8203 - val_loss: 0.3063 - val_custom_accuracy: 0.7734
Epoch 759/1000
4/4 [==========] - 1s 344ms/step - loss: 0.2377 - custom_accuracy: 0.
8438 - val_loss: 0.2992 - val_custom_accuracy: 0.7656
Epoch 760/1000
4/4 [==========] - 1s 334ms/step - loss: 0.2394 - custom_accuracy: 0.
6719 - val_loss: 0.2901 - val_custom_accuracy: 0.7578
Epoch 761/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2398 - custom_accuracy: 0.
7969 - val_loss: 0.2931 - val_custom_accuracy: 0.7578
Epoch 762/1000
4/4 [==========] - 1s 344ms/step - loss: 0.2358 - custom_accuracy: 0.
7812 - val_loss: 0.3083 - val_custom_accuracy: 0.7734
Epoch 763/1000
4/4 [==========] - 1s 339ms/step - loss: 0.2354 - custom_accuracy: 0.
7812 - val_loss: 0.3189 - val_custom_accuracy: 0.7734
Epoch 764/1000
4/4 [==========] - 1s 341ms/step - loss: 0.2358 - custom_accuracy: 0.
8359 - val_loss: 0.3068 - val_custom_accuracy: 0.7656
Epoch 765/1000
4/4 [==========] - 1s 347ms/step - loss: 0.2335 - custom_accuracy: 0.
7812 - val_loss: 0.2946 - val_custom_accuracy: 0.7578
Epoch 766/1000
4/4 [==========] - 2s 585ms/step - loss: 0.2372 - custom_accuracy: 0.
8359 - val_loss: 0.2907 - val_custom_accuracy: 0.7500
Epoch 767/1000
4/4 [==========] - 2s 565ms/step - loss: 0.2369 - custom_accuracy: 0.
8359 - val_loss: 0.2977 - val_custom_accuracy: 0.7578
Epoch 768/1000
4/4 [==========] - 2s 577ms/step - loss: 0.2339 - custom_accuracy: 0.
7266 - val_loss: 0.3149 - val_custom_accuracy: 0.7734
Epoch 769/1000
4/4 [==========] - 2s 560ms/step - loss: 0.2339 - custom_accuracy: 0.

4/4 [==============================] - 2s 506ms/step - loss: 0.2359 - custom_accuracy: 0.
8281 - val_loss: 0.3184 - val_custom_accuracy: 0.7734
Epoch 770/1000
4/4 [==============================] - 1s 344ms/step - loss: 0.2340 - custom_accuracy: 0.
7188 - val_loss: 0.3121 - val_custom_accuracy: 0.7734
Epoch 771/1000
4/4 [==============================] - 1s 338ms/step - loss: 0.2327 - custom_accuracy: 0.
7812 - val_loss: 0.3082 - val_custom_accuracy: 0.7656
Epoch 772/1000
4/4 [==============================] - 1s 339ms/step - loss: 0.2321 - custom_accuracy: 0.
7812 - val_loss: 0.3034 - val_custom_accuracy: 0.7578
Epoch 773/1000
4/4 [==============================] - 1s 340ms/step - loss: 0.2315 - custom_accuracy: 0.
7422 - val_loss: 0.2918 - val_custom_accuracy: 0.7422
Epoch 774/1000
4/4 [==============================] - 1s 344ms/step - loss: 0.2421 - custom_accuracy: 0.
7812 - val_loss: 0.2929 - val_custom_accuracy: 0.7969
Epoch 775/1000
4/4 [==============================] - 1s 340ms/step - loss: 0.2509 - custom_accuracy: 0.
7031 - val_loss: 0.2934 - val_custom_accuracy: 0.7422
Epoch 776/1000
4/4 [==============================] - 1s 353ms/step - loss: 0.2371 - custom_accuracy: 0.
7891 - val_loss: 0.3170 - val_custom_accuracy: 0.7656
Epoch 777/1000
4/4 [==============================] - 1s 343ms/step - loss: 0.2383 - custom_accuracy: 0.
7734 - val_loss: 0.3178 - val_custom_accuracy: 0.7656
Epoch 778/1000
4/4 [==============================] - 2s 597ms/step - loss: 0.2409 - custom_accuracy: 0.
7734 - val_loss: 0.2996 - val_custom_accuracy: 0.7656
Epoch 779/1000
4/4 [==============================] - 2s 566ms/step - loss: 0.2370 - custom_accuracy: 0.
8281 - val_loss: 0.3118 - val_custom_accuracy: 0.7734
Epoch 780/1000
4/4 [==============================] - 2s 567ms/step - loss: 0.2368 - custom_accuracy: 0.
7734 - val_loss: 0.3116 - val_custom_accuracy: 0.7734
Epoch 781/1000
4/4 [==============================] - 2s 555ms/step - loss: 0.2341 - custom_accuracy: 0.
7812 - val_loss: 0.2953 - val_custom_accuracy: 0.7500
Epoch 782/1000
4/4 [==============================] - 1s 361ms/step - loss: 0.2390 - custom_accuracy: 0.
7422 - val_loss: 0.2919 - val_custom_accuracy: 0.7422
Epoch 783/1000
4/4 [==============================] - 1s 350ms/step - loss: 0.2404 - custom_accuracy: 0.
8438 - val_loss: 0.3039 - val_custom_accuracy: 0.7578
Epoch 784/1000
4/4 [==============================] - 1s 334ms/step - loss: 0.2329 - custom_accuracy: 0.
8359 - val_loss: 0.3217 - val_custom_accuracy: 0.7734
Epoch 785/1000
4/4 [==============================] - 1s 335ms/step - loss: 0.2369 - custom_accuracy: 0.
7734 - val_loss: 0.3192 - val_custom_accuracy: 0.7734
Epoch 786/1000
4/4 [==============================] - 1s 340ms/step - loss: 0.2378 - custom_accuracy: 0.
7734 - val_loss: 0.3118 - val_custom_accuracy: 0.7734
Epoch 787/1000
4/4 [==============================] - 1s 335ms/step - loss: 0.2380 - custom_accuracy: 0.
7734 - val_loss: 0.3188 - val_custom_accuracy: 0.7734
Epoch 788/1000
4/4 [==============================] - 1s 336ms/step - loss: 0.2356 - custom_accuracy: 0.
8281 - val_loss: 0.3167 - val_custom_accuracy: 0.7734
Epoch 789/1000
4/4 [==============================] - 1s 340ms/step - loss: 0.2343 - custom_accuracy: 0.
7266 - val_loss: 0.3106 - val_custom_accuracy: 0.7656
Epoch 790/1000
4/4 [==============================] - 2s 584ms/step - loss: 0.2322 - custom_accuracy: 0.
8359 - val_loss: 0.3064 - val_custom_accuracy: 0.7578
Epoch 791/1000
4/4 [==============================] - 2s 564ms/step - loss: 0.2322 - custom_accuracy: 0.
7969 - val_loss: 0.2935 - val_custom_accuracy: 0.7422
Epoch 792/1000
4/4 [==============================] - 2s 550ms/step - loss: 0.2361 - custom_accuracy: 0.
8359 - val_loss: 0.2972 - val_custom_accuracy: 0.7500
Epoch 793/1000
4/4 [==============================] - 2s 540ms/step - loss: 0.2306 - custom_accuracy: 0.

4/4 [==========] - 2s 540ms/step - loss: 0.2306 - custom_accuracy: 0.
7344 - val_loss: 0.3202 - val_custom_accuracy: 0.7734
Epoch 794/1000
4/4 [==========] - 2s 459ms/step - loss: 0.2338 - custom_accuracy: 0.
8281 - val_loss: 0.3207 - val_custom_accuracy: 0.7734
Epoch 795/1000
4/4 [==========] - 1s 341ms/step - loss: 0.2353 - custom_accuracy: 0.
7188 - val_loss: 0.3139 - val_custom_accuracy: 0.7734
Epoch 796/1000
4/4 [==========] - 1s 342ms/step - loss: 0.2343 - custom_accuracy: 0.
7188 - val_loss: 0.3047 - val_custom_accuracy: 0.7656
Epoch 797/1000
4/4 [==========] - 1s 340ms/step - loss: 0.2358 - custom_accuracy: 0.
8438 - val_loss: 0.2950 - val_custom_accuracy: 0.7422
Epoch 798/1000
4/4 [==========] - 1s 338ms/step - loss: 0.2353 - custom_accuracy: 0.
7969 - val_loss: 0.2979 - val_custom_accuracy: 0.7578
Epoch 799/1000
4/4 [==========] - 1s 337ms/step - loss: 0.2358 - custom_accuracy: 0.
8516 - val_loss: 0.2943 - val_custom_accuracy: 0.7500
Epoch 800/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2360 - custom_accuracy: 0.
7891 - val_loss: 0.3022 - val_custom_accuracy: 0.7578
Epoch 801/1000
4/4 [==========] - 1s 336ms/step - loss: 0.2329 - custom_accuracy: 0.
7812 - val_loss: 0.3191 - val_custom_accuracy: 0.7734
Epoch 802/1000
4/4 [==========] - 2s 477ms/step - loss: 0.2346 - custom_accuracy: 0.
8359 - val_loss: 0.3252 - val_custom_accuracy: 0.7734
Epoch 803/1000
4/4 [==========] - 2s 579ms/step - loss: 0.2350 - custom_accuracy: 0.
7188 - val_loss: 0.3299 - val_custom_accuracy: 0.7734
Epoch 804/1000
4/4 [==========] - 2s 565ms/step - loss: 0.2350 - custom_accuracy: 0.
7734 - val_loss: 0.3189 - val_custom_accuracy: 0.7734
Epoch 805/1000
4/4 [==========] - 2s 566ms/step - loss: 0.2337 - custom_accuracy: 0.
6719 - val_loss: 0.2973 - val_custom_accuracy: 0.7578
Epoch 806/1000
4/4 [==========] - 2s 508ms/step - loss: 0.2351 - custom_accuracy: 0.
7969 - val_loss: 0.2936 - val_custom_accuracy: 0.7422
Epoch 807/1000
4/4 [==========] - 1s 337ms/step - loss: 0.2350 - custom_accuracy: 0.
7422 - val_loss: 0.2979 - val_custom_accuracy: 0.7500
Epoch 808/1000
4/4 [==========] - 1s 331ms/step - loss: 0.2337 - custom_accuracy: 0.
7969 - val_loss: 0.3032 - val_custom_accuracy: 0.7500
Epoch 809/1000
4/4 [==========] - 1s 342ms/step - loss: 0.2330 - custom_accuracy: 0.
7188 - val_loss: 0.3204 - val_custom_accuracy: 0.7734
Epoch 810/1000
4/4 [==========] - 1s 339ms/step - loss: 0.2349 - custom_accuracy: 0.
8281 - val_loss: 0.3230 - val_custom_accuracy: 0.7734
Epoch 811/1000
4/4 [==========] - 1s 345ms/step - loss: 0.2337 - custom_accuracy: 0.
7812 - val_loss: 0.3140 - val_custom_accuracy: 0.7656
Epoch 812/1000
4/4 [==========] - 1s 333ms/step - loss: 0.2331 - custom_accuracy: 0.
7812 - val_loss: 0.3084 - val_custom_accuracy: 0.7500
Epoch 813/1000
4/4 [==========] - 1s 343ms/step - loss: 0.2309 - custom_accuracy: 0.
8359 - val_loss: 0.3091 - val_custom_accuracy: 0.7656
Epoch 814/1000
4/4 [==========] - 2s 441ms/step - loss: 0.2303 - custom_accuracy: 0.
8438 - val_loss: 0.3043 - val_custom_accuracy: 0.7578
Epoch 815/1000
4/4 [==========] - 2s 571ms/step - loss: 0.2343 - custom_accuracy: 0.
7969 - val_loss: 0.2960 - val_custom_accuracy: 0.7422
Epoch 816/1000
4/4 [==========] - 2s 564ms/step - loss: 0.2353 - custom_accuracy: 0.
7422 - val_loss: 0.3056 - val_custom_accuracy: 0.7578
Epoch 817/1000
4/4 [==========] - 2s 543ms/step - loss: 0.2306 - custom_accuracy: 0.

4/4 [==========] - 2s 545ms/step - loss: 0.2306 - custom_accuracy: 0.
7891 - val_loss: 0.3147 - val_custom_accuracy: 0.7734
Epoch 818/1000
4/4 [==========] - 2s 566ms/step - loss: 0.2316 - custom_accuracy: 0.
7734 - val_loss: 0.3208 - val_custom_accuracy: 0.7734
Epoch 819/1000
4/4 [==========] - 1s 331ms/step - loss: 0.2315 - custom_accuracy: 0.
8281 - val_loss: 0.3233 - val_custom_accuracy: 0.7734
Epoch 820/1000
4/4 [==========] - 1s 333ms/step - loss: 0.2305 - custom_accuracy: 0.
8281 - val_loss: 0.3183 - val_custom_accuracy: 0.7656
Epoch 821/1000
4/4 [==========] - 1s 347ms/step - loss: 0.2309 - custom_accuracy: 0.
7188 - val_loss: 0.3030 - val_custom_accuracy: 0.7578
Epoch 822/1000
4/4 [==========] - 1s 343ms/step - loss: 0.2395 - custom_accuracy: 0.
8438 - val_loss: 0.2914 - val_custom_accuracy: 0.7812
Epoch 823/1000
4/4 [==========] - 1s 336ms/step - loss: 0.2588 - custom_accuracy: 0.
7969 - val_loss: 0.2874 - val_custom_accuracy: 0.7500
Epoch 824/1000
4/4 [==========] - 1s 341ms/step - loss: 0.2453 - custom_accuracy: 0.
7656 - val_loss: 0.2973 - val_custom_accuracy: 0.7734
Epoch 825/1000
4/4 [==========] - 1s 333ms/step - loss: 0.2393 - custom_accuracy: 0.
6719 - val_loss: 0.3042 - val_custom_accuracy: 0.7734
Epoch 826/1000
4/4 [==========] - 1s 344ms/step - loss: 0.2366 - custom_accuracy: 0.
8359 - val_loss: 0.3054 - val_custom_accuracy: 0.7734
Epoch 827/1000
4/4 [==========] - 2s 581ms/step - loss: 0.2356 - custom_accuracy: 0.
8438 - val_loss: 0.3109 - val_custom_accuracy: 0.7734
Epoch 828/1000
4/4 [==========] - 2s 574ms/step - loss: 0.2353 - custom_accuracy: 0.
8438 - val_loss: 0.3118 - val_custom_accuracy: 0.7734
Epoch 829/1000
4/4 [==========] - 2s 560ms/step - loss: 0.2354 - custom_accuracy: 0.
8438 - val_loss: 0.3113 - val_custom_accuracy: 0.7734
Epoch 830/1000
4/4 [==========] - 2s 551ms/step - loss: 0.2342 - custom_accuracy: 0.
7891 - val_loss: 0.3100 - val_custom_accuracy: 0.7734
Epoch 831/1000
4/4 [==========] - 1s 362ms/step - loss: 0.2342 - custom_accuracy: 0.
8438 - val_loss: 0.3071 - val_custom_accuracy: 0.7578
Epoch 832/1000
4/4 [==========] - 1s 345ms/step - loss: 0.2328 - custom_accuracy: 0.
7891 - val_loss: 0.3154 - val_custom_accuracy: 0.7734
Epoch 833/1000
4/4 [==========] - 1s 342ms/step - loss: 0.2323 - custom_accuracy: 0.
7812 - val_loss: 0.3195 - val_custom_accuracy: 0.7734
Epoch 834/1000
4/4 [==========] - 1s 336ms/step - loss: 0.2320 - custom_accuracy: 0.
7188 - val_loss: 0.3218 - val_custom_accuracy: 0.7734
Epoch 835/1000
4/4 [==========] - 1s 349ms/step - loss: 0.2310 - custom_accuracy: 0.
8281 - val_loss: 0.3196 - val_custom_accuracy: 0.7734
Epoch 836/1000
4/4 [==========] - 1s 340ms/step - loss: 0.2311 - custom_accuracy: 0.
8281 - val_loss: 0.3180 - val_custom_accuracy: 0.7734
Epoch 837/1000
4/4 [==========] - 1s 333ms/step - loss: 0.2310 - custom_accuracy: 0.
7734 - val_loss: 0.3124 - val_custom_accuracy: 0.7734
Epoch 838/1000
4/4 [==========] - 1s 324ms/step - loss: 0.2302 - custom_accuracy: 0.
7812 - val_loss: 0.3154 - val_custom_accuracy: 0.7734
Epoch 839/1000
4/4 [==========] - 2s 577ms/step - loss: 0.2298 - custom_accuracy: 0.
7266 - val_loss: 0.3186 - val_custom_accuracy: 0.7734
Epoch 840/1000
4/4 [==========] - 2s 543ms/step - loss: 0.2300 - custom_accuracy: 0.
8281 - val_loss: 0.3203 - val_custom_accuracy: 0.7734
Epoch 841/1000
4/4 [==========] - 2s 543ms/step - loss: 0.2295 - custom_accuracy: 0.

4/4 [==========] - 2s 545ms/step - loss: 0.2295 - custom_accuracy: 0.
8281 - val_loss: 0.3180 - val_custom_accuracy: 0.7656
Epoch 842/1000
4/4 [==========] - 2s 552ms/step - loss: 0.2292 - custom_accuracy: 0.
8359 - val_loss: 0.3173 - val_custom_accuracy: 0.7656
Epoch 843/1000
4/4 [==========] - 2s 463ms/step - loss: 0.2294 - custom_accuracy: 0.
8359 - val_loss: 0.3213 - val_custom_accuracy: 0.7656
Epoch 844/1000
4/4 [==========] - 1s 337ms/step - loss: 0.2293 - custom_accuracy: 0.
8359 - val_loss: 0.3255 - val_custom_accuracy: 0.7734
Epoch 845/1000
4/4 [==========] - 1s 338ms/step - loss: 0.2299 - custom_accuracy: 0.
7734 - val_loss: 0.3236 - val_custom_accuracy: 0.7656
Epoch 846/1000
4/4 [==========] - 1s 336ms/step - loss: 0.2297 - custom_accuracy: 0.
8359 - val_loss: 0.3181 - val_custom_accuracy: 0.7656
Epoch 847/1000
4/4 [==========] - 1s 340ms/step - loss: 0.2292 - custom_accuracy: 0.
7812 - val_loss: 0.3054 - val_custom_accuracy: 0.7578
Epoch 848/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2305 - custom_accuracy: 0.
7969 - val_loss: 0.2930 - val_custom_accuracy: 0.7578
Epoch 849/1000
4/4 [==========] - 1s 333ms/step - loss: 0.2401 - custom_accuracy: 0.
7344 - val_loss: 0.2961 - val_custom_accuracy: 0.7422
Epoch 850/1000
4/4 [==========] - 1s 339ms/step - loss: 0.2333 - custom_accuracy: 0.
8516 - val_loss: 0.3136 - val_custom_accuracy: 0.7656
Epoch 851/1000
4/4 [==========] - 2s 457ms/step - loss: 0.2307 - custom_accuracy: 0.
8281 - val_loss: 0.3335 - val_custom_accuracy: 0.7656
Epoch 852/1000
4/4 [==========] - 2s 582ms/step - loss: 0.2356 - custom_accuracy: 0.
7734 - val_loss: 0.3362 - val_custom_accuracy: 0.7656
Epoch 853/1000
4/4 [==========] - 2s 557ms/step - loss: 0.2338 - custom_accuracy: 0.
7734 - val_loss: 0.3208 - val_custom_accuracy: 0.7734
Epoch 854/1000
4/4 [==========] - 2s 570ms/step - loss: 0.2328 - custom_accuracy: 0.
7734 - val_loss: 0.3056 - val_custom_accuracy: 0.7656
Epoch 855/1000
4/4 [==========] - 2s 537ms/step - loss: 0.2322 - custom_accuracy: 0.
8359 - val_loss: 0.3014 - val_custom_accuracy: 0.7578
Epoch 856/1000
4/4 [==========] - 1s 336ms/step - loss: 0.2314 - custom_accuracy: 0.
7812 - val_loss: 0.3100 - val_custom_accuracy: 0.7578
Epoch 857/1000
4/4 [==========] - 1s 337ms/step - loss: 0.2296 - custom_accuracy: 0.
7266 - val_loss: 0.3231 - val_custom_accuracy: 0.7734
Epoch 858/1000
4/4 [==========] - 1s 344ms/step - loss: 0.2305 - custom_accuracy: 0.
8359 - val_loss: 0.3291 - val_custom_accuracy: 0.7734
Epoch 859/1000
4/4 [==========] - 1s 340ms/step - loss: 0.2312 - custom_accuracy: 0.
7188 - val_loss: 0.3161 - val_custom_accuracy: 0.7656
Epoch 860/1000
4/4 [==========] - 1s 349ms/step - loss: 0.2291 - custom_accuracy: 0.
8516 - val_loss: 0.2964 - val_custom_accuracy: 0.7344
Epoch 861/1000
4/4 [==========] - 1s 343ms/step - loss: 0.2344 - custom_accuracy: 0.
7266 - val_loss: 0.2932 - val_custom_accuracy: 0.7578
Epoch 862/1000
4/4 [==========] - 1s 336ms/step - loss: 0.2440 - custom_accuracy: 0.
8281 - val_loss: 0.2942 - val_custom_accuracy: 0.7656
Epoch 863/1000
4/4 [==========] - 1s 403ms/step - loss: 0.2386 - custom_accuracy: 0.
8438 - val_loss: 0.3045 - val_custom_accuracy: 0.7578
Epoch 864/1000
4/4 [==========] - 2s 579ms/step - loss: 0.2287 - custom_accuracy: 0.
7891 - val_loss: 0.3212 - val_custom_accuracy: 0.7734
Epoch 865/1000
4/4 [==========] - 2s 549ms/step - loss: 0.2319 - custom_accuracy: 0.

4/4 [==========] - 2s 549ms/step - loss: 0.2319 - custom_accuracy: 0.
8281 - val_loss: 0.3321 - val_custom_accuracy: 0.7734
Epoch 866/1000
4/4 [==========] - 2s 565ms/step - loss: 0.2324 - custom_accuracy: 0.
7734 - val_loss: 0.3255 - val_custom_accuracy: 0.7734
Epoch 867/1000
4/4 [==========] - 2s 559ms/step - loss: 0.2308 - custom_accuracy: 0.
8281 - val_loss: 0.3169 - val_custom_accuracy: 0.7734
Epoch 868/1000
4/4 [==========] - 1s 338ms/step - loss: 0.2292 - custom_accuracy: 0.
7188 - val_loss: 0.3050 - val_custom_accuracy: 0.7578
Epoch 869/1000
4/4 [==========] - 1s 343ms/step - loss: 0.2365 - custom_accuracy: 0.
7969 - val_loss: 0.2954 - val_custom_accuracy: 0.7422
Epoch 870/1000
4/4 [==========] - 1s 337ms/step - loss: 0.2329 - custom_accuracy: 0.
7891 - val_loss: 0.3069 - val_custom_accuracy: 0.7656
Epoch 871/1000
4/4 [==========] - 1s 345ms/step - loss: 0.2302 - custom_accuracy: 0.
8438 - val_loss: 0.3134 - val_custom_accuracy: 0.7656
Epoch 872/1000
4/4 [==========] - 1s 346ms/step - loss: 0.2297 - custom_accuracy: 0.
8281 - val_loss: 0.3237 - val_custom_accuracy: 0.7734
Epoch 873/1000
4/4 [==========] - 1s 338ms/step - loss: 0.2300 - custom_accuracy: 0.
7734 - val_loss: 0.3227 - val_custom_accuracy: 0.7734
Epoch 874/1000
4/4 [==========] - 1s 340ms/step - loss: 0.2294 - custom_accuracy: 0.
7734 - val_loss: 0.3163 - val_custom_accuracy: 0.7656
Epoch 875/1000
4/4 [==========] - 1s 364ms/step - loss: 0.2297 - custom_accuracy: 0.
8438 - val_loss: 0.3114 - val_custom_accuracy: 0.7656
Epoch 876/1000
4/4 [==========] - 2s 581ms/step - loss: 0.2287 - custom_accuracy: 0.
7344 - val_loss: 0.3166 - val_custom_accuracy: 0.7656
Epoch 877/1000
4/4 [==========] - 2s 540ms/step - loss: 0.2293 - custom_accuracy: 0.
7188 - val_loss: 0.3137 - val_custom_accuracy: 0.7656
Epoch 878/1000
4/4 [==========] - 2s 557ms/step - loss: 0.2297 - custom_accuracy: 0.
7344 - val_loss: 0.3105 - val_custom_accuracy: 0.7656
Epoch 879/1000
4/4 [==========] - 2s 551ms/step - loss: 0.2301 - custom_accuracy: 0.
7891 - val_loss: 0.3109 - val_custom_accuracy: 0.7656
Epoch 880/1000
4/4 [==========] - 2s 382ms/step - loss: 0.2288 - custom_accuracy: 0.
8438 - val_loss: 0.3114 - val_custom_accuracy: 0.7578
Epoch 881/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2287 - custom_accuracy: 0.
7891 - val_loss: 0.3097 - val_custom_accuracy: 0.7578
Epoch 882/1000
4/4 [==========] - 1s 331ms/step - loss: 0.2294 - custom_accuracy: 0.
8516 - val_loss: 0.2992 - val_custom_accuracy: 0.7500
Epoch 883/1000
4/4 [==========] - 1s 347ms/step - loss: 0.2317 - custom_accuracy: 0.
8438 - val_loss: 0.2984 - val_custom_accuracy: 0.7500
Epoch 884/1000
4/4 [==========] - 1s 334ms/step - loss: 0.2334 - custom_accuracy: 0.
7344 - val_loss: 0.2972 - val_custom_accuracy: 0.7344
Epoch 885/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2318 - custom_accuracy: 0.
7344 - val_loss: 0.3057 - val_custom_accuracy: 0.7578
Epoch 886/1000
4/4 [==========] - 1s 336ms/step - loss: 0.2295 - custom_accuracy: 0.
8359 - val_loss: 0.3232 - val_custom_accuracy: 0.7656
Epoch 887/1000
4/4 [==========] - 1s 340ms/step - loss: 0.2307 - custom_accuracy: 0.
8281 - val_loss: 0.3363 - val_custom_accuracy: 0.7734
Epoch 888/1000
4/4 [==========] - 2s 565ms/step - loss: 0.2306 - custom_accuracy: 0.
7734 - val_loss: 0.3299 - val_custom_accuracy: 0.7734
Epoch 889/1000
4/4 [==========] - 2s 578ms/step - loss: 0.2291 - custom_accuracy: 0.

4/4 [==============================] - 2s 570ms/step - loss: 0.2291 - custom_accuracy: 0.
7188 - val_loss: 0.3171 - val_custom_accuracy: 0.7656
Epoch 890/1000
4/4 [==============================] - 2s 544ms/step - loss: 0.2285 - custom_accuracy: 0.
7422 - val_loss: 0.3063 - val_custom_accuracy: 0.7578
Epoch 891/1000
4/4 [==============================] - 2s 568ms/step - loss: 0.2297 - custom_accuracy: 0.
8516 - val_loss: 0.3051 - val_custom_accuracy: 0.7422
Epoch 892/1000
4/4 [==============================] - 2s 435ms/step - loss: 0.2285 - custom_accuracy: 0.
7969 - val_loss: 0.3159 - val_custom_accuracy: 0.7578
Epoch 893/1000
4/4 [==============================] - 1s 347ms/step - loss: 0.2282 - custom_accuracy: 0.
8359 - val_loss: 0.3271 - val_custom_accuracy: 0.7734
Epoch 894/1000
4/4 [==============================] - 1s 340ms/step - loss: 0.2326 - custom_accuracy: 0.
8281 - val_loss: 0.3415 - val_custom_accuracy: 0.7734
Epoch 895/1000
4/4 [==============================] - 1s 337ms/step - loss: 0.2337 - custom_accuracy: 0.
7734 - val_loss: 0.3379 - val_custom_accuracy: 0.7734
Epoch 896/1000
4/4 [==============================] - 1s 335ms/step - loss: 0.2331 - custom_accuracy: 0.
8281 - val_loss: 0.3238 - val_custom_accuracy: 0.7734
Epoch 897/1000
4/4 [==============================] - 1s 331ms/step - loss: 0.2292 - custom_accuracy: 0.
7812 - val_loss: 0.3147 - val_custom_accuracy: 0.7656
Epoch 898/1000
4/4 [==============================] - 1s 333ms/step - loss: 0.2281 - custom_accuracy: 0.
7969 - val_loss: 0.3040 - val_custom_accuracy: 0.7500
Epoch 899/1000
4/4 [==============================] - 1s 338ms/step - loss: 0.2299 - custom_accuracy: 0.
7969 - val_loss: 0.3070 - val_custom_accuracy: 0.7500
Epoch 900/1000
4/4 [==============================] - 2s 490ms/step - loss: 0.2280 - custom_accuracy: 0.
7969 - val_loss: 0.3215 - val_custom_accuracy: 0.7734
Epoch 901/1000
4/4 [==============================] - 2s 559ms/step - loss: 0.2289 - custom_accuracy: 0.
7891 - val_loss: 0.3347 - val_custom_accuracy: 0.7656
Epoch 902/1000
4/4 [==============================] - 2s 564ms/step - loss: 0.2318 - custom_accuracy: 0.
7812 - val_loss: 0.3379 - val_custom_accuracy: 0.7656
Epoch 903/1000
4/4 [==============================] - 2s 550ms/step - loss: 0.2319 - custom_accuracy: 0.
7812 - val_loss: 0.3238 - val_custom_accuracy: 0.7656
Epoch 904/1000
4/4 [==============================] - 2s 504ms/step - loss: 0.2314 - custom_accuracy: 0.
8438 - val_loss: 0.3049 - val_custom_accuracy: 0.7578
Epoch 905/1000
4/4 [==============================] - 1s 343ms/step - loss: 0.2332 - custom_accuracy: 0.
7969 - val_loss: 0.3061 - val_custom_accuracy: 0.7578
Epoch 906/1000
4/4 [==============================] - 1s 338ms/step - loss: 0.2309 - custom_accuracy: 0.
8516 - val_loss: 0.3149 - val_custom_accuracy: 0.7578
Epoch 907/1000
4/4 [==============================] - 1s 341ms/step - loss: 0.2306 - custom_accuracy: 0.
7812 - val_loss: 0.3201 - val_custom_accuracy: 0.7656
Epoch 908/1000
4/4 [==============================] - 1s 346ms/step - loss: 0.2264 - custom_accuracy: 0.
7422 - val_loss: 0.2964 - val_custom_accuracy: 0.7422
Epoch 909/1000
4/4 [==============================] - 1s 340ms/step - loss: 0.2452 - custom_accuracy: 0.
8359 - val_loss: 0.2893 - val_custom_accuracy: 0.7734
Epoch 910/1000
4/4 [==============================] - 1s 340ms/step - loss: 0.2509 - custom_accuracy: 0.
7812 - val_loss: 0.3022 - val_custom_accuracy: 0.7734
Epoch 911/1000
4/4 [==============================] - 1s 335ms/step - loss: 0.2539 - custom_accuracy: 0.
8125 - val_loss: 0.3079 - val_custom_accuracy: 0.7734
Epoch 912/1000
4/4 [==============================] - 2s 421ms/step - loss: 0.2500 - custom_accuracy: 0.
7031 - val_loss: 0.2949 - val_custom_accuracy: 0.7734
Epoch 913/1000
4/4 [==============================] - 2s 573ms/step - loss: 0.2438 - custom_accuracy: 0.

4/4 [==========] - 2s 575ms/step - loss: 0.2456 - custom_accuracy: 0.
7891 - val_loss: 0.2930 - val_custom_accuracy: 0.7578
Epoch 914/1000
4/4 [==========] - 2s 559ms/step - loss: 0.2371 - custom_accuracy: 0.
7891 - val_loss: 0.3005 - val_custom_accuracy: 0.7578
Epoch 915/1000
4/4 [==========] - 2s 551ms/step - loss: 0.2327 - custom_accuracy: 0.
7891 - val_loss: 0.3129 - val_custom_accuracy: 0.7656
Epoch 916/1000
4/4 [==========] - 2s 534ms/step - loss: 0.2328 - custom_accuracy: 0.
7344 - val_loss: 0.3258 - val_custom_accuracy: 0.7734
Epoch 917/1000
4/4 [==========] - 1s 345ms/step - loss: 0.2351 - custom_accuracy: 0.
7188 - val_loss: 0.3336 - val_custom_accuracy: 0.7734
Epoch 918/1000
4/4 [==========] - 1s 343ms/step - loss: 0.2335 - custom_accuracy: 0.
7734 - val_loss: 0.3251 - val_custom_accuracy: 0.7656
Epoch 919/1000
4/4 [==========] - 1s 345ms/step - loss: 0.2318 - custom_accuracy: 0.
8359 - val_loss: 0.3136 - val_custom_accuracy: 0.7500
Epoch 920/1000
4/4 [==========] - 1s 343ms/step - loss: 0.2297 - custom_accuracy: 0.
8359 - val_loss: 0.3082 - val_custom_accuracy: 0.7500
Epoch 921/1000
4/4 [==========] - 1s 341ms/step - loss: 0.2280 - custom_accuracy: 0.
7422 - val_loss: 0.3105 - val_custom_accuracy: 0.7656
Epoch 922/1000
4/4 [==========] - 1s 344ms/step - loss: 0.2276 - custom_accuracy: 0.
7891 - val_loss: 0.3136 - val_custom_accuracy: 0.7656
Epoch 923/1000
4/4 [==========] - 1s 335ms/step - loss: 0.2275 - custom_accuracy: 0.
8438 - val_loss: 0.3160 - val_custom_accuracy: 0.7656
Epoch 924/1000
4/4 [==========] - 1s 398ms/step - loss: 0.2271 - custom_accuracy: 0.
7891 - val_loss: 0.3160 - val_custom_accuracy: 0.7656
Epoch 925/1000
4/4 [==========] - 2s 595ms/step - loss: 0.2270 - custom_accuracy: 0.
7891 - val_loss: 0.3152 - val_custom_accuracy: 0.7656
Epoch 926/1000
4/4 [==========] - 2s 550ms/step - loss: 0.2271 - custom_accuracy: 0.
7891 - val_loss: 0.3139 - val_custom_accuracy: 0.7656
Epoch 927/1000
4/4 [==========] - 2s 558ms/step - loss: 0.2271 - custom_accuracy: 0.
7891 - val_loss: 0.3133 - val_custom_accuracy: 0.7578
Epoch 928/1000
4/4 [==========] - 2s 558ms/step - loss: 0.2276 - custom_accuracy: 0.
8438 - val_loss: 0.3185 - val_custom_accuracy: 0.7656
Epoch 929/1000
4/4 [==========] - 1s 345ms/step - loss: 0.2307 - custom_accuracy: 0.
7188 - val_loss: 0.3339 - val_custom_accuracy: 0.7656
Epoch 930/1000
4/4 [==========] - 1s 333ms/step - loss: 0.2313 - custom_accuracy: 0.
8281 - val_loss: 0.3258 - val_custom_accuracy: 0.7656
Epoch 931/1000
4/4 [==========] - 1s 338ms/step - loss: 0.2318 - custom_accuracy: 0.
8281 - val_loss: 0.3199 - val_custom_accuracy: 0.7734
Epoch 932/1000
4/4 [==========] - 1s 340ms/step - loss: 0.2318 - custom_accuracy: 0.
8281 - val_loss: 0.3190 - val_custom_accuracy: 0.7734
Epoch 933/1000
4/4 [==========] - 1s 343ms/step - loss: 0.2299 - custom_accuracy: 0.
7812 - val_loss: 0.3169 - val_custom_accuracy: 0.7656
Epoch 934/1000
4/4 [==========] - 1s 330ms/step - loss: 0.2286 - custom_accuracy: 0.
8438 - val_loss: 0.3163 - val_custom_accuracy: 0.7656
Epoch 935/1000
4/4 [==========] - 1s 339ms/step - loss: 0.2280 - custom_accuracy: 0.
7812 - val_loss: 0.3249 - val_custom_accuracy: 0.7656
Epoch 936/1000
4/4 [==========] - 1s 338ms/step - loss: 0.2279 - custom_accuracy: 0.
8359 - val_loss: 0.3214 - val_custom_accuracy: 0.7656
Epoch 937/1000
4/4 [==========] - 2s 569ms/step - loss: 0.2286 - custom_accuracy: 0.

4/4 [==============================] - 2s 509ms/step - loss: 0.2280 - custom_accuracy: 0.
8438 - val_loss: 0.3076 - val_custom_accuracy: 0.7578
Epoch 938/1000
4/4 [==============================] - 2s 536ms/step - loss: 0.2280 - custom_accuracy: 0.
7969 - val_loss: 0.3100 - val_custom_accuracy: 0.7578
Epoch 939/1000
4/4 [==============================] - 2s 547ms/step - loss: 0.2269 - custom_accuracy: 0.
8516 - val_loss: 0.3159 - val_custom_accuracy: 0.7656
Epoch 940/1000
4/4 [==============================] - 2s 568ms/step - loss: 0.2275 - custom_accuracy: 0.
8438 - val_loss: 0.3223 - val_custom_accuracy: 0.7656
Epoch 941/1000
4/4 [==============================] - 2s 412ms/step - loss: 0.2272 - custom_accuracy: 0.
7344 - val_loss: 0.3217 - val_custom_accuracy: 0.7656
Epoch 942/1000
4/4 [==============================] - 1s 344ms/step - loss: 0.2271 - custom_accuracy: 0.
8359 - val_loss: 0.3222 - val_custom_accuracy: 0.7734
Epoch 943/1000
4/4 [==============================] - 1s 334ms/step - loss: 0.2278 - custom_accuracy: 0.
8359 - val_loss: 0.3280 - val_custom_accuracy: 0.7734
Epoch 944/1000
4/4 [==============================] - 1s 333ms/step - loss: 0.2287 - custom_accuracy: 0.
7812 - val_loss: 0.3258 - val_custom_accuracy: 0.7734
Epoch 945/1000
4/4 [==============================] - 1s 335ms/step - loss: 0.2279 - custom_accuracy: 0.
7891 - val_loss: 0.3226 - val_custom_accuracy: 0.7734
Epoch 946/1000
4/4 [==============================] - 1s 337ms/step - loss: 0.2269 - custom_accuracy: 0.
8359 - val_loss: 0.3232 - val_custom_accuracy: 0.7656
Epoch 947/1000
4/4 [==============================] - 1s 343ms/step - loss: 0.2270 - custom_accuracy: 0.
8359 - val_loss: 0.3225 - val_custom_accuracy: 0.7656
Epoch 948/1000
4/4 [==============================] - 1s 345ms/step - loss: 0.2266 - custom_accuracy: 0.
7266 - val_loss: 0.3191 - val_custom_accuracy: 0.7656
Epoch 949/1000
4/4 [==============================] - 2s 513ms/step - loss: 0.2270 - custom_accuracy: 0.
7891 - val_loss: 0.3111 - val_custom_accuracy: 0.7578
Epoch 950/1000
4/4 [==============================] - 2s 570ms/step - loss: 0.2285 - custom_accuracy: 0.
8516 - val_loss: 0.2963 - val_custom_accuracy: 0.7422
Epoch 951/1000
4/4 [==============================] - 2s 552ms/step - loss: 0.2326 - custom_accuracy: 0.
8516 - val_loss: 0.2997 - val_custom_accuracy: 0.7422
Epoch 952/1000
4/4 [==============================] - 2s 566ms/step - loss: 0.2294 - custom_accuracy: 0.
8516 - val_loss: 0.3080 - val_custom_accuracy: 0.7500
Epoch 953/1000
4/4 [==============================] - 2s 498ms/step - loss: 0.2272 - custom_accuracy: 0.
8516 - val_loss: 0.3098 - val_custom_accuracy: 0.7500
Epoch 954/1000
4/4 [==============================] - 1s 336ms/step - loss: 0.2263 - custom_accuracy: 0.
7969 - val_loss: 0.3212 - val_custom_accuracy: 0.7656
Epoch 955/1000
4/4 [==============================] - 1s 348ms/step - loss: 0.2264 - custom_accuracy: 0.
6250 - val_loss: 0.3250 - val_custom_accuracy: 0.7656
Epoch 956/1000
4/4 [==============================] - 1s 338ms/step - loss: 0.2268 - custom_accuracy: 0.
7266 - val_loss: 0.3166 - val_custom_accuracy: 0.7656
Epoch 957/1000
4/4 [==============================] - 1s 330ms/step - loss: 0.2308 - custom_accuracy: 0.
8438 - val_loss: 0.3111 - val_custom_accuracy: 0.7656
Epoch 958/1000
4/4 [==============================] - 1s 330ms/step - loss: 0.2302 - custom_accuracy: 0.
7812 - val_loss: 0.3263 - val_custom_accuracy: 0.7734
Epoch 959/1000
4/4 [==============================] - 1s 333ms/step - loss: 0.2277 - custom_accuracy: 0.
7812 - val_loss: 0.3203 - val_custom_accuracy: 0.7656
Epoch 960/1000
4/4 [==============================] - 1s 339ms/step - loss: 0.2272 - custom_accuracy: 0.
8438 - val_loss: 0.3113 - val_custom_accuracy: 0.7656
Epoch 961/1000
4/4 [==============================] - 1s 407ms/step - loss: 0.2284 - custom_accuracy: 0.

4/4 [==============================] - 1s 407ms/step - loss: 0.2264 - custom_accuracy: 0.
8438 - val_loss: 0.3076 - val_custom_accuracy: 0.7578
Epoch 962/1000
4/4 [==============================] - 2s 580ms/step - loss: 0.2275 - custom_accuracy: 0.
8438 - val_loss: 0.3246 - val_custom_accuracy: 0.7656
Epoch 963/1000
4/4 [==============================] - 2s 563ms/step - loss: 0.2299 - custom_accuracy: 0.
8281 - val_loss: 0.3360 - val_custom_accuracy: 0.7734
Epoch 964/1000
4/4 [==============================] - 2s 553ms/step - loss: 0.2298 - custom_accuracy: 0.
7188 - val_loss: 0.3299 - val_custom_accuracy: 0.7734
Epoch 965/1000
4/4 [==============================] - 2s 545ms/step - loss: 0.2287 - custom_accuracy: 0.
7812 - val_loss: 0.3214 - val_custom_accuracy: 0.7656
Epoch 966/1000
4/4 [==============================] - 1s 338ms/step - loss: 0.2281 - custom_accuracy: 0.
7266 - val_loss: 0.3087 - val_custom_accuracy: 0.7578
Epoch 967/1000
4/4 [==============================] - 1s 340ms/step - loss: 0.2308 - custom_accuracy: 0.
7969 - val_loss: 0.2955 - val_custom_accuracy: 0.7422
Epoch 968/1000
4/4 [==============================] - 1s 342ms/step - loss: 0.2381 - custom_accuracy: 0.
8438 - val_loss: 0.2972 - val_custom_accuracy: 0.7422
Epoch 969/1000
4/4 [==============================] - 1s 331ms/step - loss: 0.2328 - custom_accuracy: 0.
6953 - val_loss: 0.3052 - val_custom_accuracy: 0.7500
Epoch 970/1000
4/4 [==============================] - 1s 331ms/step - loss: 0.2282 - custom_accuracy: 0.
7500 - val_loss: 0.3138 - val_custom_accuracy: 0.7656
Epoch 971/1000
4/4 [==============================] - 1s 339ms/step - loss: 0.2283 - custom_accuracy: 0.
7891 - val_loss: 0.3225 - val_custom_accuracy: 0.7734
Epoch 972/1000
4/4 [==============================] - 1s 339ms/step - loss: 0.2285 - custom_accuracy: 0.
8359 - val_loss: 0.3297 - val_custom_accuracy: 0.7734
Epoch 973/1000
4/4 [==============================] - 1s 333ms/step - loss: 0.2284 - custom_accuracy: 0.
8359 - val_loss: 0.3351 - val_custom_accuracy: 0.7734
Epoch 974/1000
4/4 [==============================] - 2s 565ms/step - loss: 0.2290 - custom_accuracy: 0.
8281 - val_loss: 0.3367 - val_custom_accuracy: 0.7734
Epoch 975/1000
4/4 [==============================] - 2s 562ms/step - loss: 0.2285 - custom_accuracy: 0.
8281 - val_loss: 0.3316 - val_custom_accuracy: 0.7734
Epoch 976/1000
4/4 [==============================] - 2s 544ms/step - loss: 0.2270 - custom_accuracy: 0.
8359 - val_loss: 0.3241 - val_custom_accuracy: 0.7656
Epoch 977/1000
4/4 [==============================] - 2s 551ms/step - loss: 0.2263 - custom_accuracy: 0.
7266 - val_loss: 0.3211 - val_custom_accuracy: 0.7656
Epoch 978/1000
4/4 [==============================] - 2s 458ms/step - loss: 0.2259 - custom_accuracy: 0.
8438 - val_loss: 0.3184 - val_custom_accuracy: 0.7656
Epoch 979/1000
4/4 [==============================] - 1s 341ms/step - loss: 0.2254 - custom_accuracy: 0.
7891 - val_loss: 0.3182 - val_custom_accuracy: 0.7656
Epoch 980/1000
4/4 [==============================] - 1s 340ms/step - loss: 0.2261 - custom_accuracy: 0.
8438 - val_loss: 0.3191 - val_custom_accuracy: 0.7656
Epoch 981/1000
4/4 [==============================] - 1s 336ms/step - loss: 0.2259 - custom_accuracy: 0.
8438 - val_loss: 0.3131 - val_custom_accuracy: 0.7578
Epoch 982/1000
4/4 [==============================] - 1s 333ms/step - loss: 0.2259 - custom_accuracy: 0.
7969 - val_loss: 0.3127 - val_custom_accuracy: 0.7656
Epoch 983/1000
4/4 [==============================] - 1s 339ms/step - loss: 0.2256 - custom_accuracy: 0.
7969 - val_loss: 0.3179 - val_custom_accuracy: 0.7656
Epoch 984/1000
4/4 [==============================] - 1s 338ms/step - loss: 0.2254 - custom_accuracy: 0.
8438 - val_loss: 0.3219 - val_custom_accuracy: 0.7656
Epoch 985/1000
4/4 [==============================] - 1s 342ms/step - loss: 0.2257 - custom_accuracy: 0.

```
4/4 [==============================] - 1s 342ms/step - loss: 0.2257 - custom_accuracy: 0.
7891 - val_loss: 0.3266 - val_custom_accuracy: 0.7656
Epoch 986/1000
4/4 [==============================] - 2s 519ms/step - loss: 0.2262 - custom_accuracy: 0.
7266 - val_loss: 0.3367 - val_custom_accuracy: 0.7734
Epoch 987/1000
4/4 [==============================] - 2s 572ms/step - loss: 0.2290 - custom_accuracy: 0.
8281 - val_loss: 0.3395 - val_custom_accuracy: 0.7734
Epoch 988/1000
4/4 [==============================] - 2s 559ms/step - loss: 0.2287 - custom_accuracy: 0.
7188 - val_loss: 0.3282 - val_custom_accuracy: 0.7656
Epoch 989/1000
4/4 [==============================] - 2s 556ms/step - loss: 0.2271 - custom_accuracy: 0.
7812 - val_loss: 0.3223 - val_custom_accuracy: 0.7578
Epoch 990/1000
4/4 [==============================] - 2s 484ms/step - loss: 0.2260 - custom_accuracy: 0.
7891 - val_loss: 0.3156 - val_custom_accuracy: 0.7656
Epoch 991/1000
4/4 [==============================] - 1s 336ms/step - loss: 0.2260 - custom_accuracy: 0.
8516 - val_loss: 0.3117 - val_custom_accuracy: 0.7578
Epoch 992/1000
4/4 [==============================] - 1s 337ms/step - loss: 0.2265 - custom_accuracy: 0.
7969 - val_loss: 0.3129 - val_custom_accuracy: 0.7578
Epoch 993/1000
4/4 [==============================] - 1s 331ms/step - loss: 0.2284 - custom_accuracy: 0.
7812 - val_loss: 0.3175 - val_custom_accuracy: 0.7578
Epoch 994/1000
4/4 [==============================] - 1s 335ms/step - loss: 0.2276 - custom_accuracy: 0.
8359 - val_loss: 0.3172 - val_custom_accuracy: 0.7578
Epoch 995/1000
4/4 [==============================] - 1s 339ms/step - loss: 0.2273 - custom_accuracy: 0.
7812 - val_loss: 0.3163 - val_custom_accuracy: 0.7578
Epoch 996/1000
4/4 [==============================] - 1s 338ms/step - loss: 0.2290 - custom_accuracy: 0.
8438 - val_loss: 0.3009 - val_custom_accuracy: 0.7422
Epoch 997/1000
4/4 [==============================] - 1s 337ms/step - loss: 0.2282 - custom_accuracy: 0.
8516 - val_loss: 0.3077 - val_custom_accuracy: 0.7422
Epoch 998/1000
4/4 [==============================] - 1s 391ms/step - loss: 0.2254 - custom_accuracy: 0.
8516 - val_loss: 0.3221 - val_custom_accuracy: 0.7656
Epoch 999/1000
4/4 [==============================] - 2s 580ms/step - loss: 0.2278 - custom_accuracy: 0.
7188 - val_loss: 0.3387 - val_custom_accuracy: 0.7734
Epoch 1000/1000
4/4 [==============================] - 2s 555ms/step - loss: 0.2291 - custom_accuracy: 0.
8281 - val_loss: 0.3397 - val_custom_accuracy: 0.7734
```

In [ ]:

```
plt.plot(H.history['loss'])
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.title("Discriminator's Loss in cycle 5")
plt.show()
```

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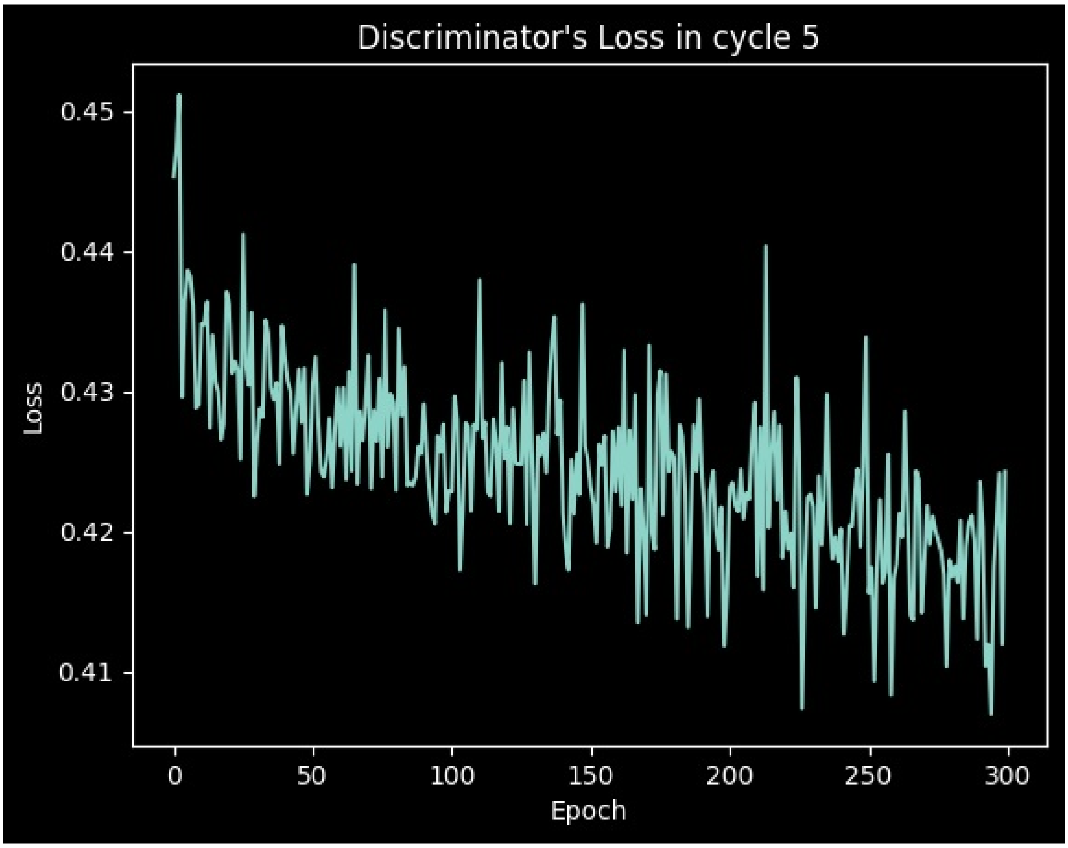

In [ ]:

```python
plt.plot(H.history['custom_accuracy'])
plt.xlabel('Epoch')
plt.ylabel('Accuracy')
plt.title("Discriminator's Accuracy in cycle 5")
plt.show()
```

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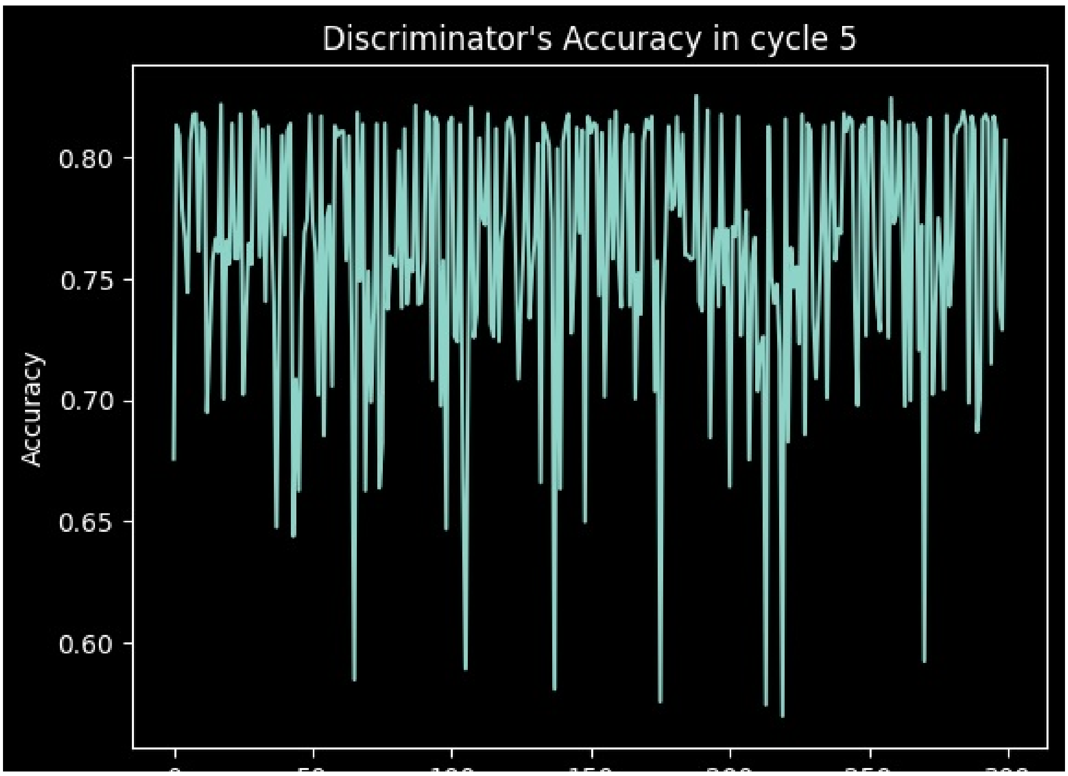
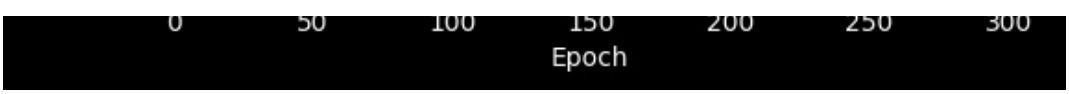
```





In [ ]:

```
qdisc_model.save_weights('disc_final.h5')
qgen_model.save_weights('gen_final.h5')
```

In [ ]:

```
qdisc_model.load_weights('disc_final.h5')
```

In [ ]:

```
from sklearn.metrics import roc_auc_score

print("Training Accuracy:", custom_accuracy(np.array(y_train, dtype=np.float32), qdisc_m
odel.predict(train_quantum_data)).numpy())
print("Testing Accuracy", custom_accuracy(np.array(y_test, dtype=np.float32), qdisc_mode
l.predict(test_quantum_data)).numpy())

print("Training AUC:", roc_auc_score(np.argmax(((y_train+1)/2)[:, :2], axis=1), (((qdisc
_model.predict(train_quantum_data)+1)/2)[:, :2])[:, 1]))
print("Testing AUC:", roc_auc_score(np.argmax(((y_test+1)/2)[:, :2], axis=1), (((qdisc_m
odel.predict(test_quantum_data)+1)/2)[:, :2])[:, 1]))
```

```
Training Accuracy: 0.78
Testing Accuracy 0.71
Training AUC: 0.8132
Testing AUC: 0.6784
```