

# BTC-RNN-Deep-Learning

September 29, 2021

## 1 Recurrent Neural Network - LSTM - BTC

### 1.0.1 Importing Libraries

```
[1]: import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
from sklearn.preprocessing import MinMaxScaler
plt.style.use("ggplot")

from keras.models import Sequential
from keras.layers import LSTM, Dense, Dropout
```

Using TensorFlow backend.

### 1.0.2 Loading the Data

```
[19]: df = pd.read_csv("BTC-USD.csv")
```

## 1.1 Preprocessing Data

```
[20]: # Setting the datetime index as the date, only selecting the 'Close' column,
      ↪ then only the last 1000 closing prices.
df = df.set_index("Date")[['Close']].tail(1000)
df = df.set_index(pd.to_datetime(df.index))

# Normalizing/Scaling the Data
scaler = MinMaxScaler()
df = pd.DataFrame(scaler.fit_transform(df), columns=df.columns, index=df.index)
```

```
[21]: # Checking the newly formatted DataFrame
df.head()
```

```
[21]:          Close
Date
2017-03-08  0.011448
2017-03-09  0.013522
```

```
2017-03-10  0.009655
2017-03-11  0.012840
2017-03-12  0.015294
```

```
[22]: # Plotting the Closing Prices
df.plot(figsize=(14,8))
plt.title("BTC Closing Prices")
plt.ylabel("Price (Normalized)")
plt.show()
```



### 1.1.1 Functions to prepare the data for LSTM

```
[23]: def split_sequence(seq, n_steps_in, n_steps_out):
      """
      Splits the univariate time sequence
      """
      X, y = [], []

      for i in range(len(seq)):
          end = i + n_steps_in
          out_end = end + n_steps_out

          if out_end > len(seq):
              break
```

```

    seq_x, seq_y = seq[i:end], seq[end:out_end]

    X.append(seq_x)
    y.append(seq_y)

    return np.array(X), np.array(y)

```

```

[24]: def visualize_training_results(results):
    """
    Plots the loss and accuracy for the training and testing data
    """
    history = results.history
    plt.figure(figsize=(12,4))
    plt.plot(history['val_loss'])
    plt.plot(history['loss'])
    plt.legend(['val_loss', 'loss'])
    plt.title('Loss')
    plt.xlabel('Epochs')
    plt.ylabel('Loss')
    plt.show()

    plt.figure(figsize=(12,4))
    plt.plot(history['val_accuracy'])
    plt.plot(history['accuracy'])
    plt.legend(['val_accuracy', 'accuracy'])
    plt.title('Accuracy')
    plt.xlabel('Epochs')
    plt.ylabel('Accuracy')
    plt.show()

```

```

[25]: def layer_maker(n_layers, n_nodes, activation, drop=None, d_rate=.5):
    """
    Creates a specified number of hidden layers for an RNN
    Optional: Adds regularization option - the dropout layer to prevent
    ↪ potential overfitting (if necessary)
    """

    # Creating the specified number of hidden layers with the specified number
    ↪ of nodes
    for x in range(1,n_layers+1):
        model.add(LSTM(n_nodes, activation=activation, return_sequences=True))

        # Adds a Dropout layer after every Nth hidden layer (the 'drop'
        ↪ variable)
        try:
            if x % drop == 0:
                model.add(Dropout(d_rate))

```

```
except:
    pass
```

### 1.1.2 Splitting the Data

```
[26]: # How many periods looking back to learn
n_per_in = 30

# How many periods to predict
n_per_out = 10

# Features (in this case it's 1 because there is only one feature: price)
n_features = 1

# Splitting the data into appropriate sequences
X, y = split_sequence(list(df.Close), n_per_in, n_per_out)

# Reshaping the X variable from 2D to 3D
X = X.reshape((X.shape[0], X.shape[1], n_features))
```

## 1.2 Modeling - LSTM (RNN)

### 1.2.1 Creating the Neural Network

```
[62]: # Instatiating the model
model = Sequential()

# Activation
activ = "softsign"

# Input layer
model.add(LSTM(30, activation=activ, return_sequences=True,
    ↪input_shape=(n_per_in, n_features)))

# Hidden layers
layer_maker(n_layers=6, n_nodes=12, activation=activ)

# Final Hidden layer
model.add(LSTM(10, activation=activ))

# Output layer
model.add(Dense(n_per_out))

# Model summary
model.summary()
```

Model: "sequential\_13"

Layer (type)	Output Shape	Param #
lstm_68 (LSTM)	(None, 30, 30)	3840
lstm_69 (LSTM)	(None, 30, 12)	2064
lstm_70 (LSTM)	(None, 30, 12)	1200
lstm_71 (LSTM)	(None, 30, 12)	1200
lstm_72 (LSTM)	(None, 30, 12)	1200
lstm_73 (LSTM)	(None, 30, 12)	1200
lstm_74 (LSTM)	(None, 30, 12)	1200
lstm_75 (LSTM)	(None, 10)	920
dense_13 (Dense)	(None, 10)	110
Total params: 12,934		
Trainable params: 12,934		
Non-trainable params: 0		

```
[63]: # Compiling the data with selected specifications
model.compile(optimizer='adam', loss='mse', metrics=['accuracy'])
```

## 1.2.2 Fitting and Training the RNN

```
[64]: res = model.fit(X, y, epochs=800, batch_size=32, validation_split=0.1)
```

```
Train on 864 samples, validate on 97 samples
Epoch 1/800
864/864 [=====] - 6s 7ms/step - loss: 0.0907 -
accuracy: 0.0671 - val_loss: 0.0835 - val_accuracy: 0.0515
Epoch 2/800
864/864 [=====] - 3s 4ms/step - loss: 0.0474 -
accuracy: 0.0660 - val_loss: 0.0283 - val_accuracy: 0.0515
Epoch 3/800
864/864 [=====] - 2s 3ms/step - loss: 0.0353 -
accuracy: 0.0764 - val_loss: 0.0188 - val_accuracy: 0.0722
Epoch 4/800
864/864 [=====] - 2s 3ms/step - loss: 0.0293 -
accuracy: 0.0752 - val_loss: 0.0072 - val_accuracy: 0.0515
Epoch 5/800
```

864/864 [=====] - 2s 3ms/step - loss: 0.0163 - accuracy: 0.1123 - val\_loss: 0.0030 - val\_accuracy: 0.0722  
Epoch 6/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0142 - accuracy: 0.0833 - val\_loss: 0.0029 - val\_accuracy: 0.0515  
Epoch 7/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0125 - accuracy: 0.0914 - val\_loss: 0.0028 - val\_accuracy: 0.0619  
Epoch 8/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0115 - accuracy: 0.0903 - val\_loss: 0.0038 - val\_accuracy: 0.0515  
Epoch 9/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0112 - accuracy: 0.0984 - val\_loss: 0.0032 - val\_accuracy: 0.0722  
Epoch 10/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0107 - accuracy: 0.0984 - val\_loss: 0.0033 - val\_accuracy: 0.0722  
Epoch 11/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0101 - accuracy: 0.0868 - val\_loss: 0.0040 - val\_accuracy: 0.0722  
Epoch 12/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0093 - accuracy: 0.1065 - val\_loss: 0.0026 - val\_accuracy: 0.0722  
Epoch 13/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0087 - accuracy: 0.0972 - val\_loss: 0.0025 - val\_accuracy: 0.0722  
Epoch 14/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0075 - accuracy: 0.0914 - val\_loss: 0.0030 - val\_accuracy: 0.0722  
Epoch 15/800  
864/864 [=====] - 3s 4ms/step - loss: 0.0075 - accuracy: 0.1134 - val\_loss: 0.0030 - val\_accuracy: 0.0515  
Epoch 16/800  
864/864 [=====] - 3s 4ms/step - loss: 0.0069 - accuracy: 0.1007 - val\_loss: 0.0030 - val\_accuracy: 0.0722  
Epoch 17/800  
864/864 [=====] - 4s 4ms/step - loss: 0.0061 - accuracy: 0.0891 - val\_loss: 0.0032 - val\_accuracy: 0.0825  
Epoch 18/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0059 - accuracy: 0.0914 - val\_loss: 0.0033 - val\_accuracy: 0.0722  
Epoch 19/800  
864/864 [=====] - 4s 5ms/step - loss: 0.0058 - accuracy: 0.1053 - val\_loss: 0.0026 - val\_accuracy: 0.0515  
Epoch 20/800  
864/864 [=====] - 3s 4ms/step - loss: 0.0053 - accuracy: 0.0926 - val\_loss: 0.0028 - val\_accuracy: 0.0619  
Epoch 21/800

864/864 [=====] - 2s 3ms/step - loss: 0.0055 -  
accuracy: 0.0972 - val\_loss: 0.0055 - val\_accuracy: 0.0515  
Epoch 22/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0057 -  
accuracy: 0.0961 - val\_loss: 0.0030 - val\_accuracy: 0.0515  
Epoch 23/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0050 -  
accuracy: 0.0903 - val\_loss: 0.0029 - val\_accuracy: 0.0722  
Epoch 24/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0050 -  
accuracy: 0.0914 - val\_loss: 0.0029 - val\_accuracy: 0.0722  
Epoch 25/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0048 -  
accuracy: 0.0961 - val\_loss: 0.0032 - val\_accuracy: 0.0722  
Epoch 26/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0047 -  
accuracy: 0.1053 - val\_loss: 0.0030 - val\_accuracy: 0.0619  
Epoch 27/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0051 -  
accuracy: 0.1030 - val\_loss: 0.0042 - val\_accuracy: 0.0722  
Epoch 28/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0049 -  
accuracy: 0.1169 - val\_loss: 0.0028 - val\_accuracy: 0.0619  
Epoch 29/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0047 -  
accuracy: 0.1100 - val\_loss: 0.0047 - val\_accuracy: 0.0825  
Epoch 30/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0048 -  
accuracy: 0.1539 - val\_loss: 0.0030 - val\_accuracy: 0.0515  
Epoch 31/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0046 -  
accuracy: 0.1076 - val\_loss: 0.0031 - val\_accuracy: 0.0722  
Epoch 32/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0045 -  
accuracy: 0.1331 - val\_loss: 0.0028 - val\_accuracy: 0.0619  
Epoch 33/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0043 -  
accuracy: 0.1366 - val\_loss: 0.0029 - val\_accuracy: 0.0515  
Epoch 34/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0042 -  
accuracy: 0.1192 - val\_loss: 0.0027 - val\_accuracy: 0.0619  
Epoch 35/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0042 -  
accuracy: 0.1192 - val\_loss: 0.0030 - val\_accuracy: 0.0515  
Epoch 36/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0045 -  
accuracy: 0.1400 - val\_loss: 0.0036 - val\_accuracy: 0.0309  
Epoch 37/800

864/864 [=====] - 2s 3ms/step - loss: 0.0041 -  
accuracy: 0.1331 - val\_loss: 0.0032 - val\_accuracy: 0.0515  
Epoch 38/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0040 -  
accuracy: 0.1227 - val\_loss: 0.0028 - val\_accuracy: 0.0412  
Epoch 39/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0039 -  
accuracy: 0.1019 - val\_loss: 0.0026 - val\_accuracy: 0.0412  
Epoch 40/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0039 -  
accuracy: 0.1273 - val\_loss: 0.0034 - val\_accuracy: 0.0309  
Epoch 41/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0039 -  
accuracy: 0.1181 - val\_loss: 0.0026 - val\_accuracy: 0.0515  
Epoch 42/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0037 -  
accuracy: 0.1296 - val\_loss: 0.0030 - val\_accuracy: 0.0515  
Epoch 43/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0043 -  
accuracy: 0.1088 - val\_loss: 0.0034 - val\_accuracy: 0.0619  
Epoch 44/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0041 -  
accuracy: 0.1435 - val\_loss: 0.0026 - val\_accuracy: 0.1443  
Epoch 45/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0038 -  
accuracy: 0.1273 - val\_loss: 0.0031 - val\_accuracy: 0.0722  
Epoch 46/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0038 -  
accuracy: 0.1215 - val\_loss: 0.0027 - val\_accuracy: 0.0515  
Epoch 47/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0035 -  
accuracy: 0.1250 - val\_loss: 0.0028 - val\_accuracy: 0.0515  
Epoch 48/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0033 -  
accuracy: 0.1331 - val\_loss: 0.0028 - val\_accuracy: 0.0515  
Epoch 49/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0032 -  
accuracy: 0.1285 - val\_loss: 0.0027 - val\_accuracy: 0.0309  
Epoch 50/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0034 -  
accuracy: 0.1435 - val\_loss: 0.0028 - val\_accuracy: 0.0412  
Epoch 51/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0032 -  
accuracy: 0.1181 - val\_loss: 0.0029 - val\_accuracy: 0.0412  
Epoch 52/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0033 -  
accuracy: 0.1424 - val\_loss: 0.0029 - val\_accuracy: 0.0309  
Epoch 53/800



864/864 [=====] - 2s 3ms/step - loss: 0.0035 -  
accuracy: 0.1296 - val\_loss: 0.0029 - val\_accuracy: 0.0722  
Epoch 54/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0030 -  
accuracy: 0.1516 - val\_loss: 0.0027 - val\_accuracy: 0.0619  
Epoch 55/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0029 -  
accuracy: 0.1296 - val\_loss: 0.0028 - val\_accuracy: 0.0619  
Epoch 56/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0028 -  
accuracy: 0.1354 - val\_loss: 0.0028 - val\_accuracy: 0.0412  
Epoch 57/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0028 -  
accuracy: 0.1343 - val\_loss: 0.0045 - val\_accuracy: 0.0825  
Epoch 58/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0029 -  
accuracy: 0.1412 - val\_loss: 0.0029 - val\_accuracy: 0.0722  
Epoch 59/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0027 -  
accuracy: 0.1574 - val\_loss: 0.0028 - val\_accuracy: 0.0825  
Epoch 60/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0026 -  
accuracy: 0.1296 - val\_loss: 0.0029 - val\_accuracy: 0.0619  
Epoch 61/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0027 -  
accuracy: 0.1574 - val\_loss: 0.0031 - val\_accuracy: 0.1443  
Epoch 62/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0025 -  
accuracy: 0.1678 - val\_loss: 0.0033 - val\_accuracy: 0.0412  
Epoch 63/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0027 -  
accuracy: 0.1400 - val\_loss: 0.0029 - val\_accuracy: 0.0928  
Epoch 64/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0026 -  
accuracy: 0.1562 - val\_loss: 0.0034 - val\_accuracy: 0.1031  
Epoch 65/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0025 -  
accuracy: 0.1493 - val\_loss: 0.0028 - val\_accuracy: 0.1237  
Epoch 66/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0025 -  
accuracy: 0.1262 - val\_loss: 0.0039 - val\_accuracy: 0.0515  
Epoch 67/800  
864/864 [=====] - 4s 5ms/step - loss: 0.0024 -  
accuracy: 0.1632 - val\_loss: 0.0030 - val\_accuracy: 0.2062  
Epoch 68/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0024 -  
accuracy: 0.1447 - val\_loss: 0.0025 - val\_accuracy: 0.1753  
Epoch 69/800

864/864 [=====] - 2s 3ms/step - loss: 0.0023 -  
accuracy: 0.1655 - val\_loss: 0.0027 - val\_accuracy: 0.0515  
Epoch 70/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0023 -  
accuracy: 0.1493 - val\_loss: 0.0033 - val\_accuracy: 0.0825  
Epoch 71/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0022 -  
accuracy: 0.1701 - val\_loss: 0.0036 - val\_accuracy: 0.1753  
Epoch 72/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0023 -  
accuracy: 0.1736 - val\_loss: 0.0032 - val\_accuracy: 0.1031  
Epoch 73/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0023 -  
accuracy: 0.1493 - val\_loss: 0.0035 - val\_accuracy: 0.1340  
Epoch 74/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0021 -  
accuracy: 0.1574 - val\_loss: 0.0038 - val\_accuracy: 0.0206  
Epoch 75/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0023 -  
accuracy: 0.1644 - val\_loss: 0.0030 - val\_accuracy: 0.1237  
Epoch 76/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0023 -  
accuracy: 0.1620 - val\_loss: 0.0032 - val\_accuracy: 0.0619  
Epoch 77/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0022 -  
accuracy: 0.1458 - val\_loss: 0.0031 - val\_accuracy: 0.0619  
Epoch 78/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0022 -  
accuracy: 0.1748 - val\_loss: 0.0033 - val\_accuracy: 0.0619  
Epoch 79/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0020 -  
accuracy: 0.1644 - val\_loss: 0.0032 - val\_accuracy: 0.0515  
Epoch 80/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0021 -  
accuracy: 0.1655 - val\_loss: 0.0030 - val\_accuracy: 0.0515  
Epoch 81/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0021 -  
accuracy: 0.1539 - val\_loss: 0.0035 - val\_accuracy: 0.0515  
Epoch 82/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0019 -  
accuracy: 0.1632 - val\_loss: 0.0040 - val\_accuracy: 0.0928  
Epoch 83/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0021 -  
accuracy: 0.1470 - val\_loss: 0.0042 - val\_accuracy: 0.1031  
Epoch 84/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0023 -  
accuracy: 0.1701 - val\_loss: 0.0035 - val\_accuracy: 0.0515  
Epoch 85/800

864/864 [=====] - 2s 3ms/step - loss: 0.0022 -  
accuracy: 0.1782 - val\_loss: 0.0038 - val\_accuracy: 0.1546  
Epoch 86/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0019 -  
accuracy: 0.1597 - val\_loss: 0.0039 - val\_accuracy: 0.2268  
Epoch 87/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0020 -  
accuracy: 0.1736 - val\_loss: 0.0041 - val\_accuracy: 0.0619  
Epoch 88/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0022 -  
accuracy: 0.1678 - val\_loss: 0.0037 - val\_accuracy: 0.0722  
Epoch 89/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0022 -  
accuracy: 0.1470 - val\_loss: 0.0039 - val\_accuracy: 0.0722  
Epoch 90/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0019 -  
accuracy: 0.1667 - val\_loss: 0.0035 - val\_accuracy: 0.1340  
Epoch 91/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0019 -  
accuracy: 0.1678 - val\_loss: 0.0029 - val\_accuracy: 0.0206  
Epoch 92/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0019 -  
accuracy: 0.1493 - val\_loss: 0.0037 - val\_accuracy: 0.0722  
Epoch 93/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0018 -  
accuracy: 0.1748 - val\_loss: 0.0033 - val\_accuracy: 0.0722  
Epoch 94/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0018 -  
accuracy: 0.1632 - val\_loss: 0.0044 - val\_accuracy: 0.2577  
Epoch 95/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0018 -  
accuracy: 0.1655 - val\_loss: 0.0037 - val\_accuracy: 0.1959  
Epoch 96/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0018 -  
accuracy: 0.1713 - val\_loss: 0.0031 - val\_accuracy: 0.1134  
Epoch 97/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0018 -  
accuracy: 0.1632 - val\_loss: 0.0033 - val\_accuracy: 0.0619  
Epoch 98/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0017 -  
accuracy: 0.1470 - val\_loss: 0.0035 - val\_accuracy: 0.1649  
Epoch 99/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0016 -  
accuracy: 0.1863 - val\_loss: 0.0034 - val\_accuracy: 0.0825  
Epoch 100/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0017 -  
accuracy: 0.1528 - val\_loss: 0.0032 - val\_accuracy: 0.0825  
Epoch 101/800

864/864 [=====] - 2s 3ms/step - loss: 0.0017 -  
accuracy: 0.1817 - val\_loss: 0.0031 - val\_accuracy: 0.1649  
Epoch 102/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0020 -  
accuracy: 0.1644 - val\_loss: 0.0039 - val\_accuracy: 0.1753  
Epoch 103/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0016 -  
accuracy: 0.1794 - val\_loss: 0.0037 - val\_accuracy: 0.0619  
Epoch 104/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0016 -  
accuracy: 0.1551 - val\_loss: 0.0036 - val\_accuracy: 0.2784  
Epoch 105/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0015 -  
accuracy: 0.1771 - val\_loss: 0.0044 - val\_accuracy: 0.2062  
Epoch 106/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0016 -  
accuracy: 0.1933 - val\_loss: 0.0041 - val\_accuracy: 0.1031  
Epoch 107/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0016 -  
accuracy: 0.1632 - val\_loss: 0.0037 - val\_accuracy: 0.2371  
Epoch 108/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0016 -  
accuracy: 0.1968 - val\_loss: 0.0033 - val\_accuracy: 0.1443  
Epoch 109/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0017 -  
accuracy: 0.1701 - val\_loss: 0.0034 - val\_accuracy: 0.0619  
Epoch 110/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0015 -  
accuracy: 0.1551 - val\_loss: 0.0042 - val\_accuracy: 0.2784  
Epoch 111/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0017 -  
accuracy: 0.2060 - val\_loss: 0.0035 - val\_accuracy: 0.0825  
Epoch 112/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0016 -  
accuracy: 0.1574 - val\_loss: 0.0042 - val\_accuracy: 0.1856  
Epoch 113/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0015 -  
accuracy: 0.1690 - val\_loss: 0.0037 - val\_accuracy: 0.1856  
Epoch 114/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0015 -  
accuracy: 0.2106 - val\_loss: 0.0034 - val\_accuracy: 0.0309  
Epoch 115/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0016 -  
accuracy: 0.1736 - val\_loss: 0.0034 - val\_accuracy: 0.2680  
Epoch 116/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0015 -  
accuracy: 0.1806 - val\_loss: 0.0038 - val\_accuracy: 0.1237  
Epoch 117/800

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864/864 [=====] - 2s 3ms/step - loss: 0.0015 -
accuracy: 0.1968 - val_loss: 0.0033 - val_accuracy: 0.1340
Epoch 118/800
864/864 [=====] - 2s 3ms/step - loss: 0.0014 -
accuracy: 0.1910 - val_loss: 0.0039 - val_accuracy: 0.2680
Epoch 119/800
864/864 [=====] - 2s 3ms/step - loss: 0.0014 -
accuracy: 0.1968 - val_loss: 0.0042 - val_accuracy: 0.2474
Epoch 120/800
864/864 [=====] - 2s 3ms/step - loss: 0.0014 -
accuracy: 0.1736 - val_loss: 0.0039 - val_accuracy: 0.1340
Epoch 121/800
864/864 [=====] - 2s 3ms/step - loss: 0.0015 -
accuracy: 0.2002 - val_loss: 0.0039 - val_accuracy: 0.2990
Epoch 122/800
864/864 [=====] - 2s 3ms/step - loss: 0.0015 -
accuracy: 0.1933 - val_loss: 0.0040 - val_accuracy: 0.1959
Epoch 123/800
864/864 [=====] - 2s 3ms/step - loss: 0.0016 -
accuracy: 0.1817 - val_loss: 0.0030 - val_accuracy: 0.3299
Epoch 124/800
864/864 [=====] - 2s 3ms/step - loss: 0.0015 -
accuracy: 0.1690 - val_loss: 0.0040 - val_accuracy: 0.2680
Epoch 125/800
864/864 [=====] - 2s 3ms/step - loss: 0.0013 -
accuracy: 0.2072 - val_loss: 0.0034 - val_accuracy: 0.3093
Epoch 126/800
864/864 [=====] - 2s 3ms/step - loss: 0.0013 -
accuracy: 0.1921 - val_loss: 0.0041 - val_accuracy: 0.1753
Epoch 127/800
864/864 [=====] - 2s 3ms/step - loss: 0.0013 -
accuracy: 0.1748 - val_loss: 0.0036 - val_accuracy: 0.2680
Epoch 128/800
864/864 [=====] - 2s 3ms/step - loss: 0.0013 -
accuracy: 0.1898 - val_loss: 0.0033 - val_accuracy: 0.1340
Epoch 129/800
864/864 [=====] - 2s 3ms/step - loss: 0.0013 -
accuracy: 0.2106 - val_loss: 0.0035 - val_accuracy: 0.1237
Epoch 130/800
864/864 [=====] - 2s 3ms/step - loss: 0.0014 -
accuracy: 0.2211 - val_loss: 0.0035 - val_accuracy: 0.0619
Epoch 131/800
864/864 [=====] - 2s 3ms/step - loss: 0.0013 -
accuracy: 0.1736 - val_loss: 0.0043 - val_accuracy: 0.2990
Epoch 132/800
864/864 [=====] - 2s 3ms/step - loss: 0.0013 -
accuracy: 0.1910 - val_loss: 0.0050 - val_accuracy: 0.2268
Epoch 133/800

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864/864 [=====] - 2s 3ms/step - loss: 0.0013 -  
accuracy: 0.1956 - val\_loss: 0.0038 - val\_accuracy: 0.2784  
Epoch 134/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0013 -  
accuracy: 0.2257 - val\_loss: 0.0033 - val\_accuracy: 0.2062  
Epoch 135/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0015 -  
accuracy: 0.1875 - val\_loss: 0.0042 - val\_accuracy: 0.2577  
Epoch 136/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0014 -  
accuracy: 0.1968 - val\_loss: 0.0039 - val\_accuracy: 0.1031  
Epoch 137/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0014 -  
accuracy: 0.2037 - val\_loss: 0.0043 - val\_accuracy: 0.1959  
Epoch 138/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0018 -  
accuracy: 0.1840 - val\_loss: 0.0082 - val\_accuracy: 0.2577  
Epoch 139/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0016 -  
accuracy: 0.2049 - val\_loss: 0.0043 - val\_accuracy: 0.2268  
Epoch 140/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0014 -  
accuracy: 0.1794 - val\_loss: 0.0047 - val\_accuracy: 0.2680  
Epoch 141/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0013 -  
accuracy: 0.2106 - val\_loss: 0.0046 - val\_accuracy: 0.2577  
Epoch 142/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0013 -  
accuracy: 0.2164 - val\_loss: 0.0038 - val\_accuracy: 0.2268  
Epoch 143/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0012 -  
accuracy: 0.1887 - val\_loss: 0.0035 - val\_accuracy: 0.1649  
Epoch 144/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0012 -  
accuracy: 0.2118 - val\_loss: 0.0034 - val\_accuracy: 0.2371  
Epoch 145/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0012 -  
accuracy: 0.2106 - val\_loss: 0.0054 - val\_accuracy: 0.2577  
Epoch 146/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0012 -  
accuracy: 0.1944 - val\_loss: 0.0036 - val\_accuracy: 0.1959  
Epoch 147/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0012 -  
accuracy: 0.2141 - val\_loss: 0.0061 - val\_accuracy: 0.2474  
Epoch 148/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0015 -  
accuracy: 0.1887 - val\_loss: 0.0039 - val\_accuracy: 0.1753  
Epoch 149/800

864/864 [=====] - 2s 3ms/step - loss: 0.0014 -  
accuracy: 0.2002 - val\_loss: 0.0030 - val\_accuracy: 0.2165  
Epoch 150/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0014 -  
accuracy: 0.2049 - val\_loss: 0.0034 - val\_accuracy: 0.2784  
Epoch 151/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0012 -  
accuracy: 0.2176 - val\_loss: 0.0031 - val\_accuracy: 0.2165  
Epoch 152/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0012 -  
accuracy: 0.1863 - val\_loss: 0.0031 - val\_accuracy: 0.2577  
Epoch 153/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0014 -  
accuracy: 0.2106 - val\_loss: 0.0036 - val\_accuracy: 0.2577  
Epoch 154/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0018 -  
accuracy: 0.1782 - val\_loss: 0.0028 - val\_accuracy: 0.2474  
Epoch 155/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0017 -  
accuracy: 0.1921 - val\_loss: 0.0027 - val\_accuracy: 0.2165  
Epoch 156/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0013 -  
accuracy: 0.1956 - val\_loss: 0.0032 - val\_accuracy: 0.2784  
Epoch 157/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0013 -  
accuracy: 0.2176 - val\_loss: 0.0034 - val\_accuracy: 0.2577  
Epoch 158/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0011 -  
accuracy: 0.1782 - val\_loss: 0.0036 - val\_accuracy: 0.2990  
Epoch 159/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0011 -  
accuracy: 0.2118 - val\_loss: 0.0045 - val\_accuracy: 0.3093  
Epoch 160/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0011 -  
accuracy: 0.2164 - val\_loss: 0.0035 - val\_accuracy: 0.2577  
Epoch 161/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0011 -  
accuracy: 0.1991 - val\_loss: 0.0041 - val\_accuracy: 0.2268  
Epoch 162/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0011 -  
accuracy: 0.1956 - val\_loss: 0.0033 - val\_accuracy: 0.2371  
Epoch 163/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0011 -  
accuracy: 0.2095 - val\_loss: 0.0035 - val\_accuracy: 0.2474  
Epoch 164/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0012 -  
accuracy: 0.1979 - val\_loss: 0.0039 - val\_accuracy: 0.2474  
Epoch 165/800

864/864 [=====] - 2s 3ms/step - loss: 0.0011 -  
accuracy: 0.1979 - val\_loss: 0.0035 - val\_accuracy: 0.2062  
Epoch 166/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0011 -  
accuracy: 0.1944 - val\_loss: 0.0030 - val\_accuracy: 0.2474  
Epoch 167/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0013 -  
accuracy: 0.2072 - val\_loss: 0.0051 - val\_accuracy: 0.1340  
Epoch 168/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0014 -  
accuracy: 0.1736 - val\_loss: 0.0028 - val\_accuracy: 0.2268  
Epoch 169/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0012 -  
accuracy: 0.2153 - val\_loss: 0.0029 - val\_accuracy: 0.2784  
Epoch 170/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0011 -  
accuracy: 0.2164 - val\_loss: 0.0036 - val\_accuracy: 0.2577  
Epoch 171/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0011 -  
accuracy: 0.2188 - val\_loss: 0.0035 - val\_accuracy: 0.2784  
Epoch 172/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0011 -  
accuracy: 0.1829 - val\_loss: 0.0033 - val\_accuracy: 0.2887  
Epoch 173/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0011 -  
accuracy: 0.2245 - val\_loss: 0.0030 - val\_accuracy: 0.2680  
Epoch 174/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0012 -  
accuracy: 0.1968 - val\_loss: 0.0029 - val\_accuracy: 0.3196  
Epoch 175/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0011 -  
accuracy: 0.2164 - val\_loss: 0.0032 - val\_accuracy: 0.2784  
Epoch 176/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0010 -  
accuracy: 0.2106 - val\_loss: 0.0037 - val\_accuracy: 0.2165  
Epoch 177/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0010 -  
accuracy: 0.1991 - val\_loss: 0.0030 - val\_accuracy: 0.2165  
Epoch 178/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0011 -  
accuracy: 0.2083 - val\_loss: 0.0033 - val\_accuracy: 0.2165  
Epoch 179/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0010 -  
accuracy: 0.2176 - val\_loss: 0.0030 - val\_accuracy: 0.2062  
Epoch 180/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0010 -  
accuracy: 0.1933 - val\_loss: 0.0030 - val\_accuracy: 0.2062  
Epoch 181/800



864/864 [=====] - 3s 3ms/step - loss: 9.7486e-04 -  
accuracy: 0.1852 - val\_loss: 0.0031 - val\_accuracy: 0.2577  
Epoch 182/800  
864/864 [=====] - 3s 3ms/step - loss: 9.9327e-04 -  
accuracy: 0.2176 - val\_loss: 0.0035 - val\_accuracy: 0.2784  
Epoch 183/800  
864/864 [=====] - 2s 3ms/step - loss: 9.9449e-04 -  
accuracy: 0.2222 - val\_loss: 0.0031 - val\_accuracy: 0.2784  
Epoch 184/800  
864/864 [=====] - 2s 3ms/step - loss: 9.3915e-04 -  
accuracy: 0.2153 - val\_loss: 0.0031 - val\_accuracy: 0.3196  
Epoch 185/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0011 -  
accuracy: 0.2141 - val\_loss: 0.0055 - val\_accuracy: 0.2474  
Epoch 186/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0015 -  
accuracy: 0.2025 - val\_loss: 0.0023 - val\_accuracy: 0.2474  
Epoch 187/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0012 -  
accuracy: 0.2222 - val\_loss: 0.0032 - val\_accuracy: 0.3196  
Epoch 188/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0011 -  
accuracy: 0.2153 - val\_loss: 0.0025 - val\_accuracy: 0.3196  
Epoch 189/800  
864/864 [=====] - 2s 3ms/step - loss: 9.6520e-04 -  
accuracy: 0.2338 - val\_loss: 0.0031 - val\_accuracy: 0.3196  
Epoch 190/800  
864/864 [=====] - 2s 3ms/step - loss: 9.8436e-04 -  
accuracy: 0.1863 - val\_loss: 0.0035 - val\_accuracy: 0.3299  
Epoch 191/800  
864/864 [=====] - 2s 3ms/step - loss: 9.8362e-04 -  
accuracy: 0.2106 - val\_loss: 0.0029 - val\_accuracy: 0.3093  
Epoch 192/800  
864/864 [=====] - 2s 3ms/step - loss: 9.5760e-04 -  
accuracy: 0.2442 - val\_loss: 0.0032 - val\_accuracy: 0.2784  
Epoch 193/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0011 -  
accuracy: 0.1933 - val\_loss: 0.0036 - val\_accuracy: 0.2784  
Epoch 194/800  
864/864 [=====] - 2s 3ms/step - loss: 9.9285e-04 -  
accuracy: 0.2211 - val\_loss: 0.0032 - val\_accuracy: 0.2577  
Epoch 195/800  
864/864 [=====] - 2s 3ms/step - loss: 9.4669e-04 -  
accuracy: 0.2130 - val\_loss: 0.0029 - val\_accuracy: 0.2474  
Epoch 196/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0010 -  
accuracy: 0.1921 - val\_loss: 0.0031 - val\_accuracy: 0.2784  
Epoch 197/800

864/864 [=====] - 2s 3ms/step - loss: 9.4855e-04 -  
accuracy: 0.2326 - val\_loss: 0.0028 - val\_accuracy: 0.2577  
Epoch 198/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0011 -  
accuracy: 0.2396 - val\_loss: 0.0045 - val\_accuracy: 0.2165  
Epoch 199/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0011 -  
accuracy: 0.2280 - val\_loss: 0.0037 - val\_accuracy: 0.2784  
Epoch 200/800  
864/864 [=====] - 2s 3ms/step - loss: 9.9761e-04 -  
accuracy: 0.2095 - val\_loss: 0.0030 - val\_accuracy: 0.3299  
Epoch 201/800  
864/864 [=====] - 3s 3ms/step - loss: 9.7464e-04 -  
accuracy: 0.2072 - val\_loss: 0.0033 - val\_accuracy: 0.2680  
Epoch 202/800  
864/864 [=====] - 2s 3ms/step - loss: 9.5458e-04 -  
accuracy: 0.2095 - val\_loss: 0.0035 - val\_accuracy: 0.2062  
Epoch 203/800  
864/864 [=====] - 2s 3ms/step - loss: 9.3166e-04 -  
accuracy: 0.2303 - val\_loss: 0.0036 - val\_accuracy: 0.2887  
Epoch 204/800  
864/864 [=====] - 2s 3ms/step - loss: 9.9721e-04 -  
accuracy: 0.2338 - val\_loss: 0.0035 - val\_accuracy: 0.2887  
Epoch 205/800  
864/864 [=====] - 2s 3ms/step - loss: 8.8234e-04 -  
accuracy: 0.2326 - val\_loss: 0.0035 - val\_accuracy: 0.1856  
Epoch 206/800  
864/864 [=====] - 2s 3ms/step - loss: 9.0097e-04 -  
accuracy: 0.1910 - val\_loss: 0.0032 - val\_accuracy: 0.2784  
Epoch 207/800  
864/864 [=====] - 2s 3ms/step - loss: 8.8516e-04 -  
accuracy: 0.2396 - val\_loss: 0.0033 - val\_accuracy: 0.2680  
Epoch 208/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0012 -  
accuracy: 0.2488 - val\_loss: 0.0024 - val\_accuracy: 0.1753  
Epoch 209/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0010 -  
accuracy: 0.1944 - val\_loss: 0.0025 - val\_accuracy: 0.3196  
Epoch 210/800  
864/864 [=====] - 2s 3ms/step - loss: 9.7196e-04 -  
accuracy: 0.1991 - val\_loss: 0.0032 - val\_accuracy: 0.2887  
Epoch 211/800  
864/864 [=====] - 2s 3ms/step - loss: 9.1276e-04 -  
accuracy: 0.2188 - val\_loss: 0.0032 - val\_accuracy: 0.3196  
Epoch 212/800  
864/864 [=====] - 2s 3ms/step - loss: 9.5389e-04 -  
accuracy: 0.2581 - val\_loss: 0.0033 - val\_accuracy: 0.2887  
Epoch 213/800

864/864 [=====] - 2s 3ms/step - loss: 9.2216e-04 -  
accuracy: 0.2384 - val\_loss: 0.0029 - val\_accuracy: 0.2474  
Epoch 214/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0011 -  
accuracy: 0.2338 - val\_loss: 0.0030 - val\_accuracy: 0.2680  
Epoch 215/800  
864/864 [=====] - 2s 3ms/step - loss: 9.5951e-04 -  
accuracy: 0.2523 - val\_loss: 0.0033 - val\_accuracy: 0.2268  
Epoch 216/800  
864/864 [=====] - 2s 3ms/step - loss: 8.5604e-04 -  
accuracy: 0.2211 - val\_loss: 0.0035 - val\_accuracy: 0.2165  
Epoch 217/800  
864/864 [=====] - 2s 3ms/step - loss: 8.6408e-04 -  
accuracy: 0.2303 - val\_loss: 0.0031 - val\_accuracy: 0.2268  
Epoch 218/800  
864/864 [=====] - 3s 3ms/step - loss: 9.0955e-04 -  
accuracy: 0.2292 - val\_loss: 0.0037 - val\_accuracy: 0.2371  
Epoch 219/800  
864/864 [=====] - 2s 3ms/step - loss: 9.2585e-04 -  
accuracy: 0.2454 - val\_loss: 0.0032 - val\_accuracy: 0.2680  
Epoch 220/800  
864/864 [=====] - 2s 3ms/step - loss: 8.3806e-04 -  
accuracy: 0.2442 - val\_loss: 0.0031 - val\_accuracy: 0.3196  
Epoch 221/800  
864/864 [=====] - 3s 3ms/step - loss: 8.4507e-04 -  
accuracy: 0.2662 - val\_loss: 0.0039 - val\_accuracy: 0.2887  
Epoch 222/800  
864/864 [=====] - 3s 3ms/step - loss: 8.5512e-04 -  
accuracy: 0.2292 - val\_loss: 0.0035 - val\_accuracy: 0.3299  
Epoch 223/800  
864/864 [=====] - 2s 3ms/step - loss: 8.6927e-04 -  
accuracy: 0.2431 - val\_loss: 0.0031 - val\_accuracy: 0.2784  
Epoch 224/800  
864/864 [=====] - 3s 3ms/step - loss: 8.2996e-04 -  
accuracy: 0.2280 - val\_loss: 0.0035 - val\_accuracy: 0.2577  
Epoch 225/800  
864/864 [=====] - 3s 3ms/step - loss: 7.8978e-04 -  
accuracy: 0.2477 - val\_loss: 0.0034 - val\_accuracy: 0.2784  
Epoch 226/800  
864/864 [=====] - 3s 3ms/step - loss: 9.6018e-04 -  
accuracy: 0.2546 - val\_loss: 0.0035 - val\_accuracy: 0.2474  
Epoch 227/800  
864/864 [=====] - 3s 4ms/step - loss: 0.0011 -  
accuracy: 0.2674 - val\_loss: 0.0033 - val\_accuracy: 0.2784  
Epoch 228/800  
864/864 [=====] - 3s 3ms/step - loss: 0.0012 -  
accuracy: 0.2396 - val\_loss: 0.0031 - val\_accuracy: 0.3402  
Epoch 229/800

864/864 [=====] - 2s 3ms/step - loss: 0.0011 -  
accuracy: 0.2593 - val\_loss: 0.0038 - val\_accuracy: 0.2887  
Epoch 230/800

864/864 [=====] - 2s 3ms/step - loss: 9.9190e-04 -  
accuracy: 0.2431 - val\_loss: 0.0029 - val\_accuracy: 0.2680  
Epoch 231/800

864/864 [=====] - 2s 3ms/step - loss: 9.5123e-04 -  
accuracy: 0.2465 - val\_loss: 0.0033 - val\_accuracy: 0.2990  
Epoch 232/800

864/864 [=====] - 2s 3ms/step - loss: 0.0010 -  
accuracy: 0.2627 - val\_loss: 0.0032 - val\_accuracy: 0.2268  
Epoch 233/800

864/864 [=====] - 2s 3ms/step - loss: 8.6919e-04 -  
accuracy: 0.2396 - val\_loss: 0.0034 - val\_accuracy: 0.2887  
Epoch 234/800

864/864 [=====] - 3s 3ms/step - loss: 8.2840e-04 -  
accuracy: 0.2697 - val\_loss: 0.0034 - val\_accuracy: 0.3196  
Epoch 235/800

864/864 [=====] - 2s 3ms/step - loss: 8.0177e-04 -  
accuracy: 0.2697 - val\_loss: 0.0033 - val\_accuracy: 0.3299  
Epoch 236/800

864/864 [=====] - 2s 3ms/step - loss: 7.8744e-04 -  
accuracy: 0.2558 - val\_loss: 0.0034 - val\_accuracy: 0.2990  
Epoch 237/800

864/864 [=====] - 2s 3ms/step - loss: 7.5329e-04 -  
accuracy: 0.2662 - val\_loss: 0.0030 - val\_accuracy: 0.3402  
Epoch 238/800

864/864 [=====] - 2s 3ms/step - loss: 8.2290e-04 -  
accuracy: 0.2546 - val\_loss: 0.0032 - val\_accuracy: 0.3299  
Epoch 239/800

864/864 [=====] - 2s 3ms/step - loss: 8.6151e-04 -  
accuracy: 0.2396 - val\_loss: 0.0029 - val\_accuracy: 0.2784  
Epoch 240/800

864/864 [=====] - 2s 3ms/step - loss: 8.6304e-04 -  
accuracy: 0.2454 - val\_loss: 0.0029 - val\_accuracy: 0.3196  
Epoch 241/800

864/864 [=====] - 3s 3ms/step - loss: 8.6011e-04 -  
accuracy: 0.2755 - val\_loss: 0.0030 - val\_accuracy: 0.2577  
Epoch 242/800

864/864 [=====] - 3s 3ms/step - loss: 8.1014e-04 -  
accuracy: 0.2627 - val\_loss: 0.0030 - val\_accuracy: 0.2680  
Epoch 243/800

864/864 [=====] - 3s 3ms/step - loss: 8.2561e-04 -  
accuracy: 0.2593 - val\_loss: 0.0027 - val\_accuracy: 0.2577  
Epoch 244/800

864/864 [=====] - 2s 3ms/step - loss: 7.8158e-04 -  
accuracy: 0.2882 - val\_loss: 0.0035 - val\_accuracy: 0.2268  
Epoch 245/800

864/864 [=====] - 2s 3ms/step - loss: 7.6924e-04 - accuracy: 0.2546 - val\_loss: 0.0029 - val\_accuracy: 0.3505  
Epoch 246/800  
864/864 [=====] - 2s 3ms/step - loss: 7.8329e-04 - accuracy: 0.2697 - val\_loss: 0.0033 - val\_accuracy: 0.2784  
Epoch 247/800  
864/864 [=====] - 2s 3ms/step - loss: 7.9679e-04 - accuracy: 0.2674 - val\_loss: 0.0034 - val\_accuracy: 0.3093  
Epoch 248/800  
864/864 [=====] - 2s 3ms/step - loss: 7.7207e-04 - accuracy: 0.2755 - val\_loss: 0.0030 - val\_accuracy: 0.3402  
Epoch 249/800  
864/864 [=====] - 2s 3ms/step - loss: 7.7947e-04 - accuracy: 0.2512 - val\_loss: 0.0034 - val\_accuracy: 0.3505  
Epoch 250/800  
864/864 [=====] - 2s 3ms/step - loss: 7.4722e-04 - accuracy: 0.2917 - val\_loss: 0.0032 - val\_accuracy: 0.2887  
Epoch 251/800  
864/864 [=====] - 3s 3ms/step - loss: 7.6212e-04 - accuracy: 0.2743 - val\_loss: 0.0033 - val\_accuracy: 0.3196  
Epoch 252/800  
864/864 [=====] - 3s 3ms/step - loss: 8.4834e-04 - accuracy: 0.2697 - val\_loss: 0.0036 - val\_accuracy: 0.3299  
Epoch 253/800  
864/864 [=====] - 2s 3ms/step - loss: 8.9709e-04 - accuracy: 0.2338 - val\_loss: 0.0025 - val\_accuracy: 0.3299  
Epoch 254/800  
864/864 [=====] - 2s 3ms/step - loss: 8.7469e-04 - accuracy: 0.2604 - val\_loss: 0.0038 - val\_accuracy: 0.2680  
Epoch 255/800  
864/864 [=====] - 3s 3ms/step - loss: 8.0000e-04 - accuracy: 0.2454 - val\_loss: 0.0028 - val\_accuracy: 0.2268  
Epoch 256/800  
864/864 [=====] - 3s 3ms/step - loss: 8.1304e-04 - accuracy: 0.2535 - val\_loss: 0.0030 - val\_accuracy: 0.2990  
Epoch 257/800  
864/864 [=====] - 2s 3ms/step - loss: 7.9657e-04 - accuracy: 0.2731 - val\_loss: 0.0029 - val\_accuracy: 0.2990  
Epoch 258/800  
864/864 [=====] - 2s 3ms/step - loss: 7.5629e-04 - accuracy: 0.2697 - val\_loss: 0.0033 - val\_accuracy: 0.3196  
Epoch 259/800  
864/864 [=====] - 2s 3ms/step - loss: 7.3828e-04 - accuracy: 0.2558 - val\_loss: 0.0032 - val\_accuracy: 0.2268  
Epoch 260/800  
864/864 [=====] - 2s 3ms/step - loss: 7.0237e-04 - accuracy: 0.2766 - val\_loss: 0.0034 - val\_accuracy: 0.2990  
Epoch 261/800

864/864 [=====] - 2s 3ms/step - loss: 9.0266e-04 -  
accuracy: 0.2569 - val\_loss: 0.0031 - val\_accuracy: 0.2474  
Epoch 262/800  
864/864 [=====] - 2s 3ms/step - loss: 9.7052e-04 -  
accuracy: 0.2859 - val\_loss: 0.0028 - val\_accuracy: 0.2784  
Epoch 263/800  
864/864 [=====] - 2s 3ms/step - loss: 8.8839e-04 -  
accuracy: 0.2604 - val\_loss: 0.0031 - val\_accuracy: 0.2784  
Epoch 264/800  
864/864 [=====] - 2s 3ms/step - loss: 7.6002e-04 -  
accuracy: 0.2755 - val\_loss: 0.0036 - val\_accuracy: 0.3402  
Epoch 265/800  
864/864 [=====] - 2s 3ms/step - loss: 7.3447e-04 -  
accuracy: 0.2894 - val\_loss: 0.0032 - val\_accuracy: 0.3299  
Epoch 266/800  
864/864 [=====] - 2s 3ms/step - loss: 7.1526e-04 -  
accuracy: 0.2535 - val\_loss: 0.0034 - val\_accuracy: 0.3402  
Epoch 267/800  
864/864 [=====] - 2s 3ms/step - loss: 6.9813e-04 -  
accuracy: 0.2778 - val\_loss: 0.0032 - val\_accuracy: 0.3196  
Epoch 268/800  
864/864 [=====] - 2s 3ms/step - loss: 7.2816e-04 -  
accuracy: 0.2650 - val\_loss: 0.0034 - val\_accuracy: 0.3093  
Epoch 269/800  
864/864 [=====] - 2s 3ms/step - loss: 7.0866e-04 -  
accuracy: 0.2778 - val\_loss: 0.0036 - val\_accuracy: 0.3402  
Epoch 270/800  
864/864 [=====] - 2s 3ms/step - loss: 6.9509e-04 -  
accuracy: 0.2836 - val\_loss: 0.0037 - val\_accuracy: 0.2474  
Epoch 271/800  
864/864 [=====] - 2s 3ms/step - loss: 6.8982e-04 -  
accuracy: 0.2766 - val\_loss: 0.0032 - val\_accuracy: 0.3505  
Epoch 272/800  
864/864 [=====] - 2s 3ms/step - loss: 7.1776e-04 -  
accuracy: 0.2697 - val\_loss: 0.0037 - val\_accuracy: 0.2680  
Epoch 273/800  
864/864 [=====] - 3s 3ms/step - loss: 7.4064e-04 -  
accuracy: 0.2650 - val\_loss: 0.0031 - val\_accuracy: 0.2577  
Epoch 274/800  
864/864 [=====] - 3s 3ms/step - loss: 7.2141e-04 -  
accuracy: 0.2836 - val\_loss: 0.0035 - val\_accuracy: 0.2680  
Epoch 275/800  
864/864 [=====] - 2s 3ms/step - loss: 7.7154e-04 -  
accuracy: 0.2616 - val\_loss: 0.0032 - val\_accuracy: 0.2165  
Epoch 276/800  
864/864 [=====] - 2s 3ms/step - loss: 7.6681e-04 -  
accuracy: 0.2639 - val\_loss: 0.0033 - val\_accuracy: 0.3196  
Epoch 277/800

864/864 [=====] - 4s 5ms/step - loss: 7.6642e-04 - accuracy: 0.2894 - val\_loss: 0.0032 - val\_accuracy: 0.3093  
Epoch 278/800  
864/864 [=====] - 3s 3ms/step - loss: 7.7358e-04 - accuracy: 0.2708 - val\_loss: 0.0030 - val\_accuracy: 0.3196  
Epoch 279/800  
864/864 [=====] - 2s 3ms/step - loss: 6.9462e-04 - accuracy: 0.2801 - val\_loss: 0.0035 - val\_accuracy: 0.2990  
Epoch 280/800  
864/864 [=====] - 2s 3ms/step - loss: 7.2977e-04 - accuracy: 0.2720 - val\_loss: 0.0036 - val\_accuracy: 0.2268  
Epoch 281/800  
864/864 [=====] - 2s 3ms/step - loss: 9.3227e-04 - accuracy: 0.2477 - val\_loss: 0.0034 - val\_accuracy: 0.2474  
Epoch 282/800  
864/864 [=====] - 2s 3ms/step - loss: 8.9619e-04 - accuracy: 0.2894 - val\_loss: 0.0034 - val\_accuracy: 0.2371  
Epoch 283/800  
864/864 [=====] - 3s 3ms/step - loss: 8.3995e-04 - accuracy: 0.2755 - val\_loss: 0.0027 - val\_accuracy: 0.2887  
Epoch 284/800  
864/864 [=====] - 2s 3ms/step - loss: 8.2801e-04 - accuracy: 0.2928 - val\_loss: 0.0024 - val\_accuracy: 0.2680  
Epoch 285/800  
864/864 [=====] - 2s 3ms/step - loss: 7.6229e-04 - accuracy: 0.2859 - val\_loss: 0.0032 - val\_accuracy: 0.2990  
Epoch 286/800  
864/864 [=====] - 2s 3ms/step - loss: 6.9833e-04 - accuracy: 0.2697 - val\_loss: 0.0031 - val\_accuracy: 0.2990  
Epoch 287/800  
864/864 [=====] - 2s 3ms/step - loss: 6.7640e-04 - accuracy: 0.2500 - val\_loss: 0.0030 - val\_accuracy: 0.3299  
Epoch 288/800  
864/864 [=====] - 2s 3ms/step - loss: 6.9276e-04 - accuracy: 0.2963 - val\_loss: 0.0030 - val\_accuracy: 0.2165  
Epoch 289/800  
864/864 [=====] - 2s 3ms/step - loss: 7.7630e-04 - accuracy: 0.2755 - val\_loss: 0.0027 - val\_accuracy: 0.2887  
Epoch 290/800  
864/864 [=====] - 3s 3ms/step - loss: 8.4498e-04 - accuracy: 0.2523 - val\_loss: 0.0031 - val\_accuracy: 0.2784  
Epoch 291/800  
864/864 [=====] - 3s 3ms/step - loss: 7.9946e-04 - accuracy: 0.2731 - val\_loss: 0.0033 - val\_accuracy: 0.2577  
Epoch 292/800  
864/864 [=====] - 3s 4ms/step - loss: 6.9294e-04 - accuracy: 0.2870 - val\_loss: 0.0031 - val\_accuracy: 0.2887  
Epoch 293/800

864/864 [=====] - 3s 3ms/step - loss: 7.0103e-04 -  
accuracy: 0.2847 - val\_loss: 0.0030 - val\_accuracy: 0.2784  
Epoch 294/800

864/864 [=====] - 3s 3ms/step - loss: 6.9339e-04 -  
accuracy: 0.2685 - val\_loss: 0.0040 - val\_accuracy: 0.2680  
Epoch 295/800

864/864 [=====] - 3s 3ms/step - loss: 7.1000e-04 -  
accuracy: 0.2685 - val\_loss: 0.0034 - val\_accuracy: 0.2474  
Epoch 296/800

864/864 [=====] - 3s 3ms/step - loss: 7.2282e-04 -  
accuracy: 0.2778 - val\_loss: 0.0031 - val\_accuracy: 0.3402  
Epoch 297/800

864/864 [=====] - 3s 3ms/step - loss: 6.7065e-04 -  
accuracy: 0.2755 - val\_loss: 0.0033 - val\_accuracy: 0.2990  
Epoch 298/800

864/864 [=====] - 3s 3ms/step - loss: 6.8986e-04 -  
accuracy: 0.2662 - val\_loss: 0.0029 - val\_accuracy: 0.3299  
Epoch 299/800

864/864 [=====] - 2s 3ms/step - loss: 6.5274e-04 -  
accuracy: 0.2789 - val\_loss: 0.0032 - val\_accuracy: 0.2474  
Epoch 300/800

864/864 [=====] - 2s 3ms/step - loss: 7.2300e-04 -  
accuracy: 0.2755 - val\_loss: 0.0033 - val\_accuracy: 0.1856  
Epoch 301/800

864/864 [=====] - 2s 3ms/step - loss: 6.6559e-04 -  
accuracy: 0.2743 - val\_loss: 0.0033 - val\_accuracy: 0.2577  
Epoch 302/800

864/864 [=====] - 3s 3ms/step - loss: 6.6679e-04 -  
accuracy: 0.2986 - val\_loss: 0.0035 - val\_accuracy: 0.2784  
Epoch 303/800

864/864 [=====] - 2s 3ms/step - loss: 7.2281e-04 -  
accuracy: 0.2512 - val\_loss: 0.0030 - val\_accuracy: 0.2268  
Epoch 304/800

864/864 [=====] - 2s 3ms/step - loss: 7.8784e-04 -  
accuracy: 0.2836 - val\_loss: 0.0030 - val\_accuracy: 0.2784  
Epoch 305/800

864/864 [=====] - 3s 3ms/step - loss: 0.0015 -  
accuracy: 0.2488 - val\_loss: 0.0025 - val\_accuracy: 0.3093  
Epoch 306/800

864/864 [=====] - 3s 3ms/step - loss: 0.0013 -  
accuracy: 0.2569 - val\_loss: 0.0021 - val\_accuracy: 0.3093  
Epoch 307/800

864/864 [=====] - 3s 3ms/step - loss: 8.8395e-04 -  
accuracy: 0.2720 - val\_loss: 0.0025 - val\_accuracy: 0.3093  
Epoch 308/800

864/864 [=====] - 3s 3ms/step - loss: 7.7154e-04 -  
accuracy: 0.2812 - val\_loss: 0.0030 - val\_accuracy: 0.3299  
Epoch 309/800



864/864 [=====] - 3s 3ms/step - loss: 7.0191e-04 -  
accuracy: 0.2847 - val\_loss: 0.0031 - val\_accuracy: 0.2474  
Epoch 310/800  
864/864 [=====] - 3s 3ms/step - loss: 7.1565e-04 -  
accuracy: 0.2812 - val\_loss: 0.0030 - val\_accuracy: 0.3402  
Epoch 311/800  
864/864 [=====] - 3s 3ms/step - loss: 6.8558e-04 -  
accuracy: 0.2882 - val\_loss: 0.0031 - val\_accuracy: 0.2784  
Epoch 312/800  
864/864 [=====] - 2s 3ms/step - loss: 6.4891e-04 -  
accuracy: 0.2882 - val\_loss: 0.0032 - val\_accuracy: 0.3093  
Epoch 313/800  
864/864 [=====] - 2s 3ms/step - loss: 6.4257e-04 -  
accuracy: 0.2650 - val\_loss: 0.0033 - val\_accuracy: 0.3505  
Epoch 314/800  
864/864 [=====] - 2s 3ms/step - loss: 6.5440e-04 -  
accuracy: 0.2824 - val\_loss: 0.0034 - val\_accuracy: 0.3402  
Epoch 315/800  
864/864 [=====] - 2s 3ms/step - loss: 6.6806e-04 -  
accuracy: 0.2859 - val\_loss: 0.0032 - val\_accuracy: 0.2990  
Epoch 316/800  
864/864 [=====] - 2s 3ms/step - loss: 6.7053e-04 -  
accuracy: 0.2685 - val\_loss: 0.0032 - val\_accuracy: 0.3299  
Epoch 317/800  
864/864 [=====] - 2s 3ms/step - loss: 6.3526e-04 -  
accuracy: 0.2766 - val\_loss: 0.0033 - val\_accuracy: 0.2474  
Epoch 318/800  
864/864 [=====] - 2s 3ms/step - loss: 6.4852e-04 -  
accuracy: 0.2951 - val\_loss: 0.0034 - val\_accuracy: 0.3299  
Epoch 319/800  
864/864 [=====] - 2s 3ms/step - loss: 6.6101e-04 -  
accuracy: 0.2650 - val\_loss: 0.0032 - val\_accuracy: 0.2887  
Epoch 320/800  
864/864 [=====] - 2s 3ms/step - loss: 6.6190e-04 -  
accuracy: 0.2824 - val\_loss: 0.0032 - val\_accuracy: 0.2474  
Epoch 321/800  
864/864 [=====] - 2s 3ms/step - loss: 6.7773e-04 -  
accuracy: 0.2778 - val\_loss: 0.0033 - val\_accuracy: 0.3196  
Epoch 322/800  
864/864 [=====] - 2s 3ms/step - loss: 6.4948e-04 -  
accuracy: 0.2708 - val\_loss: 0.0029 - val\_accuracy: 0.2887  
Epoch 323/800  
864/864 [=====] - 2s 3ms/step - loss: 6.3685e-04 -  
accuracy: 0.2685 - val\_loss: 0.0031 - val\_accuracy: 0.2577  
Epoch 324/800  
864/864 [=====] - 2s 3ms/step - loss: 6.2373e-04 -  
accuracy: 0.3032 - val\_loss: 0.0033 - val\_accuracy: 0.3093  
Epoch 325/800

864/864 [=====] - 2s 3ms/step - loss: 6.4448e-04 -  
accuracy: 0.2894 - val\_loss: 0.0030 - val\_accuracy: 0.3402  
Epoch 326/800  
864/864 [=====] - 2s 3ms/step - loss: 6.6057e-04 -  
accuracy: 0.2743 - val\_loss: 0.0034 - val\_accuracy: 0.3093  
Epoch 327/800  
864/864 [=====] - 2s 3ms/step - loss: 6.6801e-04 -  
accuracy: 0.2685 - val\_loss: 0.0030 - val\_accuracy: 0.3299  
Epoch 328/800  
864/864 [=====] - 2s 3ms/step - loss: 6.7283e-04 -  
accuracy: 0.2812 - val\_loss: 0.0028 - val\_accuracy: 0.2990  
Epoch 329/800  
864/864 [=====] - 3s 3ms/step - loss: 6.9200e-04 -  
accuracy: 0.2789 - val\_loss: 0.0030 - val\_accuracy: 0.2165  
Epoch 330/800  
864/864 [=====] - 3s 4ms/step - loss: 6.3513e-04 -  
accuracy: 0.2731 - val\_loss: 0.0033 - val\_accuracy: 0.2062  
Epoch 331/800  
864/864 [=====] - 2s 3ms/step - loss: 6.7794e-04 -  
accuracy: 0.2720 - val\_loss: 0.0029 - val\_accuracy: 0.2577  
Epoch 332/800  
864/864 [=====] - 2s 3ms/step - loss: 7.6520e-04 -  
accuracy: 0.2905 - val\_loss: 0.0030 - val\_accuracy: 0.2268  
Epoch 333/800  
864/864 [=====] - 2s 3ms/step - loss: 6.5718e-04 -  
accuracy: 0.2639 - val\_loss: 0.0033 - val\_accuracy: 0.3402  
Epoch 334/800  
864/864 [=====] - 2s 3ms/step - loss: 6.2015e-04 -  
accuracy: 0.2847 - val\_loss: 0.0033 - val\_accuracy: 0.2371  
Epoch 335/800  
864/864 [=====] - 3s 3ms/step - loss: 6.0720e-04 -  
accuracy: 0.2882 - val\_loss: 0.0033 - val\_accuracy: 0.2990  
Epoch 336/800  
864/864 [=====] - 3s 3ms/step - loss: 6.5680e-04 -  
accuracy: 0.2755 - val\_loss: 0.0031 - val\_accuracy: 0.2784  
Epoch 337/800  
864/864 [=====] - 3s 3ms/step - loss: 6.4309e-04 -  
accuracy: 0.2801 - val\_loss: 0.0029 - val\_accuracy: 0.2680  
Epoch 338/800  
864/864 [=====] - 3s 3ms/step - loss: 6.5283e-04 -  
accuracy: 0.2720 - val\_loss: 0.0030 - val\_accuracy: 0.2887  
Epoch 339/800  
864/864 [=====] - 3s 3ms/step - loss: 6.0114e-04 -  
accuracy: 0.2662 - val\_loss: 0.0030 - val\_accuracy: 0.2577  
Epoch 340/800  
864/864 [=====] - 2s 3ms/step - loss: 7.8362e-04 -  
accuracy: 0.2697 - val\_loss: 0.0051 - val\_accuracy: 0.2577  
Epoch 341/800

864/864 [=====] - 2s 3ms/step - loss: 0.0011 -  
accuracy: 0.2500 - val\_loss: 0.0028 - val\_accuracy: 0.2268  
Epoch 342/800  
864/864 [=====] - 2s 3ms/step - loss: 9.2489e-04 -  
accuracy: 0.2512 - val\_loss: 0.0027 - val\_accuracy: 0.1546  
Epoch 343/800  
864/864 [=====] - 2s 3ms/step - loss: 7.8011e-04 -  
accuracy: 0.2639 - val\_loss: 0.0031 - val\_accuracy: 0.2268  
Epoch 344/800  
864/864 [=====] - 3s 3ms/step - loss: 7.3043e-04 -  
accuracy: 0.2743 - val\_loss: 0.0028 - val\_accuracy: 0.2165  
Epoch 345/800  
864/864 [=====] - 2s 3ms/step - loss: 6.6131e-04 -  
accuracy: 0.2859 - val\_loss: 0.0033 - val\_accuracy: 0.2784  
Epoch 346/800  
864/864 [=====] - 2s 3ms/step - loss: 6.3565e-04 -  
accuracy: 0.2812 - val\_loss: 0.0032 - val\_accuracy: 0.2887  
Epoch 347/800  
864/864 [=====] - 2s 3ms/step - loss: 6.1887e-04 -  
accuracy: 0.2951 - val\_loss: 0.0033 - val\_accuracy: 0.2784  
Epoch 348/800  
864/864 [=====] - 2s 3ms/step - loss: 6.5540e-04 -  
accuracy: 0.2755 - val\_loss: 0.0031 - val\_accuracy: 0.3196  
Epoch 349/800  
864/864 [=====] - 3s 3ms/step - loss: 6.1370e-04 -  
accuracy: 0.2824 - val\_loss: 0.0033 - val\_accuracy: 0.2784  
Epoch 350/800  
864/864 [=====] - 2s 3ms/step - loss: 6.1015e-04 -  
accuracy: 0.2917 - val\_loss: 0.0034 - val\_accuracy: 0.3505  
Epoch 351/800  
864/864 [=====] - 3s 3ms/step - loss: 6.0792e-04 -  
accuracy: 0.2789 - val\_loss: 0.0032 - val\_accuracy: 0.2474  
Epoch 352/800  
864/864 [=====] - 3s 3ms/step - loss: 5.9545e-04 -  
accuracy: 0.2766 - val\_loss: 0.0032 - val\_accuracy: 0.2887  
Epoch 353/800  
864/864 [=====] - 3s 3ms/step - loss: 5.9852e-04 -  
accuracy: 0.2778 - val\_loss: 0.0034 - val\_accuracy: 0.2990  
Epoch 354/800  
864/864 [=====] - 3s 4ms/step - loss: 5.8650e-04 -  
accuracy: 0.2847 - val\_loss: 0.0030 - val\_accuracy: 0.2784  
Epoch 355/800  
864/864 [=====] - 4s 4ms/step - loss: 5.8695e-04 -  
accuracy: 0.2778 - val\_loss: 0.0031 - val\_accuracy: 0.3093  
Epoch 356/800  
864/864 [=====] - 3s 4ms/step - loss: 6.0901e-04 -  
accuracy: 0.2801 - val\_loss: 0.0031 - val\_accuracy: 0.1753  
Epoch 357/800

864/864 [=====] - 3s 3ms/step - loss: 7.3003e-04 -  
accuracy: 0.2523 - val\_loss: 0.0025 - val\_accuracy: 0.2268  
Epoch 358/800  
864/864 [=====] - 2s 3ms/step - loss: 6.3596e-04 -  
accuracy: 0.2731 - val\_loss: 0.0030 - val\_accuracy: 0.3093  
Epoch 359/800  
864/864 [=====] - 2s 3ms/step - loss: 6.1649e-04 -  
accuracy: 0.2674 - val\_loss: 0.0030 - val\_accuracy: 0.2784  
Epoch 360/800  
864/864 [=====] - 3s 3ms/step - loss: 6.0977e-04 -  
accuracy: 0.2998 - val\_loss: 0.0036 - val\_accuracy: 0.3608  
Epoch 361/800  
864/864 [=====] - 3s 3ms/step - loss: 6.1170e-04 -  
accuracy: 0.2801 - val\_loss: 0.0032 - val\_accuracy: 0.2165  
Epoch 362/800  
864/864 [=====] - 3s 3ms/step - loss: 6.2162e-04 -  
accuracy: 0.2801 - val\_loss: 0.0029 - val\_accuracy: 0.2990  
Epoch 363/800  
864/864 [=====] - 3s 3ms/step - loss: 5.7885e-04 -  
accuracy: 0.2859 - val\_loss: 0.0031 - val\_accuracy: 0.3093  
Epoch 364/800  
864/864 [=====] - 2s 3ms/step - loss: 6.0632e-04 -  
accuracy: 0.2766 - val\_loss: 0.0033 - val\_accuracy: 0.2990  
Epoch 365/800  
864/864 [=====] - 2s 3ms/step - loss: 6.0683e-04 -  
accuracy: 0.2859 - val\_loss: 0.0030 - val\_accuracy: 0.2990  
Epoch 366/800  
864/864 [=====] - 2s 3ms/step - loss: 6.4015e-04 -  
accuracy: 0.2870 - val\_loss: 0.0040 - val\_accuracy: 0.2371  
Epoch 367/800  
864/864 [=====] - 2s 3ms/step - loss: 7.4164e-04 -  
accuracy: 0.2847 - val\_loss: 0.0033 - val\_accuracy: 0.3093  
Epoch 368/800  
864/864 [=====] - 2s 3ms/step - loss: 8.2237e-04 -  
accuracy: 0.2743 - val\_loss: 0.0032 - val\_accuracy: 0.2887  
Epoch 369/800  
864/864 [=====] - 2s 3ms/step - loss: 6.7744e-04 -  
accuracy: 0.2674 - val\_loss: 0.0032 - val\_accuracy: 0.2990  
Epoch 370/800  
864/864 [=====] - 2s 3ms/step - loss: 6.2543e-04 -  
accuracy: 0.2766 - val\_loss: 0.0031 - val\_accuracy: 0.2990  
Epoch 371/800  
864/864 [=====] - 2s 3ms/step - loss: 6.2620e-04 -  
accuracy: 0.2824 - val\_loss: 0.0033 - val\_accuracy: 0.3093  
Epoch 372/800  
864/864 [=====] - 2s 3ms/step - loss: 5.9841e-04 -  
accuracy: 0.2824 - val\_loss: 0.0035 - val\_accuracy: 0.2474  
Epoch 373/800

864/864 [=====] - 3s 3ms/step - loss: 6.3867e-04 -  
accuracy: 0.2755 - val\_loss: 0.0034 - val\_accuracy: 0.2474  
Epoch 374/800

864/864 [=====] - 3s 3ms/step - loss: 5.9167e-04 -  
accuracy: 0.2801 - val\_loss: 0.0034 - val\_accuracy: 0.2784  
Epoch 375/800

864/864 [=====] - 2s 3ms/step - loss: 5.8128e-04 -  
accuracy: 0.2847 - val\_loss: 0.0033 - val\_accuracy: 0.2784  
Epoch 376/800

864/864 [=====] - 2s 3ms/step - loss: 5.8949e-04 -  
accuracy: 0.2593 - val\_loss: 0.0033 - val\_accuracy: 0.2990  
Epoch 377/800

864/864 [=====] - 2s 3ms/step - loss: 6.9887e-04 -  
accuracy: 0.2743 - val\_loss: 0.0036 - val\_accuracy: 0.3196  
Epoch 378/800

864/864 [=====] - 2s 3ms/step - loss: 9.1864e-04 -  
accuracy: 0.2593 - val\_loss: 0.0028 - val\_accuracy: 0.2784  
Epoch 379/800

864/864 [=====] - 2s 3ms/step - loss: 6.5849e-04 -  
accuracy: 0.2812 - val\_loss: 0.0030 - val\_accuracy: 0.2784  
Epoch 380/800

864/864 [=====] - 2s 3ms/step - loss: 6.0248e-04 -  
accuracy: 0.2604 - val\_loss: 0.0034 - val\_accuracy: 0.2990  
Epoch 381/800

864/864 [=====] - 3s 3ms/step - loss: 5.8092e-04 -  
accuracy: 0.2836 - val\_loss: 0.0033 - val\_accuracy: 0.2990  
Epoch 382/800

864/864 [=====] - 3s 3ms/step - loss: 5.7129e-04 -  
accuracy: 0.2928 - val\_loss: 0.0033 - val\_accuracy: 0.3093  
Epoch 383/800

864/864 [=====] - 3s 3ms/step - loss: 5.7003e-04 -  
accuracy: 0.2720 - val\_loss: 0.0034 - val\_accuracy: 0.3093  
Epoch 384/800

864/864 [=====] - 4s 4ms/step - loss: 6.0684e-04 -  
accuracy: 0.2789 - val\_loss: 0.0034 - val\_accuracy: 0.2474  
Epoch 385/800

864/864 [=====] - 3s 3ms/step - loss: 6.2431e-04 -  
accuracy: 0.2558 - val\_loss: 0.0036 - val\_accuracy: 0.3299  
Epoch 386/800

864/864 [=====] - 2s 3ms/step - loss: 6.9479e-04 -  
accuracy: 0.2905 - val\_loss: 0.0036 - val\_accuracy: 0.2165  
Epoch 387/800

864/864 [=====] - 2s 3ms/step - loss: 6.0901e-04 -  
accuracy: 0.2986 - val\_loss: 0.0033 - val\_accuracy: 0.2990  
Epoch 388/800

864/864 [=====] - 2s 3ms/step - loss: 5.7874e-04 -  
accuracy: 0.2708 - val\_loss: 0.0033 - val\_accuracy: 0.2680  
Epoch 389/800

864/864 [=====] - 2s 3ms/step - loss: 5.7724e-04 -  
accuracy: 0.2963 - val\_loss: 0.0032 - val\_accuracy: 0.2680  
Epoch 390/800  
864/864 [=====] - 3s 3ms/step - loss: 6.7145e-04 -  
accuracy: 0.2917 - val\_loss: 0.0027 - val\_accuracy: 0.2165  
Epoch 391/800  
864/864 [=====] - 3s 3ms/step - loss: 7.4311e-04 -  
accuracy: 0.2731 - val\_loss: 0.0044 - val\_accuracy: 0.2474  
Epoch 392/800  
864/864 [=====] - 3s 3ms/step - loss: 9.4822e-04 -  
accuracy: 0.2812 - val\_loss: 0.0031 - val\_accuracy: 0.2887  
Epoch 393/800  
864/864 [=====] - 2s 3ms/step - loss: 6.2901e-04 -  
accuracy: 0.2905 - val\_loss: 0.0032 - val\_accuracy: 0.2784  
Epoch 394/800  
864/864 [=====] - 3s 3ms/step - loss: 5.9385e-04 -  
accuracy: 0.2998 - val\_loss: 0.0031 - val\_accuracy: 0.2887  
Epoch 395/800  
864/864 [=====] - 2s 3ms/step - loss: 5.6821e-04 -  
accuracy: 0.2951 - val\_loss: 0.0030 - val\_accuracy: 0.3299  
Epoch 396/800  
864/864 [=====] - 2s 3ms/step - loss: 5.6364e-04 -  
accuracy: 0.2812 - val\_loss: 0.0033 - val\_accuracy: 0.3299  
Epoch 397/800  
864/864 [=====] - 3s 3ms/step - loss: 5.7238e-04 -  
accuracy: 0.2650 - val\_loss: 0.0034 - val\_accuracy: 0.2990  
Epoch 398/800  
864/864 [=====] - 2s 3ms/step - loss: 5.7043e-04 -  
accuracy: 0.2801 - val\_loss: 0.0032 - val\_accuracy: 0.2680  
Epoch 399/800  
864/864 [=====] - 2s 3ms/step - loss: 6.0252e-04 -  
accuracy: 0.2685 - val\_loss: 0.0032 - val\_accuracy: 0.2371  
Epoch 400/800  
864/864 [=====] - 3s 3ms/step - loss: 7.6429e-04 -  
accuracy: 0.2755 - val\_loss: 0.0029 - val\_accuracy: 0.2887  
Epoch 401/800  
864/864 [=====] - 3s 3ms/step - loss: 6.2534e-04 -  
accuracy: 0.2778 - val\_loss: 0.0032 - val\_accuracy: 0.2887  
Epoch 402/800  
864/864 [=====] - 3s 3ms/step - loss: 5.5664e-04 -  
accuracy: 0.2963 - val\_loss: 0.0031 - val\_accuracy: 0.3402  
Epoch 403/800  
864/864 [=====] - 3s 3ms/step - loss: 5.6343e-04 -  
accuracy: 0.2708 - val\_loss: 0.0033 - val\_accuracy: 0.2887  
Epoch 404/800  
864/864 [=====] - 3s 3ms/step - loss: 5.8454e-04 -  
accuracy: 0.2708 - val\_loss: 0.0033 - val\_accuracy: 0.2784  
Epoch 405/800

864/864 [=====] - 3s 4ms/step - loss: 5.5613e-04 -  
accuracy: 0.3032 - val\_loss: 0.0036 - val\_accuracy: 0.3093  
Epoch 406/800  
864/864 [=====] - 3s 3ms/step - loss: 5.6922e-04 -  
accuracy: 0.2731 - val\_loss: 0.0031 - val\_accuracy: 0.2680  
Epoch 407/800  
864/864 [=====] - 2s 3ms/step - loss: 5.7342e-04 -  
accuracy: 0.2951 - val\_loss: 0.0033 - val\_accuracy: 0.2784  
Epoch 408/800  
864/864 [=====] - 2s 3ms/step - loss: 5.4636e-04 -  
accuracy: 0.2870 - val\_loss: 0.0033 - val\_accuracy: 0.2577  
Epoch 409/800  
864/864 [=====] - 3s 3ms/step - loss: 5.8300e-04 -  
accuracy: 0.2951 - val\_loss: 0.0032 - val\_accuracy: 0.3402  
Epoch 410/800  
864/864 [=====] - 2s 3ms/step - loss: 6.2095e-04 -  
accuracy: 0.2755 - val\_loss: 0.0032 - val\_accuracy: 0.2887  
Epoch 411/800  
864/864 [=====] - 3s 3ms/step - loss: 5.9032e-04 -  
accuracy: 0.2940 - val\_loss: 0.0031 - val\_accuracy: 0.3299  
Epoch 412/800  
864/864 [=====] - 3s 3ms/step - loss: 5.4954e-04 -  
accuracy: 0.2847 - val\_loss: 0.0034 - val\_accuracy: 0.2577  
Epoch 413/800  
864/864 [=====] - 2s 3ms/step - loss: 5.6074e-04 -  
accuracy: 0.2870 - val\_loss: 0.0031 - val\_accuracy: 0.2680  
Epoch 414/800  
864/864 [=====] - 2s 3ms/step - loss: 5.7459e-04 -  
accuracy: 0.2766 - val\_loss: 0.0033 - val\_accuracy: 0.2784  
Epoch 415/800  
864/864 [=====] - 2s 3ms/step - loss: 5.8296e-04 -  
accuracy: 0.3009 - val\_loss: 0.0038 - val\_accuracy: 0.2887  
Epoch 416/800  
864/864 [=====] - 2s 3ms/step - loss: 5.8018e-04 -  
accuracy: 0.2766 - val\_loss: 0.0033 - val\_accuracy: 0.2577  
Epoch 417/800  
864/864 [=====] - 2s 3ms/step - loss: 5.5796e-04 -  
accuracy: 0.2917 - val\_loss: 0.0033 - val\_accuracy: 0.2680  
Epoch 418/800  
864/864 [=====] - 2s 3ms/step - loss: 5.6592e-04 -  
accuracy: 0.2778 - val\_loss: 0.0033 - val\_accuracy: 0.2784  
Epoch 419/800  
864/864 [=====] - 2s 3ms/step - loss: 7.6030e-04 -  
accuracy: 0.2512 - val\_loss: 0.0044 - val\_accuracy: 0.3505  
Epoch 420/800  
864/864 [=====] - 2s 3ms/step - loss: 8.5035e-04 -  
accuracy: 0.2674 - val\_loss: 0.0029 - val\_accuracy: 0.2887  
Epoch 421/800

864/864 [=====] - 2s 3ms/step - loss: 6.2083e-04 -  
accuracy: 0.2685 - val\_loss: 0.0032 - val\_accuracy: 0.2887  
Epoch 422/800

864/864 [=====] - 2s 3ms/step - loss: 0.0012 -  
accuracy: 0.2604 - val\_loss: 0.0023 - val\_accuracy: 0.3093  
Epoch 423/800

864/864 [=====] - 2s 3ms/step - loss: 7.7193e-04 -  
accuracy: 0.2708 - val\_loss: 0.0029 - val\_accuracy: 0.2371  
Epoch 424/800

864/864 [=====] - 2s 3ms/step - loss: 6.0576e-04 -  
accuracy: 0.2928 - val\_loss: 0.0029 - val\_accuracy: 0.2887  
Epoch 425/800

864/864 [=====] - 3s 3ms/step - loss: 5.7945e-04 -  
accuracy: 0.2894 - val\_loss: 0.0029 - val\_accuracy: 0.2990  
Epoch 426/800

864/864 [=====] - 2s 3ms/step - loss: 5.4691e-04 -  
accuracy: 0.2812 - val\_loss: 0.0031 - val\_accuracy: 0.2784  
Epoch 427/800

864/864 [=====] - 2s 3ms/step - loss: 5.4234e-04 -  
accuracy: 0.2847 - val\_loss: 0.0032 - val\_accuracy: 0.2680  
Epoch 428/800

864/864 [=====] - 3s 3ms/step - loss: 5.4950e-04 -  
accuracy: 0.2720 - val\_loss: 0.0031 - val\_accuracy: 0.2784  
Epoch 429/800

864/864 [=====] - 2s 3ms/step - loss: 5.8086e-04 -  
accuracy: 0.2963 - val\_loss: 0.0031 - val\_accuracy: 0.2680  
Epoch 430/800

864/864 [=====] - 3s 3ms/step - loss: 5.5390e-04 -  
accuracy: 0.2639 - val\_loss: 0.0031 - val\_accuracy: 0.2990  
Epoch 431/800

864/864 [=====] - 2s 3ms/step - loss: 5.7242e-04 -  
accuracy: 0.3021 - val\_loss: 0.0032 - val\_accuracy: 0.2990  
Epoch 432/800

864/864 [=====] - 2s 3ms/step - loss: 5.3488e-04 -  
accuracy: 0.2569 - val\_loss: 0.0032 - val\_accuracy: 0.3093  
Epoch 433/800

864/864 [=====] - 2s 3ms/step - loss: 5.3651e-04 -  
accuracy: 0.2928 - val\_loss: 0.0034 - val\_accuracy: 0.2887  
Epoch 434/800

864/864 [=====] - 2s 3ms/step - loss: 5.4506e-04 -  
accuracy: 0.2963 - val\_loss: 0.0034 - val\_accuracy: 0.2887  
Epoch 435/800

864/864 [=====] - 2s 3ms/step - loss: 5.7285e-04 -  
accuracy: 0.2870 - val\_loss: 0.0032 - val\_accuracy: 0.2990  
Epoch 436/800

864/864 [=====] - 2s 3ms/step - loss: 5.4056e-04 -  
accuracy: 0.2616 - val\_loss: 0.0030 - val\_accuracy: 0.2887  
Epoch 437/800



864/864 [=====] - 2s 3ms/step - loss: 5.5896e-04 -  
accuracy: 0.2697 - val\_loss: 0.0032 - val\_accuracy: 0.3093  
Epoch 438/800  
864/864 [=====] - 2s 3ms/step - loss: 5.3001e-04 -  
accuracy: 0.2824 - val\_loss: 0.0033 - val\_accuracy: 0.2784  
Epoch 439/800  
864/864 [=====] - 2s 3ms/step - loss: 5.6919e-04 -  
accuracy: 0.2812 - val\_loss: 0.0031 - val\_accuracy: 0.2887  
Epoch 440/800  
864/864 [=====] - 2s 3ms/step - loss: 5.4788e-04 -  
accuracy: 0.3067 - val\_loss: 0.0033 - val\_accuracy: 0.2784  
Epoch 441/800  
864/864 [=====] - 2s 3ms/step - loss: 5.2984e-04 -  
accuracy: 0.2836 - val\_loss: 0.0033 - val\_accuracy: 0.2680  
Epoch 442/800  
864/864 [=====] - 2s 3ms/step - loss: 5.4164e-04 -  
accuracy: 0.2639 - val\_loss: 0.0033 - val\_accuracy: 0.2784  
Epoch 443/800  
864/864 [=====] - 2s 3ms/step - loss: 5.3823e-04 -  
accuracy: 0.2998 - val\_loss: 0.0032 - val\_accuracy: 0.2990  
Epoch 444/800  
864/864 [=====] - 2s 3ms/step - loss: 5.5637e-04 -  
accuracy: 0.2685 - val\_loss: 0.0034 - val\_accuracy: 0.3093  
Epoch 445/800  
864/864 [=====] - 2s 3ms/step - loss: 5.5690e-04 -  
accuracy: 0.2894 - val\_loss: 0.0034 - val\_accuracy: 0.3093  
Epoch 446/800  
864/864 [=====] - 2s 3ms/step - loss: 5.6304e-04 -  
accuracy: 0.2789 - val\_loss: 0.0032 - val\_accuracy: 0.2887  
Epoch 447/800  
864/864 [=====] - 2s 3ms/step - loss: 5.3126e-04 -  
accuracy: 0.2812 - val\_loss: 0.0033 - val\_accuracy: 0.2784  
Epoch 448/800  
864/864 [=====] - 2s 3ms/step - loss: 5.2968e-04 -  
accuracy: 0.2917 - val\_loss: 0.0031 - val\_accuracy: 0.2990  
Epoch 449/800  
864/864 [=====] - 2s 3ms/step - loss: 5.2533e-04 -  
accuracy: 0.2870 - val\_loss: 0.0033 - val\_accuracy: 0.2680  
Epoch 450/800  
864/864 [=====] - 2s 3ms/step - loss: 5.4695e-04 -  
accuracy: 0.2546 - val\_loss: 0.0033 - val\_accuracy: 0.2784  
Epoch 451/800  
864/864 [=====] - 2s 3ms/step - loss: 5.7358e-04 -  
accuracy: 0.2963 - val\_loss: 0.0036 - val\_accuracy: 0.2887  
Epoch 452/800  
864/864 [=====] - 2s 3ms/step - loss: 6.7234e-04 -  
accuracy: 0.2558 - val\_loss: 0.0033 - val\_accuracy: 0.3402  
Epoch 453/800

864/864 [=====] - 2s 3ms/step - loss: 5.9633e-04 -  
accuracy: 0.2789 - val\_loss: 0.0031 - val\_accuracy: 0.2990  
Epoch 454/800

864/864 [=====] - 2s 3ms/step - loss: 9.2979e-04 -  
accuracy: 0.2951 - val\_loss: 0.0042 - val\_accuracy: 0.3299  
Epoch 455/800

864/864 [=====] - 2s 3ms/step - loss: 6.7592e-04 -  
accuracy: 0.2743 - val\_loss: 0.0031 - val\_accuracy: 0.2784  
Epoch 456/800

864/864 [=====] - 2s 3ms/step - loss: 5.6516e-04 -  
accuracy: 0.2731 - val\_loss: 0.0034 - val\_accuracy: 0.2784  
Epoch 457/800

864/864 [=====] - 2s 3ms/step - loss: 5.3211e-04 -  
accuracy: 0.2778 - val\_loss: 0.0033 - val\_accuracy: 0.2062  
Epoch 458/800

864/864 [=====] - 2s 3ms/step - loss: 5.3760e-04 -  
accuracy: 0.3090 - val\_loss: 0.0035 - val\_accuracy: 0.2268  
Epoch 459/800

864/864 [=====] - 2s 3ms/step - loss: 5.6077e-04 -  
accuracy: 0.2720 - val\_loss: 0.0033 - val\_accuracy: 0.3093  
Epoch 460/800

864/864 [=====] - 2s 3ms/step - loss: 5.0678e-04 -  
accuracy: 0.2975 - val\_loss: 0.0034 - val\_accuracy: 0.3093  
Epoch 461/800

864/864 [=====] - 2s 3ms/step - loss: 5.1640e-04 -  
accuracy: 0.2801 - val\_loss: 0.0034 - val\_accuracy: 0.2990  
Epoch 462/800

864/864 [=====] - 2s 3ms/step - loss: 5.2741e-04 -  
accuracy: 0.2778 - val\_loss: 0.0034 - val\_accuracy: 0.3196  
Epoch 463/800

864/864 [=====] - 2s 3ms/step - loss: 5.3316e-04 -  
accuracy: 0.2986 - val\_loss: 0.0033 - val\_accuracy: 0.2887  
Epoch 464/800

864/864 [=====] - 2s 3ms/step - loss: 5.2141e-04 -  
accuracy: 0.3021 - val\_loss: 0.0035 - val\_accuracy: 0.3093  
Epoch 465/800

864/864 [=====] - 2s 3ms/step - loss: 5.2551e-04 -  
accuracy: 0.2894 - val\_loss: 0.0037 - val\_accuracy: 0.2887  
Epoch 466/800

864/864 [=====] - 2s 3ms/step - loss: 5.3375e-04 -  
accuracy: 0.2894 - val\_loss: 0.0034 - val\_accuracy: 0.2784  
Epoch 467/800

864/864 [=====] - 2s 3ms/step - loss: 5.6735e-04 -  
accuracy: 0.3009 - val\_loss: 0.0032 - val\_accuracy: 0.3196  
Epoch 468/800

864/864 [=====] - 2s 3ms/step - loss: 5.1861e-04 -  
accuracy: 0.2859 - val\_loss: 0.0032 - val\_accuracy: 0.2990  
Epoch 469/800

864/864 [=====] - 2s 3ms/step - loss: 5.3050e-04 -  
accuracy: 0.3032 - val\_loss: 0.0034 - val\_accuracy: 0.2577  
Epoch 470/800  
864/864 [=====] - 2s 3ms/step - loss: 5.1252e-04 -  
accuracy: 0.2824 - val\_loss: 0.0033 - val\_accuracy: 0.2887  
Epoch 471/800  
864/864 [=====] - 2s 3ms/step - loss: 5.1480e-04 -  
accuracy: 0.2917 - val\_loss: 0.0033 - val\_accuracy: 0.2784  
Epoch 472/800  
864/864 [=====] - 2s 3ms/step - loss: 5.1150e-04 -  
accuracy: 0.2766 - val\_loss: 0.0035 - val\_accuracy: 0.3093  
Epoch 473/800  
864/864 [=====] - 2s 3ms/step - loss: 5.1965e-04 -  
accuracy: 0.2593 - val\_loss: 0.0033 - val\_accuracy: 0.2680  
Epoch 474/800  
864/864 [=====] - 2s 3ms/step - loss: 5.0907e-04 -  
accuracy: 0.2882 - val\_loss: 0.0034 - val\_accuracy: 0.2577  
Epoch 475/800  
864/864 [=====] - 2s 3ms/step - loss: 5.0727e-04 -  
accuracy: 0.2905 - val\_loss: 0.0032 - val\_accuracy: 0.2990  
Epoch 476/800  
864/864 [=====] - 2s 3ms/step - loss: 4.9903e-04 -  
accuracy: 0.2951 - val\_loss: 0.0034 - val\_accuracy: 0.3505  
Epoch 477/800  
864/864 [=====] - 2s 3ms/step - loss: 5.0764e-04 -  
accuracy: 0.3009 - val\_loss: 0.0034 - val\_accuracy: 0.2784  
Epoch 478/800  
864/864 [=====] - 2s 3ms/step - loss: 5.0838e-04 -  
accuracy: 0.3079 - val\_loss: 0.0035 - val\_accuracy: 0.2577  
Epoch 479/800  
864/864 [=====] - 2s 3ms/step - loss: 5.2361e-04 -  
accuracy: 0.2477 - val\_loss: 0.0034 - val\_accuracy: 0.2577  
Epoch 480/800  
864/864 [=====] - 2s 3ms/step - loss: 6.4488e-04 -  
accuracy: 0.2963 - val\_loss: 0.0035 - val\_accuracy: 0.2887  
Epoch 481/800  
864/864 [=====] - 2s 3ms/step - loss: 7.6932e-04 -  
accuracy: 0.2523 - val\_loss: 0.0037 - val\_accuracy: 0.2784  
Epoch 482/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0021 -  
accuracy: 0.2535 - val\_loss: 0.0078 - val\_accuracy: 0.3608  
Epoch 483/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0027 -  
accuracy: 0.2083 - val\_loss: 0.0028 - val\_accuracy: 0.2474  
Epoch 484/800  
864/864 [=====] - 2s 3ms/step - loss: 0.0012 -  
accuracy: 0.2280 - val\_loss: 0.0030 - val\_accuracy: 0.3093  
Epoch 485/800

864/864 [=====] - 2s 3ms/step - loss: 8.1927e-04 -  
accuracy: 0.2697 - val\_loss: 0.0028 - val\_accuracy: 0.2887  
Epoch 486/800

864/864 [=====] - 2s 3ms/step - loss: 6.4913e-04 -  
accuracy: 0.2512 - val\_loss: 0.0028 - val\_accuracy: 0.3093  
Epoch 487/800

864/864 [=====] - 3s 3ms/step - loss: 5.6950e-04 -  
accuracy: 0.2720 - val\_loss: 0.0032 - val\_accuracy: 0.3093  
Epoch 488/800

864/864 [=====] - 3s 3ms/step - loss: 5.4703e-04 -  
accuracy: 0.2870 - val\_loss: 0.0033 - val\_accuracy: 0.3299  
Epoch 489/800

864/864 [=====] - 3s 3ms/step - loss: 5.3056e-04 -  
accuracy: 0.2627 - val\_loss: 0.0032 - val\_accuracy: 0.3196  
Epoch 490/800

864/864 [=====] - 4s 4ms/step - loss: 5.4225e-04 -  
accuracy: 0.2801 - val\_loss: 0.0033 - val\_accuracy: 0.3196  
Epoch 491/800

864/864 [=====] - 2s 3ms/step - loss: 5.2734e-04 -  
accuracy: 0.2859 - val\_loss: 0.0032 - val\_accuracy: 0.2990  
Epoch 492/800

864/864 [=====] - 2s 3ms/step - loss: 5.1573e-04 -  
accuracy: 0.2812 - val\_loss: 0.0034 - val\_accuracy: 0.3093  
Epoch 493/800

864/864 [=====] - 2s 3ms/step - loss: 5.2277e-04 -  
accuracy: 0.2685 - val\_loss: 0.0032 - val\_accuracy: 0.2990  
Epoch 494/800

864/864 [=====] - 3s 3ms/step - loss: 5.1386e-04 -  
accuracy: 0.2986 - val\_loss: 0.0033 - val\_accuracy: 0.2990  
Epoch 495/800

864/864 [=====] - 3s 3ms/step - loss: 5.0416e-04 -  
accuracy: 0.2685 - val\_loss: 0.0034 - val\_accuracy: 0.2887  
Epoch 496/800

864/864 [=====] - 2s 3ms/step - loss: 4.9129e-04 -  
accuracy: 0.2917 - val\_loss: 0.0033 - val\_accuracy: 0.3196  
Epoch 497/800

864/864 [=====] - 2s 3ms/step - loss: 5.1278e-04 -  
accuracy: 0.2778 - val\_loss: 0.0032 - val\_accuracy: 0.2887  
Epoch 498/800

864/864 [=====] - 2s 3ms/step - loss: 5.1239e-04 -  
accuracy: 0.2685 - val\_loss: 0.0032 - val\_accuracy: 0.2887  
Epoch 499/800

864/864 [=====] - 2s 3ms/step - loss: 4.9323e-04 -  
accuracy: 0.2685 - val\_loss: 0.0034 - val\_accuracy: 0.3093  
Epoch 500/800

864/864 [=====] - 2s 3ms/step - loss: 5.1982e-04 -  
accuracy: 0.2975 - val\_loss: 0.0036 - val\_accuracy: 0.3093  
Epoch 501/800

864/864 [=====] - 3s 3ms/step - loss: 5.1167e-04 -  
accuracy: 0.3125 - val\_loss: 0.0033 - val\_accuracy: 0.3093  
Epoch 502/800  
864/864 [=====] - 2s 3ms/step - loss: 4.8696e-04 -  
accuracy: 0.2581 - val\_loss: 0.0034 - val\_accuracy: 0.3093  
Epoch 503/800  
864/864 [=====] - 3s 3ms/step - loss: 4.8783e-04 -  
accuracy: 0.2847 - val\_loss: 0.0034 - val\_accuracy: 0.3093  
Epoch 504/800  
864/864 [=====] - 2s 3ms/step - loss: 4.9872e-04 -  
accuracy: 0.2986 - val\_loss: 0.0034 - val\_accuracy: 0.2577  
Epoch 505/800  
864/864 [=====] - 3s 3ms/step - loss: 5.0440e-04 -  
accuracy: 0.2720 - val\_loss: 0.0035 - val\_accuracy: 0.3093  
Epoch 506/800  
864/864 [=====] - 2s 3ms/step - loss: 4.8086e-04 -  
accuracy: 0.2882 - val\_loss: 0.0034 - val\_accuracy: 0.3093  
Epoch 507/800  
864/864 [=====] - 2s 3ms/step - loss: 4.8212e-04 -  
accuracy: 0.2650 - val\_loss: 0.0034 - val\_accuracy: 0.3402  
Epoch 508/800  
864/864 [=====] - 3s 3ms/step - loss: 5.1087e-04 -  
accuracy: 0.2836 - val\_loss: 0.0033 - val\_accuracy: 0.2990  
Epoch 509/800  
864/864 [=====] - 3s 4ms/step - loss: 5.0652e-04 -  
accuracy: 0.2674 - val\_loss: 0.0035 - val\_accuracy: 0.2784  
Epoch 510/800  
864/864 [=====] - 3s 3ms/step - loss: 5.3666e-04 -  
accuracy: 0.2812 - val\_loss: 0.0034 - val\_accuracy: 0.2887  
Epoch 511/800  
864/864 [=====] - 2s 3ms/step - loss: 5.0538e-04 -  
accuracy: 0.2743 - val\_loss: 0.0037 - val\_accuracy: 0.2680  
Epoch 512/800  
864/864 [=====] - 2s 3ms/step - loss: 4.8198e-04 -  
accuracy: 0.2743 - val\_loss: 0.0036 - val\_accuracy: 0.2887  
Epoch 513/800  
864/864 [=====] - 2s 3ms/step - loss: 4.8860e-04 -  
accuracy: 0.2708 - val\_loss: 0.0035 - val\_accuracy: 0.3196  
Epoch 514/800  
864/864 [=====] - 2s 3ms/step - loss: 4.8892e-04 -  
accuracy: 0.2616 - val\_loss: 0.0033 - val\_accuracy: 0.2577  
Epoch 515/800  
864/864 [=====] - 2s 3ms/step - loss: 4.9997e-04 -  
accuracy: 0.3009 - val\_loss: 0.0033 - val\_accuracy: 0.2887  
Epoch 516/800  
864/864 [=====] - 2s 3ms/step - loss: 5.3224e-04 -  
accuracy: 0.2697 - val\_loss: 0.0035 - val\_accuracy: 0.3093  
Epoch 517/800

864/864 [=====] - 2s 3ms/step - loss: 5.3430e-04 -  
accuracy: 0.2743 - val\_loss: 0.0033 - val\_accuracy: 0.2680  
Epoch 518/800  
864/864 [=====] - 2s 3ms/step - loss: 5.1762e-04 -  
accuracy: 0.2755 - val\_loss: 0.0033 - val\_accuracy: 0.2990  
Epoch 519/800  
864/864 [=====] - 2s 3ms/step - loss: 4.9066e-04 -  
accuracy: 0.2917 - val\_loss: 0.0035 - val\_accuracy: 0.3402  
Epoch 520/800  
864/864 [=====] - 2s 3ms/step - loss: 4.8486e-04 -  
accuracy: 0.2731 - val\_loss: 0.0035 - val\_accuracy: 0.3093  
Epoch 521/800  
864/864 [=====] - 2s 3ms/step - loss: 4.9206e-04 -  
accuracy: 0.2975 - val\_loss: 0.0034 - val\_accuracy: 0.2680  
Epoch 522/800  
864/864 [=====] - 3s 3ms/step - loss: 4.9453e-04 -  
accuracy: 0.2650 - val\_loss: 0.0036 - val\_accuracy: 0.3196  
Epoch 523/800  
864/864 [=====] - 2s 3ms/step - loss: 4.9087e-04 -  
accuracy: 0.3009 - val\_loss: 0.0037 - val\_accuracy: 0.3196  
Epoch 524/800  
864/864 [=====] - 3s 3ms/step - loss: 5.0940e-04 -  
accuracy: 0.3009 - val\_loss: 0.0035 - val\_accuracy: 0.2990  
Epoch 525/800  
864/864 [=====] - 2s 3ms/step - loss: 4.9564e-04 -  
accuracy: 0.2940 - val\_loss: 0.0035 - val\_accuracy: 0.3093  
Epoch 526/800  
864/864 [=====] - 3s 3ms/step - loss: 4.7602e-04 -  
accuracy: 0.2639 - val\_loss: 0.0037 - val\_accuracy: 0.3093  
Epoch 527/800  
864/864 [=====] - 3s 3ms/step - loss: 4.9214e-04 -  
accuracy: 0.2940 - val\_loss: 0.0037 - val\_accuracy: 0.3093  
Epoch 528/800  
864/864 [=====] - 3s 3ms/step - loss: 4.7887e-04 -  
accuracy: 0.2743 - val\_loss: 0.0036 - val\_accuracy: 0.3196  
Epoch 529/800  
864/864 [=====] - 3s 3ms/step - loss: 4.9581e-04 -  
accuracy: 0.2894 - val\_loss: 0.0035 - val\_accuracy: 0.3093  
Epoch 530/800  
864/864 [=====] - 3s 3ms/step - loss: 5.1528e-04 -  
accuracy: 0.2859 - val\_loss: 0.0033 - val\_accuracy: 0.2577  
Epoch 531/800  
864/864 [=====] - 2s 3ms/step - loss: 6.2649e-04 -  
accuracy: 0.2720 - val\_loss: 0.0035 - val\_accuracy: 0.3093  
Epoch 532/800  
864/864 [=====] - 2s 3ms/step - loss: 5.0633e-04 -  
accuracy: 0.2951 - val\_loss: 0.0039 - val\_accuracy: 0.3093  
Epoch 533/800

864/864 [=====] - 2s 3ms/step - loss: 5.3624e-04 -  
accuracy: 0.2639 - val\_loss: 0.0038 - val\_accuracy: 0.3093  
Epoch 534/800  
864/864 [=====] - 2s 3ms/step - loss: 5.0965e-04 -  
accuracy: 0.2755 - val\_loss: 0.0040 - val\_accuracy: 0.3402  
Epoch 535/800  
864/864 [=====] - 2s 3ms/step - loss: 6.0022e-04 -  
accuracy: 0.2535 - val\_loss: 0.0037 - val\_accuracy: 0.3093  
Epoch 536/800  
864/864 [=====] - 3s 3ms/step - loss: 5.2652e-04 -  
accuracy: 0.2870 - val\_loss: 0.0037 - val\_accuracy: 0.2784  
Epoch 537/800  
864/864 [=====] - 2s 3ms/step - loss: 5.7325e-04 -  
accuracy: 0.2650 - val\_loss: 0.0036 - val\_accuracy: 0.3196  
Epoch 538/800  
864/864 [=====] - 2s 3ms/step - loss: 5.1529e-04 -  
accuracy: 0.2905 - val\_loss: 0.0036 - val\_accuracy: 0.2887  
Epoch 539/800  
864/864 [=====] - 2s 3ms/step - loss: 4.7959e-04 -  
accuracy: 0.2477 - val\_loss: 0.0035 - val\_accuracy: 0.2474  
Epoch 540/800  
864/864 [=====] - 3s 3ms/step - loss: 4.7354e-04 -  
accuracy: 0.2986 - val\_loss: 0.0034 - val\_accuracy: 0.2887  
Epoch 541/800  
864/864 [=====] - 3s 3ms/step - loss: 4.7564e-04 -  
accuracy: 0.2708 - val\_loss: 0.0037 - val\_accuracy: 0.3093  
Epoch 542/800  
864/864 [=====] - 2s 3ms/step - loss: 4.8089e-04 -  
accuracy: 0.2998 - val\_loss: 0.0037 - val\_accuracy: 0.2680  
Epoch 543/800  
864/864 [=====] - 2s 3ms/step - loss: 4.7990e-04 -  
accuracy: 0.2824 - val\_loss: 0.0034 - val\_accuracy: 0.2784  
Epoch 544/800  
864/864 [=====] - 2s 3ms/step - loss: 4.6289e-04 -  
accuracy: 0.3102 - val\_loss: 0.0036 - val\_accuracy: 0.3093  
Epoch 545/800  
864/864 [=====] - 2s 3ms/step - loss: 4.8358e-04 -  
accuracy: 0.2720 - val\_loss: 0.0036 - val\_accuracy: 0.3196  
Epoch 546/800  
864/864 [=====] - 2s 3ms/step - loss: 5.2747e-04 -  
accuracy: 0.2755 - val\_loss: 0.0035 - val\_accuracy: 0.3093  
Epoch 547/800  
864/864 [=====] - 2s 3ms/step - loss: 5.3839e-04 -  
accuracy: 0.2882 - val\_loss: 0.0038 - val\_accuracy: 0.2990  
Epoch 548/800  
864/864 [=====] - 2s 3ms/step - loss: 4.9070e-04 -  
accuracy: 0.2859 - val\_loss: 0.0037 - val\_accuracy: 0.3196  
Epoch 549/800

864/864 [=====] - 2s 3ms/step - loss: 4.6913e-04 -  
accuracy: 0.2812 - val\_loss: 0.0036 - val\_accuracy: 0.2990  
Epoch 550/800  
864/864 [=====] - 2s 3ms/step - loss: 4.6854e-04 -  
accuracy: 0.2940 - val\_loss: 0.0037 - val\_accuracy: 0.2990  
Epoch 551/800  
864/864 [=====] - 2s 3ms/step - loss: 4.6744e-04 -  
accuracy: 0.3032 - val\_loss: 0.0036 - val\_accuracy: 0.2990  
Epoch 552/800  
864/864 [=====] - 2s 3ms/step - loss: 4.8193e-04 -  
accuracy: 0.2859 - val\_loss: 0.0037 - val\_accuracy: 0.3093  
Epoch 553/800  
864/864 [=====] - 2s 3ms/step - loss: 7.7170e-04 -  
accuracy: 0.2708 - val\_loss: 0.0035 - val\_accuracy: 0.2371  
Epoch 554/800  
864/864 [=====] - 2s 3ms/step - loss: 7.8486e-04 -  
accuracy: 0.2789 - val\_loss: 0.0031 - val\_accuracy: 0.2577  
Epoch 555/800  
864/864 [=====] - 2s 3ms/step - loss: 6.2833e-04 -  
accuracy: 0.2674 - val\_loss: 0.0035 - val\_accuracy: 0.3608  
Epoch 556/800  
864/864 [=====] - 2s 3ms/step - loss: 5.5313e-04 -  
accuracy: 0.2593 - val\_loss: 0.0035 - val\_accuracy: 0.3608  
Epoch 557/800  
864/864 [=====] - 2s 3ms/step - loss: 4.7656e-04 -  
accuracy: 0.2847 - val\_loss: 0.0032 - val\_accuracy: 0.2784  
Epoch 558/800  
864/864 [=====] - 2s 3ms/step - loss: 4.6196e-04 -  
accuracy: 0.2662 - val\_loss: 0.0036 - val\_accuracy: 0.3093  
Epoch 559/800  
864/864 [=====] - 2s 3ms/step - loss: 4.6357e-04 -  
accuracy: 0.2928 - val\_loss: 0.0033 - val\_accuracy: 0.3093  
Epoch 560/800  
864/864 [=====] - 2s 3ms/step - loss: 4.7299e-04 -  
accuracy: 0.2789 - val\_loss: 0.0035 - val\_accuracy: 0.3093  
Epoch 561/800  
864/864 [=====] - 2s 3ms/step - loss: 4.6938e-04 -  
accuracy: 0.3009 - val\_loss: 0.0036 - val\_accuracy: 0.3196  
Epoch 562/800  
864/864 [=====] - 2s 3ms/step - loss: 4.7315e-04 -  
accuracy: 0.2905 - val\_loss: 0.0039 - val\_accuracy: 0.3196  
Epoch 563/800  
864/864 [=====] - 2s 3ms/step - loss: 5.0107e-04 -  
accuracy: 0.2755 - val\_loss: 0.0035 - val\_accuracy: 0.3093  
Epoch 564/800  
864/864 [=====] - 2s 3ms/step - loss: 4.5928e-04 -  
accuracy: 0.2882 - val\_loss: 0.0039 - val\_accuracy: 0.2887  
Epoch 565/800



864/864 [=====] - 3s 3ms/step - loss: 4.5514e-04 -  
accuracy: 0.2685 - val\_loss: 0.0036 - val\_accuracy: 0.2990  
Epoch 566/800  
864/864 [=====] - 2s 3ms/step - loss: 4.5384e-04 -  
accuracy: 0.3148 - val\_loss: 0.0035 - val\_accuracy: 0.3093  
Epoch 567/800  
864/864 [=====] - 3s 3ms/step - loss: 4.5518e-04 -  
accuracy: 0.2905 - val\_loss: 0.0036 - val\_accuracy: 0.2990  
Epoch 568/800  
864/864 [=====] - 2s 3ms/step - loss: 4.5466e-04 -  
accuracy: 0.2593 - val\_loss: 0.0035 - val\_accuracy: 0.2990  
Epoch 569/800  
864/864 [=====] - 3s 3ms/step - loss: 4.6443e-04 -  
accuracy: 0.2836 - val\_loss: 0.0038 - val\_accuracy: 0.2887  
Epoch 570/800  
864/864 [=====] - 3s 3ms/step - loss: 4.6805e-04 -  
accuracy: 0.2743 - val\_loss: 0.0038 - val\_accuracy: 0.2990  
Epoch 571/800  
864/864 [=====] - 2s 3ms/step - loss: 4.9146e-04 -  
accuracy: 0.2998 - val\_loss: 0.0036 - val\_accuracy: 0.2887  
Epoch 572/800  
864/864 [=====] - 2s 3ms/step - loss: 4.7735e-04 -  
accuracy: 0.3067 - val\_loss: 0.0036 - val\_accuracy: 0.2887  
Epoch 573/800  
864/864 [=====] - 3s 3ms/step - loss: 4.7686e-04 -  
accuracy: 0.2789 - val\_loss: 0.0036 - val\_accuracy: 0.3196  
Epoch 574/800  
864/864 [=====] - 2s 3ms/step - loss: 4.7355e-04 -  
accuracy: 0.2963 - val\_loss: 0.0035 - val\_accuracy: 0.2990  
Epoch 575/800  
864/864 [=====] - 2s 3ms/step - loss: 5.0679e-04 -  
accuracy: 0.2940 - val\_loss: 0.0036 - val\_accuracy: 0.2680  
Epoch 576/800  
864/864 [=====] - 3s 3ms/step - loss: 5.7619e-04 -  
accuracy: 0.2639 - val\_loss: 0.0038 - val\_accuracy: 0.2990  
Epoch 577/800  
864/864 [=====] - 2s 3ms/step - loss: 6.6769e-04 -  
accuracy: 0.2674 - val\_loss: 0.0035 - val\_accuracy: 0.3196  
Epoch 578/800  
864/864 [=====] - 3s 4ms/step - loss: 5.6374e-04 -  
accuracy: 0.2639 - val\_loss: 0.0033 - val\_accuracy: 0.2990  
Epoch 579/800  
864/864 [=====] - 3s 3ms/step - loss: 4.8180e-04 -  
accuracy: 0.2847 - val\_loss: 0.0036 - val\_accuracy: 0.3093  
Epoch 580/800  
864/864 [=====] - 2s 3ms/step - loss: 4.7345e-04 -  
accuracy: 0.2593 - val\_loss: 0.0035 - val\_accuracy: 0.2680  
Epoch 581/800

864/864 [=====] - 2s 3ms/step - loss: 4.5635e-04 -  
accuracy: 0.2882 - val\_loss: 0.0036 - val\_accuracy: 0.3093  
Epoch 582/800

864/864 [=====] - 3s 4ms/step - loss: 4.6314e-04 -  
accuracy: 0.2627 - val\_loss: 0.0039 - val\_accuracy: 0.3093  
Epoch 583/800

864/864 [=====] - 3s 3ms/step - loss: 4.6103e-04 -  
accuracy: 0.2940 - val\_loss: 0.0035 - val\_accuracy: 0.3196  
Epoch 584/800

864/864 [=====] - 2s 3ms/step - loss: 4.6912e-04 -  
accuracy: 0.2801 - val\_loss: 0.0035 - val\_accuracy: 0.2577  
Epoch 585/800

864/864 [=====] - 3s 3ms/step - loss: 4.8071e-04 -  
accuracy: 0.2963 - val\_loss: 0.0043 - val\_accuracy: 0.3299  
Epoch 586/800

864/864 [=====] - 2s 3ms/step - loss: 4.7994e-04 -  
accuracy: 0.2870 - val\_loss: 0.0036 - val\_accuracy: 0.2784  
Epoch 587/800

864/864 [=====] - 3s 3ms/step - loss: 4.7294e-04 -  
accuracy: 0.2928 - val\_loss: 0.0038 - val\_accuracy: 0.3196  
Epoch 588/800

864/864 [=====] - 2s 3ms/step - loss: 4.8410e-04 -  
accuracy: 0.2882 - val\_loss: 0.0037 - val\_accuracy: 0.2268  
Epoch 589/800

864/864 [=====] - 3s 3ms/step - loss: 4.6574e-04 -  
accuracy: 0.2870 - val\_loss: 0.0036 - val\_accuracy: 0.2990  
Epoch 590/800

864/864 [=====] - 2s 3ms/step - loss: 4.6298e-04 -  
accuracy: 0.2812 - val\_loss: 0.0039 - val\_accuracy: 0.3196  
Epoch 591/800

864/864 [=====] - 2s 3ms/step - loss: 4.9415e-04 -  
accuracy: 0.2986 - val\_loss: 0.0037 - val\_accuracy: 0.2990  
Epoch 592/800

864/864 [=====] - 2s 3ms/step - loss: 4.5568e-04 -  
accuracy: 0.2928 - val\_loss: 0.0036 - val\_accuracy: 0.2784  
Epoch 593/800

864/864 [=====] - 2s 3ms/step - loss: 4.8156e-04 -  
accuracy: 0.2986 - val\_loss: 0.0037 - val\_accuracy: 0.2680  
Epoch 594/800

864/864 [=====] - 2s 3ms/step - loss: 5.7316e-04 -  
accuracy: 0.2975 - val\_loss: 0.0033 - val\_accuracy: 0.2680  
Epoch 595/800

864/864 [=====] - 2s 3ms/step - loss: 5.0656e-04 -  
accuracy: 0.2963 - val\_loss: 0.0035 - val\_accuracy: 0.2784  
Epoch 596/800

864/864 [=====] - 2s 3ms/step - loss: 4.9483e-04 -  
accuracy: 0.2789 - val\_loss: 0.0039 - val\_accuracy: 0.2165  
Epoch 597/800

864/864 [=====] - 2s 3ms/step - loss: 4.9024e-04 -  
accuracy: 0.2766 - val\_loss: 0.0036 - val\_accuracy: 0.3093  
Epoch 598/800  
864/864 [=====] - 2s 3ms/step - loss: 4.7253e-04 -  
accuracy: 0.2674 - val\_loss: 0.0037 - val\_accuracy: 0.3196  
Epoch 599/800  
864/864 [=====] - 2s 3ms/step - loss: 4.6047e-04 -  
accuracy: 0.2986 - val\_loss: 0.0038 - val\_accuracy: 0.3196  
Epoch 600/800  
864/864 [=====] - 2s 3ms/step - loss: 4.9221e-04 -  
accuracy: 0.3067 - val\_loss: 0.0037 - val\_accuracy: 0.3093  
Epoch 601/800  
864/864 [=====] - 2s 3ms/step - loss: 4.5692e-04 -  
accuracy: 0.2870 - val\_loss: 0.0037 - val\_accuracy: 0.2990  
Epoch 602/800  
864/864 [=====] - 2s 3ms/step - loss: 4.5522e-04 -  
accuracy: 0.2951 - val\_loss: 0.0036 - val\_accuracy: 0.2577  
Epoch 603/800  
864/864 [=====] - 2s 3ms/step - loss: 4.7727e-04 -  
accuracy: 0.2789 - val\_loss: 0.0038 - val\_accuracy: 0.3093  
Epoch 604/800  
864/864 [=====] - 3s 3ms/step - loss: 5.1182e-04 -  
accuracy: 0.3079 - val\_loss: 0.0036 - val\_accuracy: 0.2990  
Epoch 605/800  
864/864 [=====] - 2s 3ms/step - loss: 4.6544e-04 -  
accuracy: 0.2917 - val\_loss: 0.0035 - val\_accuracy: 0.2990  
Epoch 606/800  
864/864 [=====] - 2s 3ms/step - loss: 4.4829e-04 -  
accuracy: 0.2836 - val\_loss: 0.0035 - val\_accuracy: 0.2990  
Epoch 607/800  
864/864 [=====] - 2s 3ms/step - loss: 4.4081e-04 -  
accuracy: 0.3009 - val\_loss: 0.0038 - val\_accuracy: 0.2577  
Epoch 608/800  
864/864 [=====] - 2s 3ms/step - loss: 4.4035e-04 -  
accuracy: 0.2847 - val\_loss: 0.0036 - val\_accuracy: 0.2990  
Epoch 609/800  
864/864 [=====] - 2s 3ms/step - loss: 4.4528e-04 -  
accuracy: 0.2766 - val\_loss: 0.0037 - val\_accuracy: 0.3196  
Epoch 610/800  
864/864 [=====] - 2s 3ms/step - loss: 4.5630e-04 -  
accuracy: 0.2859 - val\_loss: 0.0039 - val\_accuracy: 0.2887  
Epoch 611/800  
864/864 [=====] - 2s 3ms/step - loss: 4.4383e-04 -  
accuracy: 0.2986 - val\_loss: 0.0036 - val\_accuracy: 0.2990  
Epoch 612/800  
864/864 [=====] - 2s 3ms/step - loss: 4.4331e-04 -  
accuracy: 0.2616 - val\_loss: 0.0036 - val\_accuracy: 0.3196  
Epoch 613/800

864/864 [=====] - 2s 3ms/step - loss: 4.5045e-04 -  
accuracy: 0.2859 - val\_loss: 0.0035 - val\_accuracy: 0.2990  
Epoch 614/800

864/864 [=====] - 2s 3ms/step - loss: 5.5378e-04 -  
accuracy: 0.2975 - val\_loss: 0.0033 - val\_accuracy: 0.3196  
Epoch 615/800

864/864 [=====] - 3s 3ms/step - loss: 4.9361e-04 -  
accuracy: 0.2604 - val\_loss: 0.0037 - val\_accuracy: 0.2990  
Epoch 616/800

864/864 [=====] - 3s 3ms/step - loss: 4.5471e-04 -  
accuracy: 0.3102 - val\_loss: 0.0037 - val\_accuracy: 0.3093  
Epoch 617/800

864/864 [=====] - 2s 3ms/step - loss: 4.3559e-04 -  
accuracy: 0.2975 - val\_loss: 0.0037 - val\_accuracy: 0.3093  
Epoch 618/800

864/864 [=====] - 2s 3ms/step - loss: 4.4747e-04 -  
accuracy: 0.2998 - val\_loss: 0.0037 - val\_accuracy: 0.2990  
Epoch 619/800

864/864 [=====] - 3s 3ms/step - loss: 4.3420e-04 -  
accuracy: 0.2812 - val\_loss: 0.0038 - val\_accuracy: 0.3093  
Epoch 620/800

864/864 [=====] - 2s 3ms/step - loss: 4.6781e-04 -  
accuracy: 0.2963 - val\_loss: 0.0036 - val\_accuracy: 0.3093  
Epoch 621/800

864/864 [=====] - 2s 3ms/step - loss: 4.4505e-04 -  
accuracy: 0.2859 - val\_loss: 0.0040 - val\_accuracy: 0.3093  
Epoch 622/800

864/864 [=====] - 2s 3ms/step - loss: 4.5329e-04 -  
accuracy: 0.3032 - val\_loss: 0.0039 - val\_accuracy: 0.3299  
Epoch 623/800

864/864 [=====] - 2s 3ms/step - loss: 4.9429e-04 -  
accuracy: 0.2940 - val\_loss: 0.0037 - val\_accuracy: 0.2990  
Epoch 624/800

864/864 [=====] - 2s 3ms/step - loss: 4.7912e-04 -  
accuracy: 0.2975 - val\_loss: 0.0034 - val\_accuracy: 0.3093  
Epoch 625/800

864/864 [=====] - 2s 3ms/step - loss: 4.4023e-04 -  
accuracy: 0.2720 - val\_loss: 0.0036 - val\_accuracy: 0.2577  
Epoch 626/800

864/864 [=====] - 2s 3ms/step - loss: 4.3724e-04 -  
accuracy: 0.2986 - val\_loss: 0.0038 - val\_accuracy: 0.2784  
Epoch 627/800

864/864 [=====] - 2s 3ms/step - loss: 4.4473e-04 -  
accuracy: 0.2940 - val\_loss: 0.0035 - val\_accuracy: 0.2990  
Epoch 628/800

864/864 [=====] - 2s 3ms/step - loss: 4.5230e-04 -  
accuracy: 0.2951 - val\_loss: 0.0038 - val\_accuracy: 0.2474  
Epoch 629/800

864/864 [=====] - 2s 3ms/step - loss: 4.4404e-04 - accuracy: 0.2604 - val\_loss: 0.0035 - val\_accuracy: 0.2887  
Epoch 630/800  
864/864 [=====] - 2s 3ms/step - loss: 4.2625e-04 - accuracy: 0.2801 - val\_loss: 0.0035 - val\_accuracy: 0.2990  
Epoch 631/800  
864/864 [=====] - 2s 3ms/step - loss: 4.3100e-04 - accuracy: 0.3160 - val\_loss: 0.0038 - val\_accuracy: 0.2680  
Epoch 632/800  
864/864 [=====] - 3s 3ms/step - loss: 4.2980e-04 - accuracy: 0.2697 - val\_loss: 0.0037 - val\_accuracy: 0.2062  
Epoch 633/800  
864/864 [=====] - 3s 3ms/step - loss: 4.4058e-04 - accuracy: 0.2778 - val\_loss: 0.0036 - val\_accuracy: 0.3402  
Epoch 634/800  
864/864 [=====] - 3s 3ms/step - loss: 4.6227e-04 - accuracy: 0.2593 - val\_loss: 0.0039 - val\_accuracy: 0.2990  
Epoch 635/800  
864/864 [=====] - 3s 4ms/step - loss: 4.4897e-04 - accuracy: 0.2928 - val\_loss: 0.0038 - val\_accuracy: 0.3093  
Epoch 636/800  
864/864 [=====] - 3s 4ms/step - loss: 4.6994e-04 - accuracy: 0.3032 - val\_loss: 0.0038 - val\_accuracy: 0.2784  
Epoch 637/800  
864/864 [=====] - 3s 4ms/step - loss: 4.4430e-04 - accuracy: 0.3125 - val\_loss: 0.0037 - val\_accuracy: 0.3402  
Epoch 638/800  
864/864 [=====] - 3s 3ms/step - loss: 4.3081e-04 - accuracy: 0.2766 - val\_loss: 0.0039 - val\_accuracy: 0.2887  
Epoch 639/800  
864/864 [=====] - 3s 3ms/step - loss: 4.2438e-04 - accuracy: 0.2581 - val\_loss: 0.0037 - val\_accuracy: 0.2887  
Epoch 640/800  
864/864 [=====] - 3s 3ms/step - loss: 4.3874e-04 - accuracy: 0.2928 - val\_loss: 0.0037 - val\_accuracy: 0.2990  
Epoch 641/800  
864/864 [=====] - 3s 3ms/step - loss: 4.2261e-04 - accuracy: 0.2882 - val\_loss: 0.0039 - val\_accuracy: 0.2887  
Epoch 642/800  
864/864 [=====] - 3s 3ms/step - loss: 4.2411e-04 - accuracy: 0.2847 - val\_loss: 0.0038 - val\_accuracy: 0.2371  
Epoch 643/800  
864/864 [=====] - 3s 3ms/step - loss: 4.2410e-04 - accuracy: 0.2708 - val\_loss: 0.0036 - val\_accuracy: 0.2887  
Epoch 644/800  
864/864 [=====] - 3s 3ms/step - loss: 5.1976e-04 - accuracy: 0.2870 - val\_loss: 0.0038 - val\_accuracy: 0.2680  
Epoch 645/800

864/864 [=====] - 3s 3ms/step - loss: 4.9284e-04 -  
accuracy: 0.3113 - val\_loss: 0.0039 - val\_accuracy: 0.2990  
Epoch 646/800  
864/864 [=====] - 3s 3ms/step - loss: 4.3771e-04 -  
accuracy: 0.2882 - val\_loss: 0.0038 - val\_accuracy: 0.2990  
Epoch 647/800  
864/864 [=====] - 3s 3ms/step - loss: 4.4617e-04 -  
accuracy: 0.3194 - val\_loss: 0.0036 - val\_accuracy: 0.2371  
Epoch 648/800  
864/864 [=====] - 3s 3ms/step - loss: 4.2071e-04 -  
accuracy: 0.2940 - val\_loss: 0.0037 - val\_accuracy: 0.2887  
Epoch 649/800  
864/864 [=====] - 3s 3ms/step - loss: 5.2017e-04 -  
accuracy: 0.2917 - val\_loss: 0.0034 - val\_accuracy: 0.2990  
Epoch 650/800  
864/864 [=====] - 3s 3ms/step - loss: 4.3481e-04 -  
accuracy: 0.2639 - val\_loss: 0.0036 - val\_accuracy: 0.3196  
Epoch 651/800  
864/864 [=====] - 3s 3ms/step - loss: 4.2506e-04 -  
accuracy: 0.3021 - val\_loss: 0.0038 - val\_accuracy: 0.2474  
Epoch 652/800  
864/864 [=====] - 3s 3ms/step - loss: 4.4661e-04 -  
accuracy: 0.2870 - val\_loss: 0.0036 - val\_accuracy: 0.3196  
Epoch 653/800  
864/864 [=====] - 3s 4ms/step - loss: 4.9720e-04 -  
accuracy: 0.2963 - val\_loss: 0.0037 - val\_accuracy: 0.3093  
Epoch 654/800  
864/864 [=====] - 3s 4ms/step - loss: 4.9394e-04 -  
accuracy: 0.2882 - val\_loss: 0.0034 - val\_accuracy: 0.2887  
Epoch 655/800  
864/864 [=====] - 4s 4ms/step - loss: 4.8723e-04 -  
accuracy: 0.2650 - val\_loss: 0.0037 - val\_accuracy: 0.3093  
Epoch 656/800  
864/864 [=====] - 3s 3ms/step - loss: 4.3607e-04 -  
accuracy: 0.3079 - val\_loss: 0.0038 - val\_accuracy: 0.3093  
Epoch 657/800  
864/864 [=====] - 3s 3ms/step - loss: 4.3466e-04 -  
accuracy: 0.2905 - val\_loss: 0.0035 - val\_accuracy: 0.2887  
Epoch 658/800  
864/864 [=====] - 3s 3ms/step - loss: 4.1875e-04 -  
accuracy: 0.2870 - val\_loss: 0.0039 - val\_accuracy: 0.3093  
Epoch 659/800  
864/864 [=====] - 4s 5ms/step - loss: 4.1596e-04 -  
accuracy: 0.3113 - val\_loss: 0.0035 - val\_accuracy: 0.2887  
Epoch 660/800  
864/864 [=====] - 3s 3ms/step - loss: 4.2212e-04 -  
accuracy: 0.2697 - val\_loss: 0.0037 - val\_accuracy: 0.2062  
Epoch 661/800

864/864 [=====] - 2s 3ms/step - loss: 4.2727e-04 - accuracy: 0.3044 - val\_loss: 0.0040 - val\_accuracy: 0.2990  
Epoch 662/800  
864/864 [=====] - 2s 3ms/step - loss: 4.1491e-04 - accuracy: 0.2847 - val\_loss: 0.0038 - val\_accuracy: 0.2990  
Epoch 663/800  
864/864 [=====] - 2s 3ms/step - loss: 6.0653e-04 - accuracy: 0.2894 - val\_loss: 0.0048 - val\_accuracy: 0.2268  
Epoch 664/800  
864/864 [=====] - 2s 3ms/step - loss: 9.8719e-04 - accuracy: 0.2801 - val\_loss: 0.0032 - val\_accuracy: 0.3093  
Epoch 665/800  
864/864 [=====] - 2s 3ms/step - loss: 5.3990e-04 - accuracy: 0.2801 - val\_loss: 0.0036 - val\_accuracy: 0.2371  
Epoch 666/800  
864/864 [=====] - 2s 3ms/step - loss: 4.6940e-04 - accuracy: 0.2928 - val\_loss: 0.0036 - val\_accuracy: 0.2887  
Epoch 667/800  
864/864 [=====] - 2s 3ms/step - loss: 4.4019e-04 - accuracy: 0.2847 - val\_loss: 0.0040 - val\_accuracy: 0.2680  
Epoch 668/800  
864/864 [=====] - 2s 3ms/step - loss: 4.4406e-04 - accuracy: 0.2963 - val\_loss: 0.0036 - val\_accuracy: 0.3196  
Epoch 669/800  
864/864 [=====] - 2s 3ms/step - loss: 4.2016e-04 - accuracy: 0.2847 - val\_loss: 0.0037 - val\_accuracy: 0.2990  
Epoch 670/800  
864/864 [=====] - 2s 3ms/step - loss: 4.2103e-04 - accuracy: 0.2743 - val\_loss: 0.0036 - val\_accuracy: 0.2887  
Epoch 671/800  
864/864 [=====] - 2s 3ms/step - loss: 4.1375e-04 - accuracy: 0.3252 - val\_loss: 0.0036 - val\_accuracy: 0.2784  
Epoch 672/800  
864/864 [=====] - 2s 3ms/step - loss: 4.0469e-04 - accuracy: 0.3067 - val\_loss: 0.0037 - val\_accuracy: 0.2887  
Epoch 673/800  
864/864 [=====] - 2s 3ms/step - loss: 4.0949e-04 - accuracy: 0.2905 - val\_loss: 0.0036 - val\_accuracy: 0.2990  
Epoch 674/800  
864/864 [=====] - 2s 3ms/step - loss: 4.1411e-04 - accuracy: 0.2731 - val\_loss: 0.0033 - val\_accuracy: 0.3093  
Epoch 675/800  
864/864 [=====] - 2s 3ms/step - loss: 4.2367e-04 - accuracy: 0.2940 - val\_loss: 0.0034 - val\_accuracy: 0.2887  
Epoch 676/800  
864/864 [=====] - 2s 3ms/step - loss: 4.6034e-04 - accuracy: 0.3102 - val\_loss: 0.0036 - val\_accuracy: 0.3093  
Epoch 677/800

864/864 [=====] - 2s 3ms/step - loss: 4.2753e-04 - accuracy: 0.2986 - val\_loss: 0.0036 - val\_accuracy: 0.2990  
Epoch 678/800  
864/864 [=====] - 2s 3ms/step - loss: 4.1671e-04 - accuracy: 0.2755 - val\_loss: 0.0040 - val\_accuracy: 0.2165  
Epoch 679/800  
864/864 [=====] - 2s 3ms/step - loss: 4.2154e-04 - accuracy: 0.3148 - val\_loss: 0.0041 - val\_accuracy: 0.2268  
Epoch 680/800  
864/864 [=====] - 2s 3ms/step - loss: 4.0193e-04 - accuracy: 0.2743 - val\_loss: 0.0035 - val\_accuracy: 0.3093  
Epoch 681/800  
864/864 [=====] - 2s 3ms/step - loss: 4.0751e-04 - accuracy: 0.2894 - val\_loss: 0.0038 - val\_accuracy: 0.2990  
Epoch 682/800  
864/864 [=====] - 2s 3ms/step - loss: 4.0902e-04 - accuracy: 0.2870 - val\_loss: 0.0038 - val\_accuracy: 0.2990  
Epoch 683/800  
864/864 [=====] - 2s 3ms/step - loss: 3.9393e-04 - accuracy: 0.3102 - val\_loss: 0.0037 - val\_accuracy: 0.2165  
Epoch 684/800  
864/864 [=====] - 2s 3ms/step - loss: 4.0619e-04 - accuracy: 0.2928 - val\_loss: 0.0038 - val\_accuracy: 0.3093  
Epoch 685/800  
864/864 [=====] - 2s 3ms/step - loss: 3.9963e-04 - accuracy: 0.3079 - val\_loss: 0.0039 - val\_accuracy: 0.3093  
Epoch 686/800  
864/864 [=====] - 2s 3ms/step - loss: 4.0841e-04 - accuracy: 0.3090 - val\_loss: 0.0040 - val\_accuracy: 0.3402  
Epoch 687/800  
864/864 [=====] - 2s 3ms/step - loss: 3.8833e-04 - accuracy: 0.2928 - val\_loss: 0.0039 - val\_accuracy: 0.3093  
Epoch 688/800  
864/864 [=====] - 3s 3ms/step - loss: 3.9121e-04 - accuracy: 0.2882 - val\_loss: 0.0039 - val\_accuracy: 0.3196  
Epoch 689/800  
864/864 [=====] - 2s 3ms/step - loss: 3.9130e-04 - accuracy: 0.2998 - val\_loss: 0.0038 - val\_accuracy: 0.2577  
Epoch 690/800  
864/864 [=====] - 3s 3ms/step - loss: 4.1291e-04 - accuracy: 0.2836 - val\_loss: 0.0039 - val\_accuracy: 0.2165  
Epoch 691/800  
864/864 [=====] - 3s 3ms/step - loss: 3.9726e-04 - accuracy: 0.3032 - val\_loss: 0.0037 - val\_accuracy: 0.2474  
Epoch 692/800  
864/864 [=====] - 2s 3ms/step - loss: 4.0953e-04 - accuracy: 0.3056 - val\_loss: 0.0037 - val\_accuracy: 0.2165  
Epoch 693/800



864/864 [=====] - 2s 3ms/step - loss: 4.3948e-04 - accuracy: 0.3125 - val\_loss: 0.0038 - val\_accuracy: 0.2062  
Epoch 694/800  
864/864 [=====] - 2s 3ms/step - loss: 4.0589e-04 - accuracy: 0.3183 - val\_loss: 0.0039 - val\_accuracy: 0.3402  
Epoch 695/800  
864/864 [=====] - 2s 3ms/step - loss: 4.1748e-04 - accuracy: 0.2789 - val\_loss: 0.0039 - val\_accuracy: 0.3093  
Epoch 696/800  
864/864 [=====] - 2s 3ms/step - loss: 4.1606e-04 - accuracy: 0.2998 - val\_loss: 0.0035 - val\_accuracy: 0.2887  
Epoch 697/800  
864/864 [=====] - 2s 3ms/step - loss: 5.0774e-04 - accuracy: 0.2697 - val\_loss: 0.0040 - val\_accuracy: 0.2990  
Epoch 698/800  
864/864 [=====] - 2s 3ms/step - loss: 4.4166e-04 - accuracy: 0.2697 - val\_loss: 0.0035 - val\_accuracy: 0.3402  
Epoch 699/800  
864/864 [=====] - 3s 3ms/step - loss: 4.1213e-04 - accuracy: 0.2859 - val\_loss: 0.0040 - val\_accuracy: 0.2062  
Epoch 700/800  
864/864 [=====] - 2s 3ms/step - loss: 4.4022e-04 - accuracy: 0.3056 - val\_loss: 0.0038 - val\_accuracy: 0.2474  
Epoch 701/800  
864/864 [=====] - 2s 3ms/step - loss: 4.1587e-04 - accuracy: 0.3021 - val\_loss: 0.0039 - val\_accuracy: 0.2887  
Epoch 702/800  
864/864 [=====] - 2s 3ms/step - loss: 4.0036e-04 - accuracy: 0.2685 - val\_loss: 0.0038 - val\_accuracy: 0.3093  
Epoch 703/800  
864/864 [=====] - 2s 3ms/step - loss: 3.9709e-04 - accuracy: 0.2824 - val\_loss: 0.0038 - val\_accuracy: 0.2990  
Epoch 704/800  
864/864 [=====] - 2s 3ms/step - loss: 4.0159e-04 - accuracy: 0.3125 - val\_loss: 0.0036 - val\_accuracy: 0.2990  
Epoch 705/800  
864/864 [=====] - 2s 3ms/step - loss: 3.7832e-04 - accuracy: 0.2812 - val\_loss: 0.0039 - val\_accuracy: 0.3196  
Epoch 706/800  
864/864 [=====] - 2s 3ms/step - loss: 3.9265e-04 - accuracy: 0.2824 - val\_loss: 0.0036 - val\_accuracy: 0.2990  
Epoch 707/800  
864/864 [=====] - 2s 3ms/step - loss: 4.0002e-04 - accuracy: 0.3021 - val\_loss: 0.0038 - val\_accuracy: 0.2371  
Epoch 708/800  
864/864 [=====] - 2s 3ms/step - loss: 3.9017e-04 - accuracy: 0.2882 - val\_loss: 0.0039 - val\_accuracy: 0.2887  
Epoch 709/800

864/864 [=====] - 2s 3ms/step - loss: 4.1292e-04 - accuracy: 0.3090 - val\_loss: 0.0037 - val\_accuracy: 0.3093  
Epoch 710/800  
864/864 [=====] - 3s 3ms/step - loss: 4.5457e-04 - accuracy: 0.2847 - val\_loss: 0.0039 - val\_accuracy: 0.2680  
Epoch 711/800  
864/864 [=====] - 2s 3ms/step - loss: 5.2238e-04 - accuracy: 0.2917 - val\_loss: 0.0031 - val\_accuracy: 0.2268  
Epoch 712/800  
864/864 [=====] - 2s 3ms/step - loss: 4.1636e-04 - accuracy: 0.2859 - val\_loss: 0.0036 - val\_accuracy: 0.2990  
Epoch 713/800  
864/864 [=====] - 2s 3ms/step - loss: 3.8371e-04 - accuracy: 0.3044 - val\_loss: 0.0043 - val\_accuracy: 0.2990  
Epoch 714/800  
864/864 [=====] - 2s 3ms/step - loss: 4.2664e-04 - accuracy: 0.2905 - val\_loss: 0.0037 - val\_accuracy: 0.2577  
Epoch 715/800  
864/864 [=====] - 2s 3ms/step - loss: 6.4815e-04 - accuracy: 0.2975 - val\_loss: 0.0032 - val\_accuracy: 0.3196  
Epoch 716/800  
864/864 [=====] - 2s 3ms/step - loss: 5.3835e-04 - accuracy: 0.2755 - val\_loss: 0.0036 - val\_accuracy: 0.3196  
Epoch 717/800  
864/864 [=====] - 2s 3ms/step - loss: 4.0727e-04 - accuracy: 0.2755 - val\_loss: 0.0034 - val\_accuracy: 0.2268  
Epoch 718/800  
864/864 [=====] - 2s 3ms/step - loss: 4.1398e-04 - accuracy: 0.2836 - val\_loss: 0.0041 - val\_accuracy: 0.3299  
Epoch 719/800  
864/864 [=====] - 2s 3ms/step - loss: 4.4396e-04 - accuracy: 0.3137 - val\_loss: 0.0035 - val\_accuracy: 0.2165  
Epoch 720/800  
864/864 [=====] - 2s 3ms/step - loss: 4.7331e-04 - accuracy: 0.3067 - val\_loss: 0.0036 - val\_accuracy: 0.2887  
Epoch 721/800  
864/864 [=====] - 2s 3ms/step - loss: 3.9090e-04 - accuracy: 0.3056 - val\_loss: 0.0038 - val\_accuracy: 0.2680  
Epoch 722/800  
864/864 [=====] - 2s 3ms/step - loss: 3.8165e-04 - accuracy: 0.3380 - val\_loss: 0.0041 - val\_accuracy: 0.2990  
Epoch 723/800  
864/864 [=====] - 2s 3ms/step - loss: 3.7372e-04 - accuracy: 0.2674 - val\_loss: 0.0034 - val\_accuracy: 0.2577  
Epoch 724/800  
864/864 [=====] - 2s 3ms/step - loss: 3.7645e-04 - accuracy: 0.3252 - val\_loss: 0.0037 - val\_accuracy: 0.3299  
Epoch 725/800

864/864 [=====] - 2s 3ms/step - loss: 3.7543e-04 -  
accuracy: 0.3021 - val\_loss: 0.0035 - val\_accuracy: 0.2990  
Epoch 726/800  
864/864 [=====] - 2s 3ms/step - loss: 3.9643e-04 -  
accuracy: 0.2674 - val\_loss: 0.0039 - val\_accuracy: 0.3196  
Epoch 727/800  
864/864 [=====] - 2s 3ms/step - loss: 3.7572e-04 -  
accuracy: 0.2951 - val\_loss: 0.0038 - val\_accuracy: 0.2680  
Epoch 728/800  
864/864 [=====] - 2s 3ms/step - loss: 3.8348e-04 -  
accuracy: 0.3021 - val\_loss: 0.0038 - val\_accuracy: 0.2784  
Epoch 729/800  
864/864 [=====] - 2s 3ms/step - loss: 4.1241e-04 -  
accuracy: 0.2928 - val\_loss: 0.0036 - val\_accuracy: 0.2990  
Epoch 730/800  
864/864 [=====] - 2s 3ms/step - loss: 3.9848e-04 -  
accuracy: 0.3275 - val\_loss: 0.0040 - val\_accuracy: 0.2165  
Epoch 731/800  
864/864 [=====] - 2s 3ms/step - loss: 3.6542e-04 -  
accuracy: 0.3067 - val\_loss: 0.0039 - val\_accuracy: 0.2990  
Epoch 732/800  
864/864 [=====] - 3s 3ms/step - loss: 3.7188e-04 -  
accuracy: 0.3009 - val\_loss: 0.0038 - val\_accuracy: 0.2887  
Epoch 733/800  
864/864 [=====] - 2s 3ms/step - loss: 3.7070e-04 -  
accuracy: 0.2951 - val\_loss: 0.0039 - val\_accuracy: 0.2990  
Epoch 734/800  
864/864 [=====] - 3s 3ms/step - loss: 3.7179e-04 -  
accuracy: 0.3090 - val\_loss: 0.0038 - val\_accuracy: 0.2887  
Epoch 735/800  
864/864 [=====] - 2s 3ms/step - loss: 3.7562e-04 -  
accuracy: 0.2917 - val\_loss: 0.0037 - val\_accuracy: 0.2680  
Epoch 736/800  
864/864 [=====] - 2s 3ms/step - loss: 3.5154e-04 -  
accuracy: 0.3160 - val\_loss: 0.0036 - val\_accuracy: 0.2474  
Epoch 737/800  
864/864 [=====] - 2s 3ms/step - loss: 3.9382e-04 -  
accuracy: 0.2975 - val\_loss: 0.0037 - val\_accuracy: 0.2990  
Epoch 738/800  
864/864 [=====] - 2s 3ms/step - loss: 3.9332e-04 -  
accuracy: 0.3079 - val\_loss: 0.0037 - val\_accuracy: 0.3093  
Epoch 739/800  
864/864 [=====] - 2s 2ms/step - loss: 4.3378e-04 -  
accuracy: 0.2928 - val\_loss: 0.0034 - val\_accuracy: 0.2680  
Epoch 740/800  
864/864 [=====] - 2s 3ms/step - loss: 4.2357e-04 -  
accuracy: 0.3079 - val\_loss: 0.0039 - val\_accuracy: 0.2990  
Epoch 741/800

864/864 [=====] - 2s 3ms/step - loss: 3.7575e-04 - accuracy: 0.2836 - val\_loss: 0.0036 - val\_accuracy: 0.2784  
Epoch 742/800  
864/864 [=====] - 2s 3ms/step - loss: 3.5486e-04 - accuracy: 0.3148 - val\_loss: 0.0038 - val\_accuracy: 0.2990  
Epoch 743/800  
864/864 [=====] - 2s 3ms/step - loss: 3.4457e-04 - accuracy: 0.2975 - val\_loss: 0.0038 - val\_accuracy: 0.2887  
Epoch 744/800  
864/864 [=====] - 2s 3ms/step - loss: 3.4584e-04 - accuracy: 0.2963 - val\_loss: 0.0041 - val\_accuracy: 0.2990  
Epoch 745/800  
864/864 [=====] - 2s 3ms/step - loss: 3.5798e-04 - accuracy: 0.3160 - val\_loss: 0.0040 - val\_accuracy: 0.2990  
Epoch 746/800  
864/864 [=====] - 2s 3ms/step - loss: 3.8364e-04 - accuracy: 0.3067 - val\_loss: 0.0041 - val\_accuracy: 0.2887  
Epoch 747/800  
864/864 [=====] - 2s 3ms/step - loss: 3.5867e-04 - accuracy: 0.3090 - val\_loss: 0.0037 - val\_accuracy: 0.2887  
Epoch 748/800  
864/864 [=====] - 2s 3ms/step - loss: 3.8475e-04 - accuracy: 0.3090 - val\_loss: 0.0040 - val\_accuracy: 0.2887  
Epoch 749/800  
864/864 [=====] - 2s 3ms/step - loss: 3.7988e-04 - accuracy: 0.3044 - val\_loss: 0.0038 - val\_accuracy: 0.1959  
Epoch 750/800  
864/864 [=====] - 2s 3ms/step - loss: 3.6304e-04 - accuracy: 0.3241 - val\_loss: 0.0041 - val\_accuracy: 0.2887  
Epoch 751/800  
864/864 [=====] - 2s 3ms/step - loss: 3.4861e-04 - accuracy: 0.3113 - val\_loss: 0.0038 - val\_accuracy: 0.2887  
Epoch 752/800  
864/864 [=====] - 3s 3ms/step - loss: 3.3538e-04 - accuracy: 0.3056 - val\_loss: 0.0039 - val\_accuracy: 0.3093  
Epoch 753/800  
864/864 [=====] - 3s 3ms/step - loss: 3.7113e-04 - accuracy: 0.2917 - val\_loss: 0.0041 - val\_accuracy: 0.1856  
Epoch 754/800  
864/864 [=====] - 2s 3ms/step - loss: 3.7467e-04 - accuracy: 0.3194 - val\_loss: 0.0039 - val\_accuracy: 0.3093  
Epoch 755/800  
864/864 [=====] - 2s 3ms/step - loss: 3.8871e-04 - accuracy: 0.3160 - val\_loss: 0.0042 - val\_accuracy: 0.2165  
Epoch 756/800  
864/864 [=====] - 2s 3ms/step - loss: 3.7942e-04 - accuracy: 0.3044 - val\_loss: 0.0037 - val\_accuracy: 0.2990  
Epoch 757/800

864/864 [=====] - 2s 3ms/step - loss: 3.6150e-04 -  
accuracy: 0.2882 - val\_loss: 0.0042 - val\_accuracy: 0.2990  
Epoch 758/800  
864/864 [=====] - 2s 3ms/step - loss: 3.4705e-04 -  
accuracy: 0.2917 - val\_loss: 0.0041 - val\_accuracy: 0.2990  
Epoch 759/800  
864/864 [=====] - 3s 4ms/step - loss: 3.7312e-04 -  
accuracy: 0.3009 - val\_loss: 0.0042 - val\_accuracy: 0.2680  
Epoch 760/800  
864/864 [=====] - 2s 3ms/step - loss: 3.6283e-04 -  
accuracy: 0.2928 - val\_loss: 0.0037 - val\_accuracy: 0.2990  
Epoch 761/800  
864/864 [=====] - 2s 3ms/step - loss: 3.4973e-04 -  
accuracy: 0.3021 - val\_loss: 0.0040 - val\_accuracy: 0.2990  
Epoch 762/800  
864/864 [=====] - 3s 3ms/step - loss: 3.4726e-04 -  
accuracy: 0.3160 - val\_loss: 0.0038 - val\_accuracy: 0.3093  
Epoch 763/800  
864/864 [=====] - 2s 3ms/step - loss: 3.8368e-04 -  
accuracy: 0.2986 - val\_loss: 0.0038 - val\_accuracy: 0.2887  
Epoch 764/800  
864/864 [=====] - 3s 3ms/step - loss: 3.8056e-04 -  
accuracy: 0.3009 - val\_loss: 0.0041 - val\_accuracy: 0.2887  
Epoch 765/800  
864/864 [=====] - 3s 3ms/step - loss: 3.6019e-04 -  
accuracy: 0.3079 - val\_loss: 0.0038 - val\_accuracy: 0.1134  
Epoch 766/800  
864/864 [=====] - 3s 3ms/step - loss: 3.7213e-04 -  
accuracy: 0.2963 - val\_loss: 0.0035 - val\_accuracy: 0.2680  
Epoch 767/800  
864/864 [=====] - 2s 3ms/step - loss: 3.9116e-04 -  
accuracy: 0.3299 - val\_loss: 0.0037 - val\_accuracy: 0.2887  
Epoch 768/800  
864/864 [=====] - 2s 3ms/step - loss: 3.5498e-04 -  
accuracy: 0.2674 - val\_loss: 0.0038 - val\_accuracy: 0.2680  
Epoch 769/800  
864/864 [=====] - 2s 3ms/step - loss: 3.9321e-04 -  
accuracy: 0.2685 - val\_loss: 0.0037 - val\_accuracy: 0.1753  
Epoch 770/800  
864/864 [=====] - 2s 3ms/step - loss: 3.7549e-04 -  
accuracy: 0.2986 - val\_loss: 0.0037 - val\_accuracy: 0.2062  
Epoch 771/800  
864/864 [=====] - 2s 3ms/step - loss: 3.8627e-04 -  
accuracy: 0.2986 - val\_loss: 0.0039 - val\_accuracy: 0.2887  
Epoch 772/800  
864/864 [=====] - 3s 3ms/step - loss: 4.3300e-04 -  
accuracy: 0.2755 - val\_loss: 0.0042 - val\_accuracy: 0.1856  
Epoch 773/800

864/864 [=====] - 2s 3ms/step - loss: 4.4002e-04 -  
accuracy: 0.3125 - val\_loss: 0.0036 - val\_accuracy: 0.2990  
Epoch 774/800  
864/864 [=====] - 2s 3ms/step - loss: 3.6895e-04 -  
accuracy: 0.2951 - val\_loss: 0.0034 - val\_accuracy: 0.1753  
Epoch 775/800  
864/864 [=====] - 2s 3ms/step - loss: 3.4451e-04 -  
accuracy: 0.2824 - val\_loss: 0.0035 - val\_accuracy: 0.2784  
Epoch 776/800  
864/864 [=====] - 2s 3ms/step - loss: 3.3560e-04 -  
accuracy: 0.3241 - val\_loss: 0.0037 - val\_accuracy: 0.1546  
Epoch 777/800  
864/864 [=====] - 2s 3ms/step - loss: 3.3910e-04 -  
accuracy: 0.3009 - val\_loss: 0.0036 - val\_accuracy: 0.2990  
Epoch 778/800  
864/864 [=====] - 3s 3ms/step - loss: 3.6528e-04 -  
accuracy: 0.2859 - val\_loss: 0.0037 - val\_accuracy: 0.1959  
Epoch 779/800  
864/864 [=====] - 2s 3ms/step - loss: 3.4957e-04 -  
accuracy: 0.3252 - val\_loss: 0.0038 - val\_accuracy: 0.2165  
Epoch 780/800  
864/864 [=====] - 2s 3ms/step - loss: 3.5301e-04 -  
accuracy: 0.3044 - val\_loss: 0.0036 - val\_accuracy: 0.2887  
Epoch 781/800  
864/864 [=====] - 2s 3ms/step - loss: 3.7836e-04 -  
accuracy: 0.2928 - val\_loss: 0.0039 - val\_accuracy: 0.2784  
Epoch 782/800  
864/864 [=====] - 2s 3ms/step - loss: 3.5592e-04 -  
accuracy: 0.2801 - val\_loss: 0.0040 - val\_accuracy: 0.2680  
Epoch 783/800  
864/864 [=====] - 2s 3ms/step - loss: 3.5222e-04 -  
accuracy: 0.2940 - val\_loss: 0.0037 - val\_accuracy: 0.2062  
Epoch 784/800  
864/864 [=====] - 2s 3ms/step - loss: 4.1597e-04 -  
accuracy: 0.2928 - val\_loss: 0.0037 - val\_accuracy: 0.2784  
Epoch 785/800  
864/864 [=====] - 2s 3ms/step - loss: 4.1289e-04 -  
accuracy: 0.3090 - val\_loss: 0.0036 - val\_accuracy: 0.2784  
Epoch 786/800  
864/864 [=====] - 2s 3ms/step - loss: 4.0552e-04 -  
accuracy: 0.2975 - val\_loss: 0.0038 - val\_accuracy: 0.2680  
Epoch 787/800  
864/864 [=====] - 2s 3ms/step - loss: 3.5105e-04 -  
accuracy: 0.3275 - val\_loss: 0.0037 - val\_accuracy: 0.2887  
Epoch 788/800  
864/864 [=====] - 2s 3ms/step - loss: 3.3556e-04 -  
accuracy: 0.3079 - val\_loss: 0.0037 - val\_accuracy: 0.2165  
Epoch 789/800

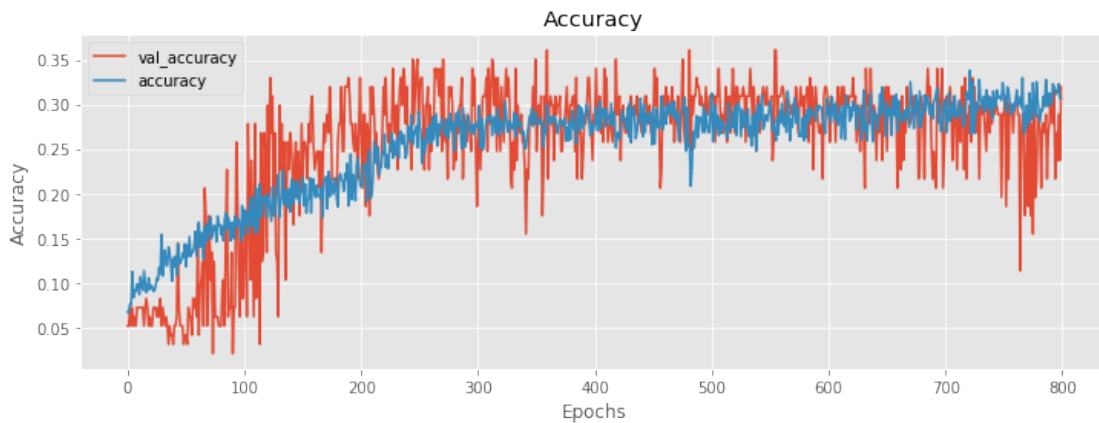
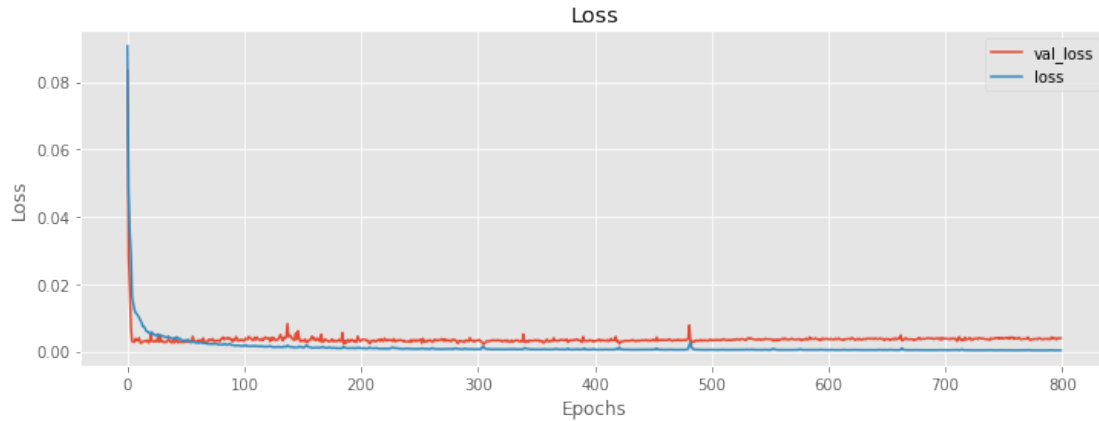
```

864/864 [=====] - 2s 3ms/step - loss: 3.3301e-04 -
accuracy: 0.2975 - val_loss: 0.0038 - val_accuracy: 0.2680
Epoch 790/800
864/864 [=====] - 2s 3ms/step - loss: 3.7840e-04 -
accuracy: 0.3125 - val_loss: 0.0036 - val_accuracy: 0.2784
Epoch 791/800
864/864 [=====] - 2s 3ms/step - loss: 3.8872e-04 -
accuracy: 0.3079 - val_loss: 0.0036 - val_accuracy: 0.3093
Epoch 792/800
864/864 [=====] - 2s 3ms/step - loss: 4.0456e-04 -
accuracy: 0.2998 - val_loss: 0.0042 - val_accuracy: 0.2990
Epoch 793/800
864/864 [=====] - 2s 3ms/step - loss: 3.7175e-04 -
accuracy: 0.3229 - val_loss: 0.0038 - val_accuracy: 0.2784
Epoch 794/800
864/864 [=====] - 2s 3ms/step - loss: 3.3592e-04 -
accuracy: 0.3194 - val_loss: 0.0040 - val_accuracy: 0.3196
Epoch 795/800
864/864 [=====] - 2s 3ms/step - loss: 3.2713e-04 -
accuracy: 0.3148 - val_loss: 0.0039 - val_accuracy: 0.2165
Epoch 796/800
864/864 [=====] - 2s 3ms/step - loss: 3.2316e-04 -
accuracy: 0.3113 - val_loss: 0.0035 - val_accuracy: 0.2680
Epoch 797/800
864/864 [=====] - 2s 3ms/step - loss: 3.2486e-04 -
accuracy: 0.3160 - val_loss: 0.0039 - val_accuracy: 0.2371
Epoch 798/800
864/864 [=====] - 2s 3ms/step - loss: 3.4808e-04 -
accuracy: 0.3229 - val_loss: 0.0039 - val_accuracy: 0.2887
Epoch 799/800
864/864 [=====] - 2s 3ms/step - loss: 3.6907e-04 -
accuracy: 0.3067 - val_loss: 0.0039 - val_accuracy: 0.2371
Epoch 800/800
864/864 [=====] - 2s 3ms/step - loss: 3.4088e-04 -
accuracy: 0.3067 - val_loss: 0.0039 - val_accuracy: 0.3196

```

### 1.2.3 Plotting the Accuracy and Loss

```
[65]: visualize_training_results(res)
```



## 1.3 Visualizing the Predictions

### 1.3.1 Validating the Model

Plotting the difference between the Actual closing prices and the Predicted prices

```
[83]: plt.figure(figsize=(12,5))

# Getting predictions by predicting from the last available X variable
yhat = model.predict(X[-1].reshape(1, n_per_in, n_features)).tolist()[0]

# Transforming values back to their normal prices
yhat = scaler.inverse_transform(np.array(yhat).reshape(-1,1)).tolist()

# Getting the actual values from the last available y variable which correspond
↳ to its respective X variable
actual = scaler.inverse_transform(y[-1].reshape(-1,1))
```



```

# Printing and plotting those predictions
print("Predicted Prices:\n", yhat)
plt.plot(yhat, label='Predicted')

# Printing and plotting the actual values
print("\nActual Prices:\n", actual.tolist())
plt.plot(actual.tolist(), label='Actual')

plt.title(f"Predicted vs Actual Closing Prices")
plt.ylabel("Price")
plt.legend()
plt.savefig("BTC_validation.png")
plt.show()

```

Predicted Prices:

```

[[7400.789307966416], [7241.380163940355], [7106.899924937646],
[7172.888593383611], [7127.823633456216], [7228.137184418529],
[7248.061391475402], [7264.6668333025145], [7504.581478017058],
[7683.578527556711]]

```

Actual Prices:

```

[[7397.796875], [7047.9169919999995], [7146.133789], [7218.371094],
[7531.663573999999], [7463.105956999999], [7761.243651999999], [7569.629883],
[7424.29248], [7321.988281]]

```



### 1.3.2 Predicting/Forecasting the future prices

```
[94]: # Predicting off of y because it contains the most recent dates
yhat = model.predict(np.array(df.tail(n_per_in)).reshape(1, n_per_in,
    ↪n_features)).tolist()[0]

# Transforming the predicted values back to their original prices
yhat = scaler.inverse_transform(np.array(yhat).reshape(-1,1)).tolist()

# Creating a DF of the predicted prices
preds = pd.DataFrame(yhat, index=pd.date_range(start=df.index[-1],
    ↪periods=len(yhat), freq="D"), columns=df.columns)

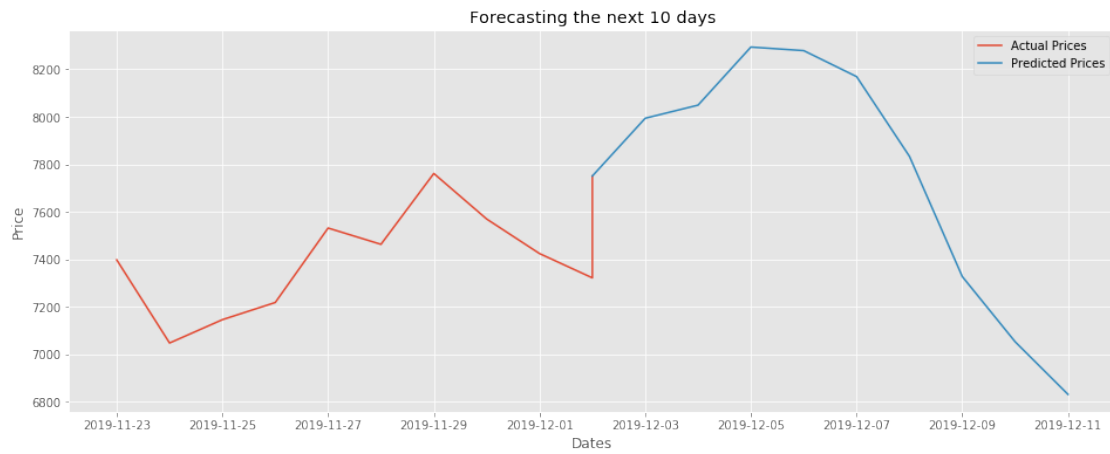
# Printing the predicted prices
print(preds)

# Number of periods back to visualize the actual values
pers = 10

# Transforming the actual values to their original price
actual = pd.DataFrame(scaler.inverse_transform(df[["Close"]].tail(pers)),
    ↪index=df.Close.tail(pers).index, columns=df.columns).append(preds.head(1))

# Plotting
plt.figure(figsize=(16,6))
plt.plot(actual, label="Actual Prices")
plt.plot(preds, label="Predicted Prices")
plt.ylabel("Price")
plt.xlabel("Dates")
plt.title(f"Forecasting the next {len(yhat)} days")
plt.legend()
plt.savefig("BTC_predictions.png")
plt.show()
```

	Close
2019-12-02	7750.527979
2019-12-03	7993.556731
2019-12-04	8048.777666
2019-12-05	8293.133372
2019-12-06	8278.055115
2019-12-07	8168.779239
2019-12-08	7833.326193
2019-12-09	7327.463403
2019-12-10	7053.108825
2019-12-11	6831.816325



[ ]: