gru-training

November 24, 2024

[2]:
```
import os
import numpy as np
import cv2
import mediapipe as mp
import matplotlib.pyplot as plt
import torch
import torch.nn as nn
import torch.optim as optim
from sklearn.model_selection import train_test_split
from sklearn.preprocessing import LabelEncoder
from sklearn.metrics import accuracy_score, classification_report
import seaborn as sns
import pandas as pd
```

[19]:
```
x = np.load('pose_landmarks_dataset.npy')
y = np.load('pose_landmarks_labels.npy')
```

[29]:
```
x_train, x_val, y_train, y_val = train_test_split(x, y, test_size=0.2,␣
↪random_state=42)
```

[30]:
```
label_encoder = LabelEncoder()
y_train_encoded = label_encoder.fit_transform(y_train)
y_val_encoded = label_encoder.transform(y_val)
```

[ ]:
```
from keras.models import Sequential
from keras.layers import LSTM, Dropout, Dense, TimeDistributed
from keras.optimizers import Adam

num_classes = len(np.unique(y_train_encoded))
```

[35]:
```
from tensorflow.keras.layers import GRU

model_gru = Sequential()
model_gru.add(GRU(128, return_sequences=True, input_shape=(x_train.shape[1],␣
↪x_train.shape[2])))
model_gru.add(Dropout(0.4))
model_gru.add(GRU(128, return_sequences=True))
```

```
model_gru.add(Dropout(0.4))
model_gru.add(GRU(64, return_sequences=True))
model_gru.add(Dropout(0.4))
model_gru.add(TimeDistributed(Dense(64, activation='relu')))
model_gru.add(Dropout(0.4))
model_gru.add(GRU(32))
model_gru.add(Dropout(0.4))
model_gru.add(Dense(num_classes, activation='softmax'))
```

```
/opt/conda/lib/python3.10/site-packages/keras/src/layers/rnn/rnn.py:204:
UserWarning: Do not pass an `input_shape`/`input_dim` argument to a layer. When
using Sequential models, prefer using an `Input(shape)` object as the first
layer in the model instead.
  super().__init__(**kwargs)
```

[42]:
```
optimizer_gru = Adam(learning_rate=0.001)

model_gru.compile(optimizer=optimizer_gru,␣
 ↪loss='sparse_categorical_crossentropy', metrics=['accuracy'])
```

[44]:
```
# Train the GRU model
history_gru = model_gru.fit(x_train, y_train_encoded,
                            validation_data=(x_val, y_val_encoded),
                            epochs=600, batch_size=32)

loss_gru, gru_val_accuracy = model_gru.evaluate(x_val, y_val_encoded, verbose=0)
print(f'GRU Model Validation Accuracy: {gru_val_accuracy:.4f}')
```

```
Epoch 1/600
150/150             16s 108ms/step -
accuracy: 0.3005 - loss: 1.7514 - val_accuracy: 0.3144 - val_loss: 1.6862
Epoch 2/600
150/150             16s 104ms/step -
accuracy: 0.3077 - loss: 1.7308 - val_accuracy: 0.3228 - val_loss: 1.6661
Epoch 3/600
150/150             16s 108ms/step -
accuracy: 0.3281 - loss: 1.6786 - val_accuracy: 0.3428 - val_loss: 1.6266
Epoch 4/600
150/150             15s 102ms/step -
accuracy: 0.3278 - loss: 1.6817 - val_accuracy: 0.3586 - val_loss: 1.6058
Epoch 5/600
150/150             16s 106ms/step -
accuracy: 0.3370 - loss: 1.6249 - val_accuracy: 0.3511 - val_loss: 1.5639
Epoch 6/600
150/150             15s 103ms/step -
accuracy: 0.3410 - loss: 1.6236 - val_accuracy: 0.3620 - val_loss: 1.5261
Epoch 7/600
```

```
150/150            16s 105ms/step -
accuracy: 0.3431 - loss: 1.5828 - val_accuracy: 0.3636 - val_loss: 1.4686
Epoch 8/600
150/150            16s 104ms/step -
accuracy: 0.3731 - loss: 1.5027 - val_accuracy: 0.4245 - val_loss: 1.3011
Epoch 9/600
150/150            16s 105ms/step -
accuracy: 0.3963 - loss: 1.4075 - val_accuracy: 0.4320 - val_loss: 1.2362
Epoch 10/600
150/150            15s 102ms/step -
accuracy: 0.4377 - loss: 1.2829 - val_accuracy: 0.4362 - val_loss: 1.2877
Epoch 11/600
150/150            16s 105ms/step -
accuracy: 0.4343 - loss: 1.2908 - val_accuracy: 0.4329 - val_loss: 1.2299
Epoch 12/600
150/150            15s 103ms/step -
accuracy: 0.4264 - loss: 1.2691 - val_accuracy: 0.4445 - val_loss: 1.2058
Epoch 13/600
150/150            16s 105ms/step -
accuracy: 0.4623 - loss: 1.2078 - val_accuracy: 0.4012 - val_loss: 1.3286
Epoch 14/600
150/150            16s 104ms/step -
accuracy: 0.4470 - loss: 1.2326 - val_accuracy: 0.4779 - val_loss: 1.1258
Epoch 15/600
150/150            16s 106ms/step -
accuracy: 0.4681 - loss: 1.1746 - val_accuracy: 0.4854 - val_loss: 1.1044
Epoch 16/600
150/150            16s 103ms/step -
accuracy: 0.4816 - loss: 1.1318 - val_accuracy: 0.4837 - val_loss: 1.1188
Epoch 17/600
150/150            16s 106ms/step -
accuracy: 0.4813 - loss: 1.1441 - val_accuracy: 0.4746 - val_loss: 1.2061
Epoch 18/600
150/150            15s 103ms/step -
accuracy: 0.4862 - loss: 1.1785 - val_accuracy: 0.4971 - val_loss: 1.0984
Epoch 19/600
150/150            21s 106ms/step -
accuracy: 0.4998 - loss: 1.1286 - val_accuracy: 0.5113 - val_loss: 1.0735
Epoch 20/600
150/150            15s 103ms/step -
accuracy: 0.5128 - loss: 1.1226 - val_accuracy: 0.5271 - val_loss: 1.0366
Epoch 21/600
150/150            16s 106ms/step -
accuracy: 0.5163 - loss: 1.0963 - val_accuracy: 0.5371 - val_loss: 1.0321
Epoch 22/600
150/150            16s 103ms/step -
accuracy: 0.5128 - loss: 1.1105 - val_accuracy: 0.5021 - val_loss: 1.0718
Epoch 23/600
```

```
150/150            16s 105ms/step -
accuracy: 0.5072 - loss: 1.0959 - val_accuracy: 0.5204 - val_loss: 1.0393
Epoch 24/600
150/150            15s 103ms/step -
accuracy: 0.5176 - loss: 1.0633 - val_accuracy: 0.5354 - val_loss: 1.0133
Epoch 25/600
150/150            16s 105ms/step -
accuracy: 0.5274 - loss: 1.0608 - val_accuracy: 0.5405 - val_loss: 1.0116
Epoch 26/600
150/150            15s 103ms/step -
accuracy: 0.5332 - loss: 1.0607 - val_accuracy: 0.5413 - val_loss: 1.0046
Epoch 27/600
150/150            16s 105ms/step -
accuracy: 0.5278 - loss: 1.0470 - val_accuracy: 0.4979 - val_loss: 1.1981
Epoch 28/600
150/150            15s 103ms/step -
accuracy: 0.5219 - loss: 1.0606 - val_accuracy: 0.5521 - val_loss: 0.9705
Epoch 29/600
150/150            21s 106ms/step -
accuracy: 0.5508 - loss: 1.0203 - val_accuracy: 0.5113 - val_loss: 1.0653
Epoch 30/600
150/150            20s 104ms/step -
accuracy: 0.5338 - loss: 1.0452 - val_accuracy: 0.5630 - val_loss: 0.9668
Epoch 31/600
150/150            16s 107ms/step -
accuracy: 0.5385 - loss: 1.0476 - val_accuracy: 0.5655 - val_loss: 0.9555
Epoch 32/600
150/150            16s 104ms/step -
accuracy: 0.5563 - loss: 1.0089 - val_accuracy: 0.5546 - val_loss: 0.9505
Epoch 33/600
150/150            16s 106ms/step -
accuracy: 0.5487 - loss: 1.0233 - val_accuracy: 0.5680 - val_loss: 0.9447
Epoch 34/600
150/150            16s 104ms/step -
accuracy: 0.5486 - loss: 1.0254 - val_accuracy: 0.5905 - val_loss: 0.9316
Epoch 35/600
150/150            16s 105ms/step -
accuracy: 0.5573 - loss: 1.0287 - val_accuracy: 0.5288 - val_loss: 1.0476
Epoch 36/600
150/150            20s 102ms/step -
accuracy: 0.5383 - loss: 1.0251 - val_accuracy: 0.5488 - val_loss: 0.9861
Epoch 37/600
150/150            21s 104ms/step -
accuracy: 0.5641 - loss: 0.9901 - val_accuracy: 0.5496 - val_loss: 1.0075
Epoch 38/600
150/150            16s 104ms/step -
accuracy: 0.5460 - loss: 0.9972 - val_accuracy: 0.5780 - val_loss: 0.9252
Epoch 39/600
```

```
150/150            16s 105ms/step -
accuracy: 0.5582 - loss: 0.9941 - val_accuracy: 0.5671 - val_loss: 0.9414
Epoch 40/600
150/150            15s 103ms/step -
accuracy: 0.5545 - loss: 0.9903 - val_accuracy: 0.5555 - val_loss: 1.0000
Epoch 41/600
150/150            16s 105ms/step -
accuracy: 0.5697 - loss: 0.9651 - val_accuracy: 0.5988 - val_loss: 0.9143
Epoch 42/600
150/150            15s 103ms/step -
accuracy: 0.5897 - loss: 0.9464 - val_accuracy: 0.5947 - val_loss: 0.9218
Epoch 43/600
150/150            16s 106ms/step -
accuracy: 0.5786 - loss: 0.9270 - val_accuracy: 0.5304 - val_loss: 1.0049
Epoch 44/600
150/150            15s 103ms/step -
accuracy: 0.5724 - loss: 0.9685 - val_accuracy: 0.5746 - val_loss: 0.9341
Epoch 45/600
150/150            20s 103ms/step -
accuracy: 0.5814 - loss: 0.9420 - val_accuracy: 0.5496 - val_loss: 0.9663
Epoch 46/600
150/150            16s 104ms/step -
accuracy: 0.5834 - loss: 0.9513 - val_accuracy: 0.5521 - val_loss: 1.0176
Epoch 47/600
150/150            20s 104ms/step -
accuracy: 0.5661 - loss: 0.9539 - val_accuracy: 0.5980 - val_loss: 0.9584
Epoch 48/600
150/150            16s 106ms/step -
accuracy: 0.5743 - loss: 0.9508 - val_accuracy: 0.5905 - val_loss: 0.9182
Epoch 49/600
150/150            15s 102ms/step -
accuracy: 0.5951 - loss: 0.9276 - val_accuracy: 0.5763 - val_loss: 0.9524
Epoch 50/600
150/150            16s 106ms/step -
accuracy: 0.5879 - loss: 0.9171 - val_accuracy: 0.5838 - val_loss: 0.9293
Epoch 51/600
150/150            15s 103ms/step -
accuracy: 0.5811 - loss: 0.9317 - val_accuracy: 0.6005 - val_loss: 0.8701
Epoch 52/600
150/150            16s 105ms/step -
accuracy: 0.5863 - loss: 0.9732 - val_accuracy: 0.5730 - val_loss: 0.9258
Epoch 53/600
150/150            20s 104ms/step -
accuracy: 0.5941 - loss: 0.9104 - val_accuracy: 0.5922 - val_loss: 0.9009
Epoch 54/600
150/150            16s 106ms/step -
accuracy: 0.6012 - loss: 0.9148 - val_accuracy: 0.5771 - val_loss: 0.9069
Epoch 55/600
```

```
150/150            16s 104ms/step -
accuracy: 0.5879 - loss: 0.9275 - val_accuracy: 0.6088 - val_loss: 0.8616
Epoch 56/600
150/150            16s 106ms/step -
accuracy: 0.6138 - loss: 0.8751 - val_accuracy: 0.6122 - val_loss: 0.8448
Epoch 57/600
150/150            16s 104ms/step -
accuracy: 0.6051 - loss: 0.8875 - val_accuracy: 0.6247 - val_loss: 0.8415
Epoch 58/600
150/150            16s 106ms/step -
accuracy: 0.6023 - loss: 0.8948 - val_accuracy: 0.6247 - val_loss: 0.8523
Epoch 59/600
150/150            15s 103ms/step -
accuracy: 0.6063 - loss: 0.8950 - val_accuracy: 0.6138 - val_loss: 0.8758
Epoch 60/600
150/150            16s 105ms/step -
accuracy: 0.6071 - loss: 0.8821 - val_accuracy: 0.5988 - val_loss: 0.8749
Epoch 61/600
150/150            15s 103ms/step -
accuracy: 0.6065 - loss: 0.8760 - val_accuracy: 0.6314 - val_loss: 0.8379
Epoch 62/600
150/150            16s 104ms/step -
accuracy: 0.6128 - loss: 0.8658 - val_accuracy: 0.6297 - val_loss: 0.8285
Epoch 63/600
150/150            20s 103ms/step -
accuracy: 0.6069 - loss: 0.8938 - val_accuracy: 0.6347 - val_loss: 0.8176
Epoch 64/600
150/150            16s 106ms/step -
accuracy: 0.6205 - loss: 0.8589 - val_accuracy: 0.6289 - val_loss: 0.8365
Epoch 65/600
150/150            15s 102ms/step -
accuracy: 0.6378 - loss: 0.8532 - val_accuracy: 0.6472 - val_loss: 0.7971
Epoch 66/600
150/150            16s 105ms/step -
accuracy: 0.6147 - loss: 0.8671 - val_accuracy: 0.6322 - val_loss: 0.8293
Epoch 67/600
150/150            16s 104ms/step -
accuracy: 0.6241 - loss: 0.8398 - val_accuracy: 0.5972 - val_loss: 0.8736
Epoch 68/600
150/150            16s 108ms/step -
accuracy: 0.6307 - loss: 0.8514 - val_accuracy: 0.6239 - val_loss: 0.8580
Epoch 69/600
150/150            16s 105ms/step -
accuracy: 0.5829 - loss: 0.9778 - val_accuracy: 0.6547 - val_loss: 0.8139
Epoch 70/600
150/150            16s 109ms/step -
accuracy: 0.6462 - loss: 0.8183 - val_accuracy: 0.6072 - val_loss: 0.8698
Epoch 71/600
```

```
150/150            16s 107ms/step -
accuracy: 0.6090 - loss: 0.9018 - val_accuracy: 0.6222 - val_loss: 0.8243
Epoch 72/600
150/150            16s 106ms/step -
accuracy: 0.6437 - loss: 0.8159 - val_accuracy: 0.6589 - val_loss: 0.8043
Epoch 73/600
150/150            16s 105ms/step -
accuracy: 0.6443 - loss: 0.8264 - val_accuracy: 0.6280 - val_loss: 0.7988
Epoch 74/600
150/150            21s 108ms/step -
accuracy: 0.6162 - loss: 0.8467 - val_accuracy: 0.6188 - val_loss: 0.8588
Epoch 75/600
150/150            16s 107ms/step -
accuracy: 0.6354 - loss: 0.8631 - val_accuracy: 0.6122 - val_loss: 0.8578
Epoch 76/600
150/150            16s 108ms/step -
accuracy: 0.6448 - loss: 0.8074 - val_accuracy: 0.6030 - val_loss: 0.9181
Epoch 77/600
150/150            16s 105ms/step -
accuracy: 0.6304 - loss: 0.8652 - val_accuracy: 0.6305 - val_loss: 0.8180
Epoch 78/600
150/150            21s 107ms/step -
accuracy: 0.6543 - loss: 0.8140 - val_accuracy: 0.6155 - val_loss: 0.8512
Epoch 79/600
150/150            15s 103ms/step -
accuracy: 0.6377 - loss: 0.8109 - val_accuracy: 0.6489 - val_loss: 0.7576
Epoch 80/600
150/150            16s 106ms/step -
accuracy: 0.6419 - loss: 0.8457 - val_accuracy: 0.6480 - val_loss: 0.7893
Epoch 81/600
150/150            15s 103ms/step -
accuracy: 0.6473 - loss: 0.8130 - val_accuracy: 0.6339 - val_loss: 0.7933
Epoch 82/600
150/150            16s 104ms/step -
accuracy: 0.6549 - loss: 0.7944 - val_accuracy: 0.5863 - val_loss: 0.9470
Epoch 83/600
150/150            16s 104ms/step -
accuracy: 0.6420 - loss: 0.8177 - val_accuracy: 0.6147 - val_loss: 0.8415
Epoch 84/600
150/150            16s 105ms/step -
accuracy: 0.6327 - loss: 0.8236 - val_accuracy: 0.6714 - val_loss: 0.7363
Epoch 85/600
150/150            20s 104ms/step -
accuracy: 0.6641 - loss: 0.7646 - val_accuracy: 0.6631 - val_loss: 0.7636
Epoch 86/600
150/150            16s 105ms/step -
accuracy: 0.6557 - loss: 0.7950 - val_accuracy: 0.6472 - val_loss: 0.8245
Epoch 87/600
```

```
150/150            15s 102ms/step -
accuracy: 0.6540 - loss: 0.7907 - val_accuracy: 0.6455 - val_loss: 0.7906
Epoch 88/600
150/150            16s 105ms/step -
accuracy: 0.6586 - loss: 0.7916 - val_accuracy: 0.6597 - val_loss: 0.7470
Epoch 89/600
150/150            15s 101ms/step -
accuracy: 0.6545 - loss: 0.8211 - val_accuracy: 0.6789 - val_loss: 0.7212
Epoch 90/600
150/150            16s 104ms/step -
accuracy: 0.6592 - loss: 0.7855 - val_accuracy: 0.6480 - val_loss: 0.8007
Epoch 91/600
150/150            15s 103ms/step -
accuracy: 0.6710 - loss: 0.7641 - val_accuracy: 0.6697 - val_loss: 0.7429
Epoch 92/600
150/150            16s 105ms/step -
accuracy: 0.6719 - loss: 0.7479 - val_accuracy: 0.6656 - val_loss: 0.7391
Epoch 93/600
150/150            15s 102ms/step -
accuracy: 0.6649 - loss: 0.7634 - val_accuracy: 0.6806 - val_loss: 0.7120
Epoch 94/600
150/150            15s 102ms/step -
accuracy: 0.6696 - loss: 0.7681 - val_accuracy: 0.6297 - val_loss: 0.7957
Epoch 95/600
150/150            20s 102ms/step -
accuracy: 0.6451 - loss: 0.8238 - val_accuracy: 0.6856 - val_loss: 0.7279
Epoch 96/600
150/150            16s 104ms/step -
accuracy: 0.6278 - loss: 0.8705 - val_accuracy: 0.6622 - val_loss: 0.7539
Epoch 97/600
150/150            20s 102ms/step -
accuracy: 0.6744 - loss: 0.7537 - val_accuracy: 0.6530 - val_loss: 0.7463
Epoch 98/600
150/150            16s 105ms/step -
accuracy: 0.6801 - loss: 0.7290 - val_accuracy: 0.6814 - val_loss: 0.7120
Epoch 99/600
150/150            15s 101ms/step -
accuracy: 0.6767 - loss: 0.7390 - val_accuracy: 0.6672 - val_loss: 0.7516
Epoch 100/600
150/150            16s 105ms/step -
accuracy: 0.6749 - loss: 0.7495 - val_accuracy: 0.6822 - val_loss: 0.7320
Epoch 101/600
150/150            15s 101ms/step -
accuracy: 0.6722 - loss: 0.7522 - val_accuracy: 0.6922 - val_loss: 0.7065
Epoch 102/600
150/150            16s 104ms/step -
accuracy: 0.6910 - loss: 0.7151 - val_accuracy: 0.6947 - val_loss: 0.6911
Epoch 103/600
```

```
150/150            15s 101ms/step -
accuracy: 0.6859 - loss: 0.7233 - val_accuracy: 0.6964 - val_loss: 0.6814
Epoch 104/600
150/150            15s 103ms/step -
accuracy: 0.6932 - loss: 0.7408 - val_accuracy: 0.7014 - val_loss: 0.6995
Epoch 105/600
150/150            15s 101ms/step -
accuracy: 0.6985 - loss: 0.6971 - val_accuracy: 0.7031 - val_loss: 0.6999
Epoch 106/600
150/150            21s 105ms/step -
accuracy: 0.7064 - loss: 0.7010 - val_accuracy: 0.6797 - val_loss: 0.7178
Epoch 107/600
150/150            15s 103ms/step -
accuracy: 0.6813 - loss: 0.7571 - val_accuracy: 0.6614 - val_loss: 0.7595
Epoch 108/600
150/150            16s 105ms/step -
accuracy: 0.6823 - loss: 0.7352 - val_accuracy: 0.6522 - val_loss: 0.7670
Epoch 109/600
150/150            15s 101ms/step -
accuracy: 0.7005 - loss: 0.7169 - val_accuracy: 0.6781 - val_loss: 0.7140
Epoch 110/600
150/150            16s 105ms/step -
accuracy: 0.6763 - loss: 0.7278 - val_accuracy: 0.6931 - val_loss: 0.6858
Epoch 111/600
150/150            16s 103ms/step -
accuracy: 0.7133 - loss: 0.6722 - val_accuracy: 0.7064 - val_loss: 0.6801
Epoch 112/600
150/150            16s 105ms/step -
accuracy: 0.6838 - loss: 0.7491 - val_accuracy: 0.6614 - val_loss: 0.7348
Epoch 113/600
150/150            16s 104ms/step -
accuracy: 0.7004 - loss: 0.7123 - val_accuracy: 0.6964 - val_loss: 0.7075
Epoch 114/600
150/150            16s 104ms/step -
accuracy: 0.7083 - loss: 0.6847 - val_accuracy: 0.7014 - val_loss: 0.6769
Epoch 115/600
150/150            16s 107ms/step -
accuracy: 0.7099 - loss: 0.6932 - val_accuracy: 0.6931 - val_loss: 0.6985
Epoch 116/600
150/150            16s 104ms/step -
accuracy: 0.7055 - loss: 0.6863 - val_accuracy: 0.6881 - val_loss: 0.7041
Epoch 117/600
150/150            20s 103ms/step -
accuracy: 0.6954 - loss: 0.7456 - val_accuracy: 0.7123 - val_loss: 0.6541
Epoch 118/600
150/150            16s 106ms/step -
accuracy: 0.7068 - loss: 0.7046 - val_accuracy: 0.6964 - val_loss: 0.6590
Epoch 119/600
```

```
150/150            15s 102ms/step -
accuracy: 0.7091 - loss: 0.6795 - val_accuracy: 0.7406 - val_loss: 0.6069
Epoch 120/600
150/150            16s 104ms/step -
accuracy: 0.7104 - loss: 0.6731 - val_accuracy: 0.7123 - val_loss: 0.6596
Epoch 121/600
150/150            20s 102ms/step -
accuracy: 0.7307 - loss: 0.6223 - val_accuracy: 0.6814 - val_loss: 0.7169
Epoch 122/600
150/150            16s 104ms/step -
accuracy: 0.6820 - loss: 0.7577 - val_accuracy: 0.6681 - val_loss: 0.7681
Epoch 123/600
150/150            15s 102ms/step -
accuracy: 0.6933 - loss: 0.7212 - val_accuracy: 0.7364 - val_loss: 0.6226
Epoch 124/600
150/150            15s 103ms/step -
accuracy: 0.7278 - loss: 0.6323 - val_accuracy: 0.7156 - val_loss: 0.6457
Epoch 125/600
150/150            15s 102ms/step -
accuracy: 0.7097 - loss: 0.6614 - val_accuracy: 0.7156 - val_loss: 0.6305
Epoch 126/600
150/150            16s 103ms/step -
accuracy: 0.6988 - loss: 0.7079 - val_accuracy: 0.6939 - val_loss: 0.6458
Epoch 127/600
150/150            20s 101ms/step -
accuracy: 0.7200 - loss: 0.6459 - val_accuracy: 0.7273 - val_loss: 0.6017
Epoch 128/600
150/150            16s 106ms/step -
accuracy: 0.7395 - loss: 0.6284 - val_accuracy: 0.6622 - val_loss: 0.7585
Epoch 129/600
150/150            15s 101ms/step -
accuracy: 0.7266 - loss: 0.6440 - val_accuracy: 0.7381 - val_loss: 0.5833
Epoch 130/600
150/150            21s 104ms/step -
accuracy: 0.7457 - loss: 0.6178 - val_accuracy: 0.6789 - val_loss: 0.7488
Epoch 131/600
150/150            20s 101ms/step -
accuracy: 0.6753 - loss: 0.7322 - val_accuracy: 0.7064 - val_loss: 0.6554
Epoch 132/600
150/150            15s 103ms/step -
accuracy: 0.7214 - loss: 0.6486 - val_accuracy: 0.7223 - val_loss: 0.6362
Epoch 133/600
150/150            15s 101ms/step -
accuracy: 0.7354 - loss: 0.6284 - val_accuracy: 0.6872 - val_loss: 0.6872
Epoch 134/600
150/150            15s 103ms/step -
accuracy: 0.7333 - loss: 0.6331 - val_accuracy: 0.7181 - val_loss: 0.6438
Epoch 135/600
```

```
150/150            15s 103ms/step -
accuracy: 0.7271 - loss: 0.6401 - val_accuracy: 0.6897 - val_loss: 0.6985
Epoch 136/600
150/150            16s 105ms/step -
accuracy: 0.7093 - loss: 0.6722 - val_accuracy: 0.7073 - val_loss: 0.6472
Epoch 137/600
150/150            20s 102ms/step -
accuracy: 0.7480 - loss: 0.6168 - val_accuracy: 0.7364 - val_loss: 0.6002
Epoch 138/600
150/150            21s 103ms/step -
accuracy: 0.7333 - loss: 0.6232 - val_accuracy: 0.7131 - val_loss: 0.6205
Epoch 139/600
150/150            21s 104ms/step -
accuracy: 0.7331 - loss: 0.6327 - val_accuracy: 0.7289 - val_loss: 0.6113
Epoch 140/600
150/150            15s 102ms/step -
accuracy: 0.7324 - loss: 0.6337 - val_accuracy: 0.7381 - val_loss: 0.6086
Epoch 141/600
150/150            16s 105ms/step -
accuracy: 0.7381 - loss: 0.6106 - val_accuracy: 0.7198 - val_loss: 0.6285
Epoch 142/600
150/150            15s 102ms/step -
accuracy: 0.7371 - loss: 0.6176 - val_accuracy: 0.7039 - val_loss: 0.6405
Epoch 143/600
150/150            16s 103ms/step -
accuracy: 0.7154 - loss: 0.6673 - val_accuracy: 0.7490 - val_loss: 0.5770
Epoch 144/600
150/150            16s 104ms/step -
accuracy: 0.7493 - loss: 0.6021 - val_accuracy: 0.7073 - val_loss: 0.6566
Epoch 145/600
150/150            21s 106ms/step -
accuracy: 0.7427 - loss: 0.6134 - val_accuracy: 0.7440 - val_loss: 0.5898
Epoch 146/600
150/150            16s 105ms/step -
accuracy: 0.7442 - loss: 0.6063 - val_accuracy: 0.7289 - val_loss: 0.5852
Epoch 147/600
150/150            16s 106ms/step -
accuracy: 0.7568 - loss: 0.5754 - val_accuracy: 0.7256 - val_loss: 0.5901
Epoch 148/600
150/150            15s 102ms/step -
accuracy: 0.7435 - loss: 0.6018 - val_accuracy: 0.7148 - val_loss: 0.6341
Epoch 149/600
150/150            16s 105ms/step -
accuracy: 0.7407 - loss: 0.6084 - val_accuracy: 0.7389 - val_loss: 0.6004
Epoch 150/600
150/150            15s 103ms/step -
accuracy: 0.7625 - loss: 0.5734 - val_accuracy: 0.7398 - val_loss: 0.5949
Epoch 151/600
```

```
150/150            16s 105ms/step -
accuracy: 0.7579 - loss: 0.5763 - val_accuracy: 0.7314 - val_loss: 0.6139
Epoch 152/600
150/150            20s 103ms/step -
accuracy: 0.7452 - loss: 0.6263 - val_accuracy: 0.7781 - val_loss: 0.5238
Epoch 153/600
150/150            16s 104ms/step -
accuracy: 0.7548 - loss: 0.5838 - val_accuracy: 0.7456 - val_loss: 0.6170
Epoch 154/600
150/150            21s 106ms/step -
accuracy: 0.7451 - loss: 0.6008 - val_accuracy: 0.7023 - val_loss: 0.7300
Epoch 155/600
150/150            16s 106ms/step -
accuracy: 0.7440 - loss: 0.6138 - val_accuracy: 0.7706 - val_loss: 0.5180
Epoch 156/600
150/150            16s 104ms/step -
accuracy: 0.7650 - loss: 0.5538 - val_accuracy: 0.6714 - val_loss: 0.7803
Epoch 157/600
150/150            16s 105ms/step -
accuracy: 0.7269 - loss: 0.6510 - val_accuracy: 0.6956 - val_loss: 0.7195
Epoch 158/600
150/150            15s 102ms/step -
accuracy: 0.7334 - loss: 0.6114 - val_accuracy: 0.7665 - val_loss: 0.5671
Epoch 159/600
150/150            16s 106ms/step -
accuracy: 0.7721 - loss: 0.5503 - val_accuracy: 0.7448 - val_loss: 0.5993
Epoch 160/600
150/150            15s 103ms/step -
accuracy: 0.7567 - loss: 0.5783 - val_accuracy: 0.7481 - val_loss: 0.5883
Epoch 161/600
150/150            16s 104ms/step -
accuracy: 0.7626 - loss: 0.5832 - val_accuracy: 0.7748 - val_loss: 0.5276
Epoch 162/600
150/150            15s 103ms/step -
accuracy: 0.7781 - loss: 0.5449 - val_accuracy: 0.7640 - val_loss: 0.5505
Epoch 163/600
150/150            16s 103ms/step -
accuracy: 0.7747 - loss: 0.5610 - val_accuracy: 0.7623 - val_loss: 0.5591
Epoch 164/600
150/150            15s 102ms/step -
accuracy: 0.7572 - loss: 0.6002 - val_accuracy: 0.7640 - val_loss: 0.5560
Epoch 165/600
150/150            16s 103ms/step -
accuracy: 0.7615 - loss: 0.5696 - val_accuracy: 0.7156 - val_loss: 0.6437
Epoch 166/600
150/150            16s 104ms/step -
accuracy: 0.7632 - loss: 0.5812 - val_accuracy: 0.7364 - val_loss: 0.6012
Epoch 167/600
```

```
150/150            15s 102ms/step -
accuracy: 0.7654 - loss: 0.5622 - val_accuracy: 0.7389 - val_loss: 0.6119
Epoch 168/600
150/150            16s 104ms/step -
accuracy: 0.7783 - loss: 0.5605 - val_accuracy: 0.7765 - val_loss: 0.5360
Epoch 169/600
150/150            15s 102ms/step -
accuracy: 0.7684 - loss: 0.5634 - val_accuracy: 0.7781 - val_loss: 0.5486
Epoch 170/600
150/150            16s 105ms/step -
accuracy: 0.7878 - loss: 0.5194 - val_accuracy: 0.7615 - val_loss: 0.5448
Epoch 171/600
150/150            15s 102ms/step -
accuracy: 0.7727 - loss: 0.5448 - val_accuracy: 0.7473 - val_loss: 0.6484
Epoch 172/600
150/150            21s 103ms/step -
accuracy: 0.8008 - loss: 0.5062 - val_accuracy: 0.7540 - val_loss: 0.6041
Epoch 173/600
150/150            15s 101ms/step -
accuracy: 0.7659 - loss: 0.5661 - val_accuracy: 0.7773 - val_loss: 0.5411
Epoch 174/600
150/150            16s 105ms/step -
accuracy: 0.7761 - loss: 0.5358 - val_accuracy: 0.7957 - val_loss: 0.4993
Epoch 175/600
150/150            20s 104ms/step -
accuracy: 0.7561 - loss: 0.5758 - val_accuracy: 0.7840 - val_loss: 0.5264
Epoch 176/600
150/150            15s 102ms/step -
accuracy: 0.7864 - loss: 0.5229 - val_accuracy: 0.7556 - val_loss: 0.5521
Epoch 177/600
150/150            15s 102ms/step -
accuracy: 0.8035 - loss: 0.5036 - val_accuracy: 0.7139 - val_loss: 0.7406
Epoch 178/600
150/150            15s 102ms/step -
accuracy: 0.7736 - loss: 0.5609 - val_accuracy: 0.7506 - val_loss: 0.5718
Epoch 179/600
150/150            15s 101ms/step -
accuracy: 0.7719 - loss: 0.5767 - val_accuracy: 0.7706 - val_loss: 0.5381
Epoch 180/600
150/150            16s 105ms/step -
accuracy: 0.7901 - loss: 0.5385 - val_accuracy: 0.7790 - val_loss: 0.5523
Epoch 181/600
150/150            15s 102ms/step -
accuracy: 0.7868 - loss: 0.5217 - val_accuracy: 0.7990 - val_loss: 0.4883
Epoch 182/600
150/150            16s 105ms/step -
accuracy: 0.8064 - loss: 0.4791 - val_accuracy: 0.7873 - val_loss: 0.5214
Epoch 183/600
```

```
150/150            15s 102ms/step -
accuracy: 0.7868 - loss: 0.4958 - val_accuracy: 0.7756 - val_loss: 0.5433
Epoch 184/600
150/150            16s 105ms/step -
accuracy: 0.8110 - loss: 0.4888 - val_accuracy: 0.7898 - val_loss: 0.5238
Epoch 185/600
150/150            15s 103ms/step -
accuracy: 0.7967 - loss: 0.4999 - val_accuracy: 0.7548 - val_loss: 0.5813
Epoch 186/600
150/150            16s 106ms/step -
accuracy: 0.8013 - loss: 0.5205 - val_accuracy: 0.7573 - val_loss: 0.5442
Epoch 187/600
150/150            16s 103ms/step -
accuracy: 0.7774 - loss: 0.5480 - val_accuracy: 0.7898 - val_loss: 0.5111
Epoch 188/600
150/150            16s 105ms/step -
accuracy: 0.8119 - loss: 0.4668 - val_accuracy: 0.7623 - val_loss: 0.5641
Epoch 189/600
150/150            15s 102ms/step -
accuracy: 0.7991 - loss: 0.5230 - val_accuracy: 0.7373 - val_loss: 0.6887
Epoch 190/600
150/150            16s 105ms/step -
accuracy: 0.7733 - loss: 0.5766 - val_accuracy: 0.7331 - val_loss: 0.6562
Epoch 191/600
150/150            15s 103ms/step -
accuracy: 0.7910 - loss: 0.5205 - val_accuracy: 0.7756 - val_loss: 0.5190
Epoch 192/600
150/150            16s 105ms/step -
accuracy: 0.7951 - loss: 0.4951 - val_accuracy: 0.7832 - val_loss: 0.5190
Epoch 193/600
150/150            15s 103ms/step -
accuracy: 0.8099 - loss: 0.4719 - val_accuracy: 0.7982 - val_loss: 0.4906
Epoch 194/600
150/150            16s 105ms/step -
accuracy: 0.8093 - loss: 0.4899 - val_accuracy: 0.8032 - val_loss: 0.5090
Epoch 195/600
150/150            15s 103ms/step -
accuracy: 0.8001 - loss: 0.5156 - val_accuracy: 0.7740 - val_loss: 0.5981
Epoch 196/600
150/150            16s 106ms/step -
accuracy: 0.7955 - loss: 0.5057 - val_accuracy: 0.8140 - val_loss: 0.4732
Epoch 197/600
150/150            15s 102ms/step -
accuracy: 0.8051 - loss: 0.4645 - val_accuracy: 0.7907 - val_loss: 0.5285
Epoch 198/600
150/150            16s 104ms/step -
accuracy: 0.8207 - loss: 0.4451 - val_accuracy: 0.8082 - val_loss: 0.4796
Epoch 199/600
```

```
150/150            20s 102ms/step -
accuracy: 0.8057 - loss: 0.4761 - val_accuracy: 0.7990 - val_loss: 0.4731
Epoch 200/600
150/150            16s 105ms/step -
accuracy: 0.8096 - loss: 0.4925 - val_accuracy: 0.7898 - val_loss: 0.5398
Epoch 201/600
150/150            15s 103ms/step -
accuracy: 0.7970 - loss: 0.5024 - val_accuracy: 0.7606 - val_loss: 0.6279
Epoch 202/600
150/150            16s 106ms/step -
accuracy: 0.7967 - loss: 0.5331 - val_accuracy: 0.8048 - val_loss: 0.4949
Epoch 203/600
150/150            20s 103ms/step -
accuracy: 0.8053 - loss: 0.4835 - val_accuracy: 0.7773 - val_loss: 0.5267
Epoch 204/600
150/150            16s 104ms/step -
accuracy: 0.8009 - loss: 0.4738 - val_accuracy: 0.8082 - val_loss: 0.4811
Epoch 205/600
150/150            16s 103ms/step -
accuracy: 0.7980 - loss: 0.5030 - val_accuracy: 0.7948 - val_loss: 0.5507
Epoch 206/600
150/150            16s 105ms/step -
accuracy: 0.8068 - loss: 0.4757 - val_accuracy: 0.8140 - val_loss: 0.4722
Epoch 207/600
150/150            15s 102ms/step -
accuracy: 0.8165 - loss: 0.4485 - val_accuracy: 0.8007 - val_loss: 0.4885
Epoch 208/600
150/150            16s 104ms/step -
accuracy: 0.8013 - loss: 0.5380 - val_accuracy: 0.7973 - val_loss: 0.5016
Epoch 209/600
150/150            15s 101ms/step -
accuracy: 0.8381 - loss: 0.4179 - val_accuracy: 0.8274 - val_loss: 0.4380
Epoch 210/600
150/150            21s 105ms/step -
accuracy: 0.8210 - loss: 0.4392 - val_accuracy: 0.8240 - val_loss: 0.4531
Epoch 211/600
150/150            15s 103ms/step -
accuracy: 0.8251 - loss: 0.4388 - val_accuracy: 0.7781 - val_loss: 0.5233
Epoch 212/600
150/150            16s 105ms/step -
accuracy: 0.8200 - loss: 0.4520 - val_accuracy: 0.7890 - val_loss: 0.5049
Epoch 213/600
150/150            16s 104ms/step -
accuracy: 0.8227 - loss: 0.4616 - val_accuracy: 0.7756 - val_loss: 0.5531
Epoch 214/600
150/150            16s 106ms/step -
accuracy: 0.8214 - loss: 0.4588 - val_accuracy: 0.8032 - val_loss: 0.4774
Epoch 215/600
```

```
150/150            15s 103ms/step -
accuracy: 0.8274 - loss: 0.4373 - val_accuracy: 0.8073 - val_loss: 0.4705
Epoch 216/600
150/150            16s 104ms/step -
accuracy: 0.8341 - loss: 0.4332 - val_accuracy: 0.7807 - val_loss: 0.5161
Epoch 217/600
150/150            15s 103ms/step -
accuracy: 0.8184 - loss: 0.4759 - val_accuracy: 0.8215 - val_loss: 0.4529
Epoch 218/600
150/150            16s 104ms/step -
accuracy: 0.8452 - loss: 0.4161 - val_accuracy: 0.7857 - val_loss: 0.5129
Epoch 219/600
150/150            20s 101ms/step -
accuracy: 0.8351 - loss: 0.4332 - val_accuracy: 0.7965 - val_loss: 0.5250
Epoch 220/600
150/150            16s 104ms/step -
accuracy: 0.8290 - loss: 0.4381 - val_accuracy: 0.8090 - val_loss: 0.4729
Epoch 221/600
150/150            15s 102ms/step -
accuracy: 0.8406 - loss: 0.4097 - val_accuracy: 0.8332 - val_loss: 0.4521
Epoch 222/600
150/150            16s 104ms/step -
accuracy: 0.8054 - loss: 0.5013 - val_accuracy: 0.8215 - val_loss: 0.4500
Epoch 223/600
150/150            15s 101ms/step -
accuracy: 0.8322 - loss: 0.4362 - val_accuracy: 0.7840 - val_loss: 0.5505
Epoch 224/600
150/150            15s 102ms/step -
accuracy: 0.8307 - loss: 0.4309 - val_accuracy: 0.7790 - val_loss: 0.5835
Epoch 225/600
150/150            20s 102ms/step -
accuracy: 0.8357 - loss: 0.4164 - val_accuracy: 0.8332 - val_loss: 0.4469
Epoch 226/600
150/150            16s 104ms/step -
accuracy: 0.8553 - loss: 0.3756 - val_accuracy: 0.7873 - val_loss: 0.5480
Epoch 227/600
150/150            15s 102ms/step -
accuracy: 0.8147 - loss: 0.4588 - val_accuracy: 0.8315 - val_loss: 0.4350
Epoch 228/600
150/150            16s 105ms/step -
accuracy: 0.8409 - loss: 0.4288 - val_accuracy: 0.8023 - val_loss: 0.4838
Epoch 229/600
150/150            15s 102ms/step -
accuracy: 0.8411 - loss: 0.3950 - val_accuracy: 0.8190 - val_loss: 0.4738
Epoch 230/600
150/150            15s 103ms/step -
accuracy: 0.8434 - loss: 0.3849 - val_accuracy: 0.7940 - val_loss: 0.5028
Epoch 231/600
```

```
150/150            20s 103ms/step -
accuracy: 0.8393 - loss: 0.4239 - val_accuracy: 0.8282 - val_loss: 0.4432
Epoch 232/600
150/150            16s 105ms/step -
accuracy: 0.8324 - loss: 0.4137 - val_accuracy: 0.8107 - val_loss: 0.4708
Epoch 233/600
150/150            16s 105ms/step -
accuracy: 0.8450 - loss: 0.3783 - val_accuracy: 0.8282 - val_loss: 0.4522
Epoch 234/600
150/150            16s 105ms/step -
accuracy: 0.8364 - loss: 0.4182 - val_accuracy: 0.8232 - val_loss: 0.4496
Epoch 235/600
150/150            15s 102ms/step -
accuracy: 0.8401 - loss: 0.4095 - val_accuracy: 0.8123 - val_loss: 0.4702
Epoch 236/600
150/150            16s 103ms/step -
accuracy: 0.8498 - loss: 0.3925 - val_accuracy: 0.8215 - val_loss: 0.4652
Epoch 237/600
150/150            20s 102ms/step -
accuracy: 0.8321 - loss: 0.4264 - val_accuracy: 0.8007 - val_loss: 0.5574
Epoch 238/600
150/150            21s 104ms/step -
accuracy: 0.8380 - loss: 0.4174 - val_accuracy: 0.8349 - val_loss: 0.4405
Epoch 239/600
150/150            15s 102ms/step -
accuracy: 0.8265 - loss: 0.4484 - val_accuracy: 0.8399 - val_loss: 0.4305
Epoch 240/600
150/150            16s 104ms/step -
accuracy: 0.8578 - loss: 0.3828 - val_accuracy: 0.8349 - val_loss: 0.4550
Epoch 241/600
150/150            15s 102ms/step -
accuracy: 0.8373 - loss: 0.4329 - val_accuracy: 0.8357 - val_loss: 0.4448
Epoch 242/600
150/150            16s 105ms/step -
accuracy: 0.8547 - loss: 0.3780 - val_accuracy: 0.8357 - val_loss: 0.4302
Epoch 243/600
150/150            15s 102ms/step -
accuracy: 0.8662 - loss: 0.3439 - val_accuracy: 0.8340 - val_loss: 0.4446
Epoch 244/600
150/150            16s 104ms/step -
accuracy: 0.8409 - loss: 0.3996 - val_accuracy: 0.8082 - val_loss: 0.5153
Epoch 245/600
150/150            16s 103ms/step -
accuracy: 0.7860 - loss: 0.5455 - val_accuracy: 0.8182 - val_loss: 0.4446
Epoch 246/600
150/150            21s 104ms/step -
accuracy: 0.8622 - loss: 0.3673 - val_accuracy: 0.7798 - val_loss: 0.6156
Epoch 247/600
```

```
150/150            15s 101ms/step -
accuracy: 0.8367 - loss: 0.4562 - val_accuracy: 0.8399 - val_loss: 0.4261
Epoch 248/600
150/150            15s 103ms/step -
accuracy: 0.8539 - loss: 0.3791 - val_accuracy: 0.8357 - val_loss: 0.4387
Epoch 249/600
150/150            20s 100ms/step -
accuracy: 0.8599 - loss: 0.3640 - val_accuracy: 0.7982 - val_loss: 0.5167
Epoch 250/600
150/150            21s 103ms/step -
accuracy: 0.8570 - loss: 0.3654 - val_accuracy: 0.8407 - val_loss: 0.4516
Epoch 251/600
150/150            15s 101ms/step -
accuracy: 0.8527 - loss: 0.3893 - val_accuracy: 0.8299 - val_loss: 0.4529
Epoch 252/600
150/150            16s 104ms/step -
accuracy: 0.8485 - loss: 0.3885 - val_accuracy: 0.8299 - val_loss: 0.4712
Epoch 253/600
150/150            15s 101ms/step -
accuracy: 0.8527 - loss: 0.3943 - val_accuracy: 0.8007 - val_loss: 0.5375
Epoch 254/600
150/150            15s 102ms/step -
accuracy: 0.8426 - loss: 0.3999 - val_accuracy: 0.8232 - val_loss: 0.4877
Epoch 255/600
150/150            15s 101ms/step -
accuracy: 0.8601 - loss: 0.3611 - val_accuracy: 0.8515 - val_loss: 0.4175
Epoch 256/600
150/150            15s 103ms/step -
accuracy: 0.8506 - loss: 0.4126 - val_accuracy: 0.8524 - val_loss: 0.4342
Epoch 257/600
150/150            15s 101ms/step -
accuracy: 0.8558 - loss: 0.3538 - val_accuracy: 0.8440 - val_loss: 0.4152
Epoch 258/600
150/150            15s 103ms/step -
accuracy: 0.8733 - loss: 0.3204 - val_accuracy: 0.8474 - val_loss: 0.4021
Epoch 259/600
150/150            15s 100ms/step -
accuracy: 0.8617 - loss: 0.3487 - val_accuracy: 0.8057 - val_loss: 0.5584
Epoch 260/600
150/150            15s 102ms/step -
accuracy: 0.8397 - loss: 0.4086 - val_accuracy: 0.8399 - val_loss: 0.3982
Epoch 261/600
150/150            20s 101ms/step -
accuracy: 0.8716 - loss: 0.3417 - val_accuracy: 0.7898 - val_loss: 0.5213
Epoch 262/600
150/150            16s 104ms/step -
accuracy: 0.8557 - loss: 0.3669 - val_accuracy: 0.8274 - val_loss: 0.4479
Epoch 263/600
```

```
150/150            15s 101ms/step -
accuracy: 0.8641 - loss: 0.3618 - val_accuracy: 0.8357 - val_loss: 0.4125
Epoch 264/600
150/150            15s 103ms/step -
accuracy: 0.8745 - loss: 0.3278 - val_accuracy: 0.8299 - val_loss: 0.4273
Epoch 265/600
150/150            20s 101ms/step -
accuracy: 0.8744 - loss: 0.3361 - val_accuracy: 0.8299 - val_loss: 0.4534
Epoch 266/600
150/150            16s 104ms/step -
accuracy: 0.8568 - loss: 0.3765 - val_accuracy: 0.8357 - val_loss: 0.4337
Epoch 267/600
150/150            20s 100ms/step -
accuracy: 0.8580 - loss: 0.3883 - val_accuracy: 0.8465 - val_loss: 0.4032
Epoch 268/600
150/150            15s 102ms/step -
accuracy: 0.8618 - loss: 0.3627 - val_accuracy: 0.8449 - val_loss: 0.3878
Epoch 269/600
150/150            15s 100ms/step -
accuracy: 0.8714 - loss: 0.3318 - val_accuracy: 0.8390 - val_loss: 0.3989
Epoch 270/600
150/150            16s 104ms/step -
accuracy: 0.8861 - loss: 0.3150 - val_accuracy: 0.8532 - val_loss: 0.3740
Epoch 271/600
150/150            15s 102ms/step -
accuracy: 0.8708 - loss: 0.3276 - val_accuracy: 0.8349 - val_loss: 0.4474
Epoch 272/600
150/150            16s 104ms/step -
accuracy: 0.8778 - loss: 0.3351 - val_accuracy: 0.8023 - val_loss: 0.5084
Epoch 273/600
150/150            20s 100ms/step -
accuracy: 0.8721 - loss: 0.3498 - val_accuracy: 0.8173 - val_loss: 0.4753
Epoch 274/600
150/150            15s 103ms/step -
accuracy: 0.8427 - loss: 0.4132 - val_accuracy: 0.7932 - val_loss: 0.5456
Epoch 275/600
150/150            15s 101ms/step -
accuracy: 0.8670 - loss: 0.3568 - val_accuracy: 0.8474 - val_loss: 0.4000
Epoch 276/600
150/150            16s 104ms/step -
accuracy: 0.8829 - loss: 0.3152 - val_accuracy: 0.8123 - val_loss: 0.4807
Epoch 277/600
150/150            15s 101ms/step -
accuracy: 0.8879 - loss: 0.3102 - val_accuracy: 0.8349 - val_loss: 0.4997
Epoch 278/600
150/150            16s 104ms/step -
accuracy: 0.8524 - loss: 0.3929 - val_accuracy: 0.7948 - val_loss: 0.6154
Epoch 279/600
```

```
150/150            15s 102ms/step -
accuracy: 0.8408 - loss: 0.4546 - val_accuracy: 0.8023 - val_loss: 0.5020
Epoch 280/600
150/150            16s 105ms/step -
accuracy: 0.8724 - loss: 0.3318 - val_accuracy: 0.8282 - val_loss: 0.4984
Epoch 281/600
150/150            15s 103ms/step -
accuracy: 0.8819 - loss: 0.3301 - val_accuracy: 0.8524 - val_loss: 0.4241
Epoch 282/600
150/150            16s 106ms/step -
accuracy: 0.8774 - loss: 0.3293 - val_accuracy: 0.8165 - val_loss: 0.5245
Epoch 283/600
150/150            16s 104ms/step -
accuracy: 0.8665 - loss: 0.3647 - val_accuracy: 0.8349 - val_loss: 0.4460
Epoch 284/600
150/150            16s 104ms/step -
accuracy: 0.8829 - loss: 0.3123 - val_accuracy: 0.8390 - val_loss: 0.4716
Epoch 285/600
150/150            15s 103ms/step -
accuracy: 0.8783 - loss: 0.3161 - val_accuracy: 0.8824 - val_loss: 0.3416
Epoch 286/600
150/150            16s 105ms/step -
accuracy: 0.8914 - loss: 0.2969 - val_accuracy: 0.8357 - val_loss: 0.4527
Epoch 287/600
150/150            16s 104ms/step -
accuracy: 0.8828 - loss: 0.3216 - val_accuracy: 0.8674 - val_loss: 0.3900
Epoch 288/600
150/150            21s 106ms/step -
accuracy: 0.8842 - loss: 0.3230 - val_accuracy: 0.8716 - val_loss: 0.3554
Epoch 289/600
150/150            16s 104ms/step -
accuracy: 0.8841 - loss: 0.2982 - val_accuracy: 0.8240 - val_loss: 0.4796
Epoch 290/600
150/150            21s 106ms/step -
accuracy: 0.8427 - loss: 0.4412 - val_accuracy: 0.8232 - val_loss: 0.4533
Epoch 291/600
150/150            16s 104ms/step -
accuracy: 0.8919 - loss: 0.2939 - val_accuracy: 0.8657 - val_loss: 0.3941
Epoch 292/600
150/150            16s 105ms/step -
accuracy: 0.8773 - loss: 0.3369 - val_accuracy: 0.8565 - val_loss: 0.3950
Epoch 293/600
150/150            20s 103ms/step -
accuracy: 0.8922 - loss: 0.2874 - val_accuracy: 0.8440 - val_loss: 0.4506
Epoch 294/600
150/150            21s 105ms/step -
accuracy: 0.8789 - loss: 0.3250 - val_accuracy: 0.8340 - val_loss: 0.4402
Epoch 295/600
```

```
150/150            20s 104ms/step -
accuracy: 0.8769 - loss: 0.3205 - val_accuracy: 0.8699 - val_loss: 0.3594
Epoch 296/600
150/150            15s 102ms/step -
accuracy: 0.8943 - loss: 0.2899 - val_accuracy: 0.7890 - val_loss: 0.5932
Epoch 297/600
150/150            16s 104ms/step -
accuracy: 0.8738 - loss: 0.3498 - val_accuracy: 0.8265 - val_loss: 0.4530
Epoch 298/600
150/150            15s 101ms/step -
accuracy: 0.8724 - loss: 0.3513 - val_accuracy: 0.8415 - val_loss: 0.4546
Epoch 299/600
150/150            15s 102ms/step -
accuracy: 0.8863 - loss: 0.3056 - val_accuracy: 0.8632 - val_loss: 0.4022
Epoch 300/600
150/150            16s 105ms/step -
accuracy: 0.8827 - loss: 0.3107 - val_accuracy: 0.7832 - val_loss: 0.5923
Epoch 301/600
150/150            15s 102ms/step -
accuracy: 0.8553 - loss: 0.3722 - val_accuracy: 0.8791 - val_loss: 0.3531
Epoch 302/600
150/150            16s 105ms/step -
accuracy: 0.9028 - loss: 0.2689 - val_accuracy: 0.8432 - val_loss: 0.4359
Epoch 303/600
150/150            20s 104ms/step -
accuracy: 0.8974 - loss: 0.2715 - val_accuracy: 0.8249 - val_loss: 0.4807
Epoch 304/600
150/150            15s 103ms/step -
accuracy: 0.8985 - loss: 0.2848 - val_accuracy: 0.8707 - val_loss: 0.3572
Epoch 305/600
150/150            15s 103ms/step -
accuracy: 0.8857 - loss: 0.3093 - val_accuracy: 0.8449 - val_loss: 0.4446
Epoch 306/600
150/150            16s 104ms/step -
accuracy: 0.8962 - loss: 0.2807 - val_accuracy: 0.8565 - val_loss: 0.4226
Epoch 307/600
150/150            15s 102ms/step -
accuracy: 0.8869 - loss: 0.3040 - val_accuracy: 0.8424 - val_loss: 0.4394
Epoch 308/600
150/150            16s 104ms/step -
accuracy: 0.8967 - loss: 0.2845 - val_accuracy: 0.8507 - val_loss: 0.4131
Epoch 309/600
150/150            21s 105ms/step -
accuracy: 0.8987 - loss: 0.2779 - val_accuracy: 0.8249 - val_loss: 0.5151
Epoch 310/600
150/150            15s 103ms/step -
accuracy: 0.8971 - loss: 0.2778 - val_accuracy: 0.8724 - val_loss: 0.3966
Epoch 311/600
```

```
150/150            16s 103ms/step -
accuracy: 0.8881 - loss: 0.3222 - val_accuracy: 0.8741 - val_loss: 0.3833
Epoch 312/600
150/150            16s 104ms/step -
accuracy: 0.9054 - loss: 0.2763 - val_accuracy: 0.8557 - val_loss: 0.3983
Epoch 313/600
150/150            15s 102ms/step -
accuracy: 0.8945 - loss: 0.2908 - val_accuracy: 0.8590 - val_loss: 0.4116
Epoch 314/600
150/150            16s 104ms/step -
accuracy: 0.8984 - loss: 0.2936 - val_accuracy: 0.8249 - val_loss: 0.4646
Epoch 315/600
150/150            15s 102ms/step -
accuracy: 0.8971 - loss: 0.2720 - val_accuracy: 0.8582 - val_loss: 0.4364
Epoch 316/600
150/150            20s 102ms/step -
accuracy: 0.9026 - loss: 0.2711 - val_accuracy: 0.8741 - val_loss: 0.3975
Epoch 317/600
150/150            15s 103ms/step -
accuracy: 0.9060 - loss: 0.2493 - val_accuracy: 0.8699 - val_loss: 0.3841
Epoch 318/600
150/150            15s 101ms/step -
accuracy: 0.9001 - loss: 0.2922 - val_accuracy: 0.8774 - val_loss: 0.3689
Epoch 319/600
150/150            15s 102ms/step -
accuracy: 0.9101 - loss: 0.2465 - val_accuracy: 0.8073 - val_loss: 0.5206
Epoch 320/600
150/150            16s 104ms/step -
accuracy: 0.8837 - loss: 0.2990 - val_accuracy: 0.8549 - val_loss: 0.3810
Epoch 321/600
150/150            20s 104ms/step -
accuracy: 0.9048 - loss: 0.2670 - val_accuracy: 0.8507 - val_loss: 0.4217
Epoch 322/600
150/150            15s 102ms/step -
accuracy: 0.8950 - loss: 0.2786 - val_accuracy: 0.8682 - val_loss: 0.3699
Epoch 323/600
150/150            15s 102ms/step -
accuracy: 0.9011 - loss: 0.2749 - val_accuracy: 0.8390 - val_loss: 0.4209
Epoch 324/600
150/150            16s 103ms/step -
accuracy: 0.9096 - loss: 0.2578 - val_accuracy: 0.8324 - val_loss: 0.5085
Epoch 325/600
150/150            15s 102ms/step -
accuracy: 0.8770 - loss: 0.3495 - val_accuracy: 0.8198 - val_loss: 0.5369
Epoch 326/600
150/150            16s 105ms/step -
accuracy: 0.8637 - loss: 0.3746 - val_accuracy: 0.8799 - val_loss: 0.3346
Epoch 327/600
```

```
150/150            16s 104ms/step -
accuracy: 0.8899 - loss: 0.3112 - val_accuracy: 0.8515 - val_loss: 0.4395
Epoch 328/600
150/150            20s 101ms/step -
accuracy: 0.8815 - loss: 0.3242 - val_accuracy: 0.8749 - val_loss: 0.3659
Epoch 329/600
150/150            16s 108ms/step -
accuracy: 0.8951 - loss: 0.3037 - val_accuracy: 0.8590 - val_loss: 0.4224
Epoch 330/600
150/150            16s 105ms/step -
accuracy: 0.9068 - loss: 0.2590 - val_accuracy: 0.8732 - val_loss: 0.3636
Epoch 331/600
150/150            16s 105ms/step -
accuracy: 0.9026 - loss: 0.2523 - val_accuracy: 0.8666 - val_loss: 0.4023
Epoch 332/600
150/150            16s 104ms/step -
accuracy: 0.9183 - loss: 0.2345 - val_accuracy: 0.8590 - val_loss: 0.4411
Epoch 333/600
150/150            15s 101ms/step -
accuracy: 0.9025 - loss: 0.2591 - val_accuracy: 0.8832 - val_loss: 0.3421
Epoch 334/600
150/150            21s 102ms/step -
accuracy: 0.9119 - loss: 0.2369 - val_accuracy: 0.8582 - val_loss: 0.3884
Epoch 335/600
150/150            16s 105ms/step -
accuracy: 0.8918 - loss: 0.2979 - val_accuracy: 0.8232 - val_loss: 0.5228
Epoch 336/600
150/150            15s 102ms/step -
accuracy: 0.8914 - loss: 0.2949 - val_accuracy: 0.8807 - val_loss: 0.3605
Epoch 337/600
150/150            16s 105ms/step -
accuracy: 0.9093 - loss: 0.2646 - val_accuracy: 0.8682 - val_loss: 0.3685
Epoch 338/600
150/150            15s 101ms/step -
accuracy: 0.9062 - loss: 0.2646 - val_accuracy: 0.8716 - val_loss: 0.3646
Epoch 339/600
150/150            15s 103ms/step -
accuracy: 0.9130 - loss: 0.2461 - val_accuracy: 0.8691 - val_loss: 0.3909
Epoch 340/600
150/150            16s 104ms/step -
accuracy: 0.8983 - loss: 0.2819 - val_accuracy: 0.8724 - val_loss: 0.3787
Epoch 341/600
150/150            15s 102ms/step -
accuracy: 0.9129 - loss: 0.2276 - val_accuracy: 0.8524 - val_loss: 0.4191
Epoch 342/600
150/150            16s 105ms/step -
accuracy: 0.8998 - loss: 0.2762 - val_accuracy: 0.8724 - val_loss: 0.3732
Epoch 343/600
```

```
150/150            15s 101ms/step -
accuracy: 0.9203 - loss: 0.2196 - val_accuracy: 0.8816 - val_loss: 0.3810
Epoch 344/600
150/150            16s 104ms/step -
accuracy: 0.8986 - loss: 0.2900 - val_accuracy: 0.8482 - val_loss: 0.4147
Epoch 345/600
150/150            15s 101ms/step -
accuracy: 0.8883 - loss: 0.2997 - val_accuracy: 0.8757 - val_loss: 0.3851
Epoch 346/600
150/150            16s 108ms/step -
accuracy: 0.9005 - loss: 0.2826 - val_accuracy: 0.8565 - val_loss: 0.4509
Epoch 347/600
150/150            15s 102ms/step -
accuracy: 0.8882 - loss: 0.3082 - val_accuracy: 0.8782 - val_loss: 0.3723
Epoch 348/600
150/150            16s 103ms/step -
accuracy: 0.9270 - loss: 0.2040 - val_accuracy: 0.7556 - val_loss: 0.7732
Epoch 349/600
150/150            15s 101ms/step -
accuracy: 0.8772 - loss: 0.3613 - val_accuracy: 0.8866 - val_loss: 0.3372
Epoch 350/600
150/150            16s 105ms/step -
accuracy: 0.9082 - loss: 0.2463 - val_accuracy: 0.8299 - val_loss: 0.4992
Epoch 351/600
150/150            15s 102ms/step -
accuracy: 0.8962 - loss: 0.2883 - val_accuracy: 0.8757 - val_loss: 0.4060
Epoch 352/600
150/150            16s 104ms/step -
accuracy: 0.9192 - loss: 0.2345 - val_accuracy: 0.8841 - val_loss: 0.3514
Epoch 353/600
150/150            15s 101ms/step -
accuracy: 0.9059 - loss: 0.2489 - val_accuracy: 0.8574 - val_loss: 0.4276
Epoch 354/600
150/150            15s 103ms/step -
accuracy: 0.9055 - loss: 0.2551 - val_accuracy: 0.8807 - val_loss: 0.3701
Epoch 355/600
150/150            15s 102ms/step -
accuracy: 0.9016 - loss: 0.2800 - val_accuracy: 0.8749 - val_loss: 0.3764
Epoch 356/600
150/150            21s 106ms/step -
accuracy: 0.9068 - loss: 0.2546 - val_accuracy: 0.8716 - val_loss: 0.3652
Epoch 357/600
150/150            16s 103ms/step -
accuracy: 0.9183 - loss: 0.2363 - val_accuracy: 0.8699 - val_loss: 0.3888
Epoch 358/600
150/150            16s 105ms/step -
accuracy: 0.9257 - loss: 0.2068 - val_accuracy: 0.8557 - val_loss: 0.3935
Epoch 359/600
```

```
150/150            15s 102ms/step -
accuracy: 0.9138 - loss: 0.2284 - val_accuracy: 0.8707 - val_loss: 0.3917
Epoch 360/600
150/150            16s 105ms/step -
accuracy: 0.9184 - loss: 0.2243 - val_accuracy: 0.8449 - val_loss: 0.4863
Epoch 361/600
150/150            15s 103ms/step -
accuracy: 0.9157 - loss: 0.2364 - val_accuracy: 0.8774 - val_loss: 0.3607
Epoch 362/600
150/150            21s 105ms/step -
accuracy: 0.9331 - loss: 0.1858 - val_accuracy: 0.8666 - val_loss: 0.3941
Epoch 363/600
150/150            20s 102ms/step -
accuracy: 0.9114 - loss: 0.2581 - val_accuracy: 0.8332 - val_loss: 0.5245
Epoch 364/600
150/150            16s 105ms/step -
accuracy: 0.9061 - loss: 0.2798 - val_accuracy: 0.8724 - val_loss: 0.3829
Epoch 365/600
150/150            20s 101ms/step -
accuracy: 0.8876 - loss: 0.3066 - val_accuracy: 0.8766 - val_loss: 0.3677
Epoch 366/600
150/150            16s 105ms/step -
accuracy: 0.9173 - loss: 0.2601 - val_accuracy: 0.8949 - val_loss: 0.3423
Epoch 367/600
150/150            15s 103ms/step -
accuracy: 0.9147 - loss: 0.2478 - val_accuracy: 0.8674 - val_loss: 0.4263
Epoch 368/600
150/150            16s 106ms/step -
accuracy: 0.8912 - loss: 0.3023 - val_accuracy: 0.8457 - val_loss: 0.4376
Epoch 369/600
150/150            15s 102ms/step -
accuracy: 0.9090 - loss: 0.2411 - val_accuracy: 0.8641 - val_loss: 0.4159
Epoch 370/600
150/150            16s 104ms/step -
accuracy: 0.9121 - loss: 0.2361 - val_accuracy: 0.7665 - val_loss: 0.7710
Epoch 371/600
150/150            20s 102ms/step -
accuracy: 0.8891 - loss: 0.3063 - val_accuracy: 0.8824 - val_loss: 0.3604
Epoch 372/600
150/150            16s 106ms/step -
accuracy: 0.9183 - loss: 0.2196 - val_accuracy: 0.8465 - val_loss: 0.4421
Epoch 373/600
150/150            15s 101ms/step -
accuracy: 0.9110 - loss: 0.2601 - val_accuracy: 0.8874 - val_loss: 0.3397
Epoch 374/600
150/150            21s 101ms/step -
accuracy: 0.9326 - loss: 0.1951 - val_accuracy: 0.8766 - val_loss: 0.3848
Epoch 375/600
```

```
150/150            21s 104ms/step -
accuracy: 0.9214 - loss: 0.2183 - val_accuracy: 0.8657 - val_loss: 0.3977
Epoch 376/600
150/150            15s 102ms/step -
accuracy: 0.9244 - loss: 0.2241 - val_accuracy: 0.8866 - val_loss: 0.3234
Epoch 377/600
150/150            21s 103ms/step -
accuracy: 0.9235 - loss: 0.2142 - val_accuracy: 0.8799 - val_loss: 0.3649
Epoch 378/600
150/150            15s 100ms/step -
accuracy: 0.9263 - loss: 0.2154 - val_accuracy: 0.8907 - val_loss: 0.3489
Epoch 379/600
150/150            16s 103ms/step -
accuracy: 0.9230 - loss: 0.2251 - val_accuracy: 0.8941 - val_loss: 0.3690
Epoch 380/600
150/150            15s 101ms/step -
accuracy: 0.9069 - loss: 0.2588 - val_accuracy: 0.8899 - val_loss: 0.3347
Epoch 381/600
150/150            16s 104ms/step -
accuracy: 0.9253 - loss: 0.2209 - val_accuracy: 0.8774 - val_loss: 0.4021
Epoch 382/600
150/150            15s 101ms/step -
accuracy: 0.9230 - loss: 0.2244 - val_accuracy: 0.8874 - val_loss: 0.3552
Epoch 383/600
150/150            16s 103ms/step -
accuracy: 0.9236 - loss: 0.2119 - val_accuracy: 0.8757 - val_loss: 0.4177
Epoch 384/600
150/150            15s 101ms/step -
accuracy: 0.8711 - loss: 0.3795 - val_accuracy: 0.8941 - val_loss: 0.3267
Epoch 385/600
150/150            21s 105ms/step -
accuracy: 0.9094 - loss: 0.2597 - val_accuracy: 0.8632 - val_loss: 0.4073
Epoch 386/600
150/150            20s 103ms/step -
accuracy: 0.8945 - loss: 0.2887 - val_accuracy: 0.8716 - val_loss: 0.4024
Epoch 387/600
150/150            20s 101ms/step -
accuracy: 0.9198 - loss: 0.2352 - val_accuracy: 0.8657 - val_loss: 0.3854
Epoch 388/600
150/150            15s 100ms/step -
accuracy: 0.9206 - loss: 0.2248 - val_accuracy: 0.8832 - val_loss: 0.3750
Epoch 389/600
150/150            16s 103ms/step -
accuracy: 0.9202 - loss: 0.2169 - val_accuracy: 0.8465 - val_loss: 0.4909
Epoch 390/600
150/150            15s 101ms/step -
accuracy: 0.9313 - loss: 0.2067 - val_accuracy: 0.8807 - val_loss: 0.3624
Epoch 391/600
```

```
150/150            16s 103ms/step -
accuracy: 0.9178 - loss: 0.2310 - val_accuracy: 0.8916 - val_loss: 0.3593
Epoch 392/600
150/150            15s 101ms/step -
accuracy: 0.9208 - loss: 0.2213 - val_accuracy: 0.8932 - val_loss: 0.3073
Epoch 393/600
150/150            15s 103ms/step -
accuracy: 0.9334 - loss: 0.1916 - val_accuracy: 0.8866 - val_loss: 0.3287
Epoch 394/600
150/150            15s 102ms/step -
accuracy: 0.9444 - loss: 0.1683 - val_accuracy: 0.8699 - val_loss: 0.3975
Epoch 395/600
150/150            15s 103ms/step -
accuracy: 0.9157 - loss: 0.2324 - val_accuracy: 0.8799 - val_loss: 0.3930
Epoch 396/600
150/150            15s 101ms/step -
accuracy: 0.9270 - loss: 0.2060 - val_accuracy: 0.8716 - val_loss: 0.4009
Epoch 397/600
150/150            15s 103ms/step -
accuracy: 0.9243 - loss: 0.2298 - val_accuracy: 0.8882 - val_loss: 0.3535
Epoch 398/600
150/150            15s 99ms/step -
accuracy: 0.9373 - loss: 0.1886 - val_accuracy: 0.8866 - val_loss: 0.3509
Epoch 399/600
150/150            15s 103ms/step -
accuracy: 0.9055 - loss: 0.2665 - val_accuracy: 0.8907 - val_loss: 0.3303
Epoch 400/600
150/150            15s 100ms/step -
accuracy: 0.9119 - loss: 0.2471 - val_accuracy: 0.8791 - val_loss: 0.3583
Epoch 401/600
150/150            21s 104ms/step -
accuracy: 0.9268 - loss: 0.2215 - val_accuracy: 0.8807 - val_loss: 0.3449
Epoch 402/600
150/150            20s 101ms/step -
accuracy: 0.9256 - loss: 0.2222 - val_accuracy: 0.8857 - val_loss: 0.3753
Epoch 403/600
150/150            15s 103ms/step -
accuracy: 0.9354 - loss: 0.1830 - val_accuracy: 0.8649 - val_loss: 0.4474
Epoch 404/600
150/150            15s 102ms/step -
accuracy: 0.8947 - loss: 0.2982 - val_accuracy: 0.8999 - val_loss: 0.2976
Epoch 405/600
150/150            16s 104ms/step -
accuracy: 0.9410 - loss: 0.1733 - val_accuracy: 0.8549 - val_loss: 0.5000
Epoch 406/600
150/150            21s 104ms/step -
accuracy: 0.9175 - loss: 0.2378 - val_accuracy: 0.8891 - val_loss: 0.3898
Epoch 407/600
```

```
150/150            16s 105ms/step -
accuracy: 0.9298 - loss: 0.1811 - val_accuracy: 0.8849 - val_loss: 0.3957
Epoch 408/600
150/150            15s 102ms/step -
accuracy: 0.9454 - loss: 0.1618 - val_accuracy: 0.8657 - val_loss: 0.3772
Epoch 409/600
150/150            16s 105ms/step -
accuracy: 0.9229 - loss: 0.2311 - val_accuracy: 0.8907 - val_loss: 0.3214
Epoch 410/600
150/150            15s 102ms/step -
accuracy: 0.9394 - loss: 0.1813 - val_accuracy: 0.9116 - val_loss: 0.3012
Epoch 411/600
150/150            16s 104ms/step -
accuracy: 0.9464 - loss: 0.1620 - val_accuracy: 0.8807 - val_loss: 0.4142
Epoch 412/600
150/150            20s 101ms/step -
accuracy: 0.9300 - loss: 0.2071 - val_accuracy: 0.8415 - val_loss: 0.4514
Epoch 413/600
150/150            16s 104ms/step -
accuracy: 0.9258 - loss: 0.2070 - val_accuracy: 0.8882 - val_loss: 0.3562
Epoch 414/600
150/150            15s 101ms/step -
accuracy: 0.9325 - loss: 0.2140 - val_accuracy: 0.8791 - val_loss: 0.3863
Epoch 415/600
150/150            16s 104ms/step -
accuracy: 0.9476 - loss: 0.1754 - val_accuracy: 0.8791 - val_loss: 0.3641
Epoch 416/600
150/150            15s 101ms/step -
accuracy: 0.9109 - loss: 0.2433 - val_accuracy: 0.8966 - val_loss: 0.3309
Epoch 417/600
150/150            15s 103ms/step -
accuracy: 0.9339 - loss: 0.1935 - val_accuracy: 0.9024 - val_loss: 0.3122
Epoch 418/600
150/150            15s 100ms/step -
accuracy: 0.9474 - loss: 0.1540 - val_accuracy: 0.8374 - val_loss: 0.5439
Epoch 419/600
150/150            15s 103ms/step -
accuracy: 0.9064 - loss: 0.2852 - val_accuracy: 0.8857 - val_loss: 0.3623
Epoch 420/600
150/150            15s 101ms/step -
accuracy: 0.8845 - loss: 0.3370 - val_accuracy: 0.8774 - val_loss: 0.3525
Epoch 421/600
150/150            16s 103ms/step -
accuracy: 0.9355 - loss: 0.1798 - val_accuracy: 0.8974 - val_loss: 0.3399
Epoch 422/600
150/150            20s 103ms/step -
accuracy: 0.9406 - loss: 0.1768 - val_accuracy: 0.8691 - val_loss: 0.3909
Epoch 423/600
```

```
150/150            16s 104ms/step -
accuracy: 0.9171 - loss: 0.2264 - val_accuracy: 0.8866 - val_loss: 0.3522
Epoch 424/600
150/150            15s 102ms/step -
accuracy: 0.9364 - loss: 0.1907 - val_accuracy: 0.8899 - val_loss: 0.3751
Epoch 425/600
150/150            16s 105ms/step -
accuracy: 0.9395 - loss: 0.1901 - val_accuracy: 0.8866 - val_loss: 0.3295
Epoch 426/600
150/150            15s 102ms/step -
accuracy: 0.9408 - loss: 0.1812 - val_accuracy: 0.8907 - val_loss: 0.3822
Epoch 427/600
150/150            16s 105ms/step -
accuracy: 0.9245 - loss: 0.2077 - val_accuracy: 0.8716 - val_loss: 0.4183
Epoch 428/600
150/150            15s 101ms/step -
accuracy: 0.9210 - loss: 0.2255 - val_accuracy: 0.8582 - val_loss: 0.4298
Epoch 429/600
150/150            16s 104ms/step -
accuracy: 0.9312 - loss: 0.2009 - val_accuracy: 0.8924 - val_loss: 0.3768
Epoch 430/600
150/150            15s 102ms/step -
accuracy: 0.9493 - loss: 0.1475 - val_accuracy: 0.8824 - val_loss: 0.3950
Epoch 431/600
150/150            15s 103ms/step -
accuracy: 0.9226 - loss: 0.2154 - val_accuracy: 0.9008 - val_loss: 0.3492
Epoch 432/600
150/150            16s 104ms/step -
accuracy: 0.9401 - loss: 0.1743 - val_accuracy: 0.8691 - val_loss: 0.3990
Epoch 433/600
150/150            15s 101ms/step -
accuracy: 0.9275 - loss: 0.2054 - val_accuracy: 0.8123 - val_loss: 0.6347
Epoch 434/600
150/150            16s 104ms/step -
accuracy: 0.9118 - loss: 0.2954 - val_accuracy: 0.8724 - val_loss: 0.3655
Epoch 435/600
150/150            15s 102ms/step -
accuracy: 0.9247 - loss: 0.2094 - val_accuracy: 0.8849 - val_loss: 0.3605
Epoch 436/600
150/150            16s 105ms/step -
accuracy: 0.9358 - loss: 0.1752 - val_accuracy: 0.8507 - val_loss: 0.4843
Epoch 437/600
150/150            15s 102ms/step -
accuracy: 0.9276 - loss: 0.2099 - val_accuracy: 0.8874 - val_loss: 0.3927
Epoch 438/600
150/150            16s 105ms/step -
accuracy: 0.9323 - loss: 0.1867 - val_accuracy: 0.8657 - val_loss: 0.4457
Epoch 439/600
```

```
150/150            15s 102ms/step -
accuracy: 0.9211 - loss: 0.2352 - val_accuracy: 0.8332 - val_loss: 0.5804
Epoch 440/600
150/150            16s 105ms/step -
accuracy: 0.9240 - loss: 0.2310 - val_accuracy: 0.9008 - val_loss: 0.3188
Epoch 441/600
150/150            15s 102ms/step -
accuracy: 0.9352 - loss: 0.1828 - val_accuracy: 0.8791 - val_loss: 0.3930
Epoch 442/600
150/150            16s 104ms/step -
accuracy: 0.9486 - loss: 0.1629 - val_accuracy: 0.9124 - val_loss: 0.3037
Epoch 443/600
150/150            15s 102ms/step -
accuracy: 0.9226 - loss: 0.2188 - val_accuracy: 0.8724 - val_loss: 0.4139
Epoch 444/600
150/150            16s 103ms/step -
accuracy: 0.9215 - loss: 0.2446 - val_accuracy: 0.8732 - val_loss: 0.3787
Epoch 445/600
150/150            15s 102ms/step -
accuracy: 0.9489 - loss: 0.1577 - val_accuracy: 0.8173 - val_loss: 0.6769
Epoch 446/600
150/150            16s 105ms/step -
accuracy: 0.9060 - loss: 0.2782 - val_accuracy: 0.8098 - val_loss: 0.6191
Epoch 447/600
150/150            15s 102ms/step -
accuracy: 0.9140 - loss: 0.2530 - val_accuracy: 0.8682 - val_loss: 0.4524
Epoch 448/600
150/150            21s 104ms/step -
accuracy: 0.9388 - loss: 0.1818 - val_accuracy: 0.8849 - val_loss: 0.3910
Epoch 449/600
150/150            20s 101ms/step -
accuracy: 0.9254 - loss: 0.2012 - val_accuracy: 0.8916 - val_loss: 0.3436
Epoch 450/600
150/150            16s 104ms/step -
accuracy: 0.8978 - loss: 0.3196 - val_accuracy: 0.8974 - val_loss: 0.3206
Epoch 451/600
150/150            15s 101ms/step -
accuracy: 0.9349 - loss: 0.1941 - val_accuracy: 0.8999 - val_loss: 0.3108
Epoch 452/600
150/150            16s 104ms/step -
accuracy: 0.9524 - loss: 0.1664 - val_accuracy: 0.8807 - val_loss: 0.4066
Epoch 453/600
150/150            15s 101ms/step -
accuracy: 0.9301 - loss: 0.2166 - val_accuracy: 0.8674 - val_loss: 0.4377
Epoch 454/600
150/150            15s 103ms/step -
accuracy: 0.9267 - loss: 0.2092 - val_accuracy: 0.8849 - val_loss: 0.3543
Epoch 455/600
```

```
150/150            15s 101ms/step -
accuracy: 0.9315 - loss: 0.2064 - val_accuracy: 0.9074 - val_loss: 0.2985
Epoch 456/600
150/150            21s 104ms/step -
accuracy: 0.9361 - loss: 0.1863 - val_accuracy: 0.8841 - val_loss: 0.3917
Epoch 457/600
150/150            15s 101ms/step -
accuracy: 0.9363 - loss: 0.1902 - val_accuracy: 0.8774 - val_loss: 0.4043
Epoch 458/600
150/150            16s 104ms/step -
accuracy: 0.9462 - loss: 0.1615 - val_accuracy: 0.8699 - val_loss: 0.4279
Epoch 459/600
150/150            15s 102ms/step -
accuracy: 0.9285 - loss: 0.1989 - val_accuracy: 0.8974 - val_loss: 0.3413
Epoch 460/600
150/150            16s 104ms/step -
accuracy: 0.9120 - loss: 0.2675 - val_accuracy: 0.8841 - val_loss: 0.3954
Epoch 461/600
150/150            15s 102ms/step -
accuracy: 0.9563 - loss: 0.1416 - val_accuracy: 0.9183 - val_loss: 0.2884
Epoch 462/600
150/150            16s 104ms/step -
accuracy: 0.9156 - loss: 0.2445 - val_accuracy: 0.8982 - val_loss: 0.3291
Epoch 463/600
150/150            15s 102ms/step -
accuracy: 0.9348 - loss: 0.1945 - val_accuracy: 0.8932 - val_loss: 0.3609
Epoch 464/600
150/150            21s 103ms/step -
accuracy: 0.9287 - loss: 0.2008 - val_accuracy: 0.8949 - val_loss: 0.3425
Epoch 465/600
150/150            20s 101ms/step -
accuracy: 0.9430 - loss: 0.1623 - val_accuracy: 0.9016 - val_loss: 0.3460
Epoch 466/600
150/150            16s 104ms/step -
accuracy: 0.9276 - loss: 0.2082 - val_accuracy: 0.8874 - val_loss: 0.3456
Epoch 467/600
150/150            15s 101ms/step -
accuracy: 0.9432 - loss: 0.1750 - val_accuracy: 0.8916 - val_loss: 0.3525
Epoch 468/600
150/150            16s 104ms/step -
accuracy: 0.9300 - loss: 0.1949 - val_accuracy: 0.8891 - val_loss: 0.3827
Epoch 469/600
150/150            15s 101ms/step -
accuracy: 0.9495 - loss: 0.1396 - val_accuracy: 0.8832 - val_loss: 0.3820
Epoch 470/600
150/150            16s 103ms/step -
accuracy: 0.8999 - loss: 0.3125 - val_accuracy: 0.8932 - val_loss: 0.3468
Epoch 471/600
```

```
150/150            15s 101ms/step -
accuracy: 0.9175 - loss: 0.2301 - val_accuracy: 0.8657 - val_loss: 0.4293
Epoch 472/600
150/150            16s 104ms/step -
accuracy: 0.9348 - loss: 0.2003 - val_accuracy: 0.8782 - val_loss: 0.3793
Epoch 473/600
150/150            15s 101ms/step -
accuracy: 0.9432 - loss: 0.1746 - val_accuracy: 0.8807 - val_loss: 0.3949
Epoch 474/600
150/150            16s 103ms/step -
accuracy: 0.9233 - loss: 0.2053 - val_accuracy: 0.9016 - val_loss: 0.3400
Epoch 475/600
150/150            15s 102ms/step -
accuracy: 0.9485 - loss: 0.1461 - val_accuracy: 0.9066 - val_loss: 0.3155
Epoch 476/600
150/150            15s 103ms/step -
accuracy: 0.9486 - loss: 0.1601 - val_accuracy: 0.8949 - val_loss: 0.3345
Epoch 477/600
150/150            15s 103ms/step -
accuracy: 0.9487 - loss: 0.1745 - val_accuracy: 0.8057 - val_loss: 0.7934
Epoch 478/600
150/150            15s 102ms/step -
accuracy: 0.9147 - loss: 0.2717 - val_accuracy: 0.9008 - val_loss: 0.3651
Epoch 479/600
150/150            20s 101ms/step -
accuracy: 0.9586 - loss: 0.1314 - val_accuracy: 0.8782 - val_loss: 0.4452
Epoch 480/600
150/150            16s 104ms/step -
accuracy: 0.9334 - loss: 0.1922 - val_accuracy: 0.8941 - val_loss: 0.3394
Epoch 481/600
150/150            15s 101ms/step -
accuracy: 0.9309 - loss: 0.2039 - val_accuracy: 0.8941 - val_loss: 0.3994
Epoch 482/600
150/150            21s 104ms/step -
accuracy: 0.9198 - loss: 0.2358 - val_accuracy: 0.9099 - val_loss: 0.2912
Epoch 483/600
150/150            15s 102ms/step -
accuracy: 0.9587 - loss: 0.1300 - val_accuracy: 0.8932 - val_loss: 0.3945
Epoch 484/600
150/150            16s 104ms/step -
accuracy: 0.9329 - loss: 0.1888 - val_accuracy: 0.8932 - val_loss: 0.3661
Epoch 485/600
150/150            15s 102ms/step -
accuracy: 0.9533 - loss: 0.1470 - val_accuracy: 0.8774 - val_loss: 0.4434
Epoch 486/600
150/150            16s 104ms/step -
accuracy: 0.9340 - loss: 0.1962 - val_accuracy: 0.9099 - val_loss: 0.3056
Epoch 487/600
```

```
150/150            15s 101ms/step -
accuracy: 0.9508 - loss: 0.1507 - val_accuracy: 0.8565 - val_loss: 0.4334
Epoch 488/600
150/150            16s 104ms/step -
accuracy: 0.8803 - loss: 0.3525 - val_accuracy: 0.8932 - val_loss: 0.3581
Epoch 489/600
150/150            15s 100ms/step -
accuracy: 0.9474 - loss: 0.1633 - val_accuracy: 0.8866 - val_loss: 0.3877
Epoch 490/600
150/150            15s 102ms/step -
accuracy: 0.9433 - loss: 0.1787 - val_accuracy: 0.8941 - val_loss: 0.3780
Epoch 491/600
150/150            16s 104ms/step -
accuracy: 0.9426 - loss: 0.1796 - val_accuracy: 0.8791 - val_loss: 0.4531
Epoch 492/600
150/150            15s 102ms/step -
accuracy: 0.9088 - loss: 0.2775 - val_accuracy: 0.9099 - val_loss: 0.2948
Epoch 493/600
150/150            16s 104ms/step -
accuracy: 0.9502 - loss: 0.1645 - val_accuracy: 0.8832 - val_loss: 0.4001
Epoch 494/600
150/150            20s 101ms/step -
accuracy: 0.9485 - loss: 0.1517 - val_accuracy: 0.8716 - val_loss: 0.4356
Epoch 495/600
150/150            15s 103ms/step -
accuracy: 0.9490 - loss: 0.1491 - val_accuracy: 0.8899 - val_loss: 0.3864
Epoch 496/600
150/150            15s 102ms/step -
accuracy: 0.9422 - loss: 0.1612 - val_accuracy: 0.9066 - val_loss: 0.3082
Epoch 497/600
150/150            16s 105ms/step -
accuracy: 0.9353 - loss: 0.1914 - val_accuracy: 0.9008 - val_loss: 0.3492
Epoch 498/600
150/150            20s 103ms/step -
accuracy: 0.9497 - loss: 0.1408 - val_accuracy: 0.8899 - val_loss: 0.3544
Epoch 499/600
150/150            15s 100ms/step -
accuracy: 0.9261 - loss: 0.2186 - val_accuracy: 0.9058 - val_loss: 0.3466
Epoch 500/600
150/150            15s 100ms/step -
accuracy: 0.9393 - loss: 0.1595 - val_accuracy: 0.9141 - val_loss: 0.3266
Epoch 501/600
150/150            15s 103ms/step -
accuracy: 0.9492 - loss: 0.1517 - val_accuracy: 0.8565 - val_loss: 0.3877
Epoch 502/600
150/150            21s 103ms/step -
accuracy: 0.9327 - loss: 0.1979 - val_accuracy: 0.8482 - val_loss: 0.5043
Epoch 503/600
```

```
150/150            15s 100ms/step -
accuracy: 0.9154 - loss: 0.2551 - val_accuracy: 0.9024 - val_loss: 0.3075
Epoch 504/600
150/150            15s 103ms/step -
accuracy: 0.9484 - loss: 0.1555 - val_accuracy: 0.8716 - val_loss: 0.4081
Epoch 505/600
150/150            20s 101ms/step -
accuracy: 0.9363 - loss: 0.1841 - val_accuracy: 0.8941 - val_loss: 0.3834
Epoch 506/600
150/150            16s 103ms/step -
accuracy: 0.9440 - loss: 0.1653 - val_accuracy: 0.9141 - val_loss: 0.3242
Epoch 507/600
150/150            15s 101ms/step -
accuracy: 0.9473 - loss: 0.1559 - val_accuracy: 0.8899 - val_loss: 0.4020
Epoch 508/600
150/150            21s 104ms/step -
accuracy: 0.9402 - loss: 0.1924 - val_accuracy: 0.8882 - val_loss: 0.3955
Epoch 509/600
150/150            15s 101ms/step -
accuracy: 0.9388 - loss: 0.1920 - val_accuracy: 0.9033 - val_loss: 0.3480
Epoch 510/600
150/150            21s 104ms/step -
accuracy: 0.9333 - loss: 0.2091 - val_accuracy: 0.9041 - val_loss: 0.3295
Epoch 511/600
150/150            20s 102ms/step -
accuracy: 0.9517 - loss: 0.1431 - val_accuracy: 0.8649 - val_loss: 0.4679
Epoch 512/600
150/150            15s 103ms/step -
accuracy: 0.9449 - loss: 0.1646 - val_accuracy: 0.8941 - val_loss: 0.3575
Epoch 513/600
150/150            15s 100ms/step -
accuracy: 0.9526 - loss: 0.1426 - val_accuracy: 0.9016 - val_loss: 0.3378
Epoch 514/600
150/150            16s 104ms/step -
accuracy: 0.9479 - loss: 0.1596 - val_accuracy: 0.8974 - val_loss: 0.3596
Epoch 515/600
150/150            15s 102ms/step -
accuracy: 0.9486 - loss: 0.1533 - val_accuracy: 0.8907 - val_loss: 0.3705
Epoch 516/600
150/150            16s 104ms/step -
accuracy: 0.9286 - loss: 0.1983 - val_accuracy: 0.8849 - val_loss: 0.3772
Epoch 517/600
150/150            15s 101ms/step -
accuracy: 0.9563 - loss: 0.1403 - val_accuracy: 0.9033 - val_loss: 0.3110
Epoch 518/600
150/150            15s 103ms/step -
accuracy: 0.9466 - loss: 0.1727 - val_accuracy: 0.8957 - val_loss: 0.3371
Epoch 519/600
```

```
150/150            15s 100ms/step -
accuracy: 0.9448 - loss: 0.1537 - val_accuracy: 0.8782 - val_loss: 0.4427
Epoch 520/600
150/150            15s 103ms/step -
accuracy: 0.9269 - loss: 0.2037 - val_accuracy: 0.8991 - val_loss: 0.3465
Epoch 521/600
150/150            20s 101ms/step -
accuracy: 0.9558 - loss: 0.1321 - val_accuracy: 0.9208 - val_loss: 0.2841
Epoch 522/600
150/150            16s 104ms/step -
accuracy: 0.9633 - loss: 0.1038 - val_accuracy: 0.8832 - val_loss: 0.4174
Epoch 523/600
150/150            15s 101ms/step -
accuracy: 0.8992 - loss: 0.3186 - val_accuracy: 0.8907 - val_loss: 0.3594
Epoch 524/600
150/150            16s 104ms/step -
accuracy: 0.9542 - loss: 0.1343 - val_accuracy: 0.9158 - val_loss: 0.3184
Epoch 525/600
150/150            15s 101ms/step -
accuracy: 0.9605 - loss: 0.1187 - val_accuracy: 0.8766 - val_loss: 0.4632
Epoch 526/600
150/150            16s 104ms/step -
accuracy: 0.9271 - loss: 0.2302 - val_accuracy: 0.8982 - val_loss: 0.3589
Epoch 527/600
150/150            15s 102ms/step -
accuracy: 0.9383 - loss: 0.1951 - val_accuracy: 0.9024 - val_loss: 0.3332
Epoch 528/600
150/150            16s 104ms/step -
accuracy: 0.9534 - loss: 0.1457 - val_accuracy: 0.8632 - val_loss: 0.4740
Epoch 529/600
150/150            15s 101ms/step -
accuracy: 0.9178 - loss: 0.2392 - val_accuracy: 0.8932 - val_loss: 0.3419
Epoch 530/600
150/150            16s 103ms/step -
accuracy: 0.9505 - loss: 0.1380 - val_accuracy: 0.9041 - val_loss: 0.3719
Epoch 531/600
150/150            15s 101ms/step -
accuracy: 0.9381 - loss: 0.1908 - val_accuracy: 0.8607 - val_loss: 0.4334
Epoch 532/600
150/150            15s 101ms/step -
accuracy: 0.9340 - loss: 0.1848 - val_accuracy: 0.8974 - val_loss: 0.3453
Epoch 533/600
150/150            16s 104ms/step -
accuracy: 0.9550 - loss: 0.1424 - val_accuracy: 0.8524 - val_loss: 0.4992
Epoch 534/600
150/150            15s 102ms/step -
accuracy: 0.9563 - loss: 0.1451 - val_accuracy: 0.8599 - val_loss: 0.4718
Epoch 535/600
```

```
150/150            20s 101ms/step -
accuracy: 0.9323 - loss: 0.2059 - val_accuracy: 0.9099 - val_loss: 0.2995
Epoch 536/600
150/150            15s 103ms/step -
accuracy: 0.9519 - loss: 0.1502 - val_accuracy: 0.9091 - val_loss: 0.3092
Epoch 537/600
150/150            20s 101ms/step -
accuracy: 0.9494 - loss: 0.1590 - val_accuracy: 0.8907 - val_loss: 0.4418
Epoch 538/600
150/150            16s 104ms/step -
accuracy: 0.9182 - loss: 0.2378 - val_accuracy: 0.9049 - val_loss: 0.3260
Epoch 539/600
150/150            15s 100ms/step -
accuracy: 0.9470 - loss: 0.1605 - val_accuracy: 0.9033 - val_loss: 0.3364
Epoch 540/600
150/150            16s 103ms/step -
accuracy: 0.9555 - loss: 0.1370 - val_accuracy: 0.9016 - val_loss: 0.3379
Epoch 541/600
150/150            15s 101ms/step -
accuracy: 0.9454 - loss: 0.1488 - val_accuracy: 0.9033 - val_loss: 0.3573
Epoch 542/600
150/150            15s 102ms/step -
accuracy: 0.9523 - loss: 0.1536 - val_accuracy: 0.9074 - val_loss: 0.3235
Epoch 543/600
150/150            15s 103ms/step -
accuracy: 0.9449 - loss: 0.1649 - val_accuracy: 0.8791 - val_loss: 0.3899
Epoch 544/600
150/150            15s 100ms/step -
accuracy: 0.9325 - loss: 0.1922 - val_accuracy: 0.8874 - val_loss: 0.4014
Epoch 545/600
150/150            20s 100ms/step -
accuracy: 0.9536 - loss: 0.1331 - val_accuracy: 0.8999 - val_loss: 0.3716
Epoch 546/600
150/150            15s 103ms/step -
accuracy: 0.9441 - loss: 0.1755 - val_accuracy: 0.9033 - val_loss: 0.3362
Epoch 547/600
150/150            15s 101ms/step -
accuracy: 0.9379 - loss: 0.1960 - val_accuracy: 0.9024 - val_loss: 0.3535
Epoch 548/600
150/150            15s 101ms/step -
accuracy: 0.9329 - loss: 0.2020 - val_accuracy: 0.9074 - val_loss: 0.3328
Epoch 549/600
150/150            15s 101ms/step -
accuracy: 0.9426 - loss: 0.1681 - val_accuracy: 0.9066 - val_loss: 0.3197
Epoch 550/600
150/150            15s 100ms/step -
accuracy: 0.9451 - loss: 0.1657 - val_accuracy: 0.9058 - val_loss: 0.3187
Epoch 551/600
```

```
150/150            15s 103ms/step -
accuracy: 0.9447 - loss: 0.1751 - val_accuracy: 0.9133 - val_loss: 0.3213
Epoch 552/600
150/150            20s 102ms/step -
accuracy: 0.9517 - loss: 0.1510 - val_accuracy: 0.9016 - val_loss: 0.3317
Epoch 553/600
150/150            15s 102ms/step -
accuracy: 0.9300 - loss: 0.2065 - val_accuracy: 0.9183 - val_loss: 0.3159
Epoch 554/600
150/150            15s 100ms/step -
accuracy: 0.9453 - loss: 0.1585 - val_accuracy: 0.9016 - val_loss: 0.3180
Epoch 555/600
150/150            21s 101ms/step -
accuracy: 0.9560 - loss: 0.1325 - val_accuracy: 0.8991 - val_loss: 0.3585
Epoch 556/600
150/150            15s 103ms/step -
accuracy: 0.9514 - loss: 0.1479 - val_accuracy: 0.9149 - val_loss: 0.3202
Epoch 557/600
150/150            15s 100ms/step -
accuracy: 0.9562 - loss: 0.1363 - val_accuracy: 0.9108 - val_loss: 0.3053
Epoch 558/600
150/150            21s 103ms/step -
accuracy: 0.9362 - loss: 0.2079 - val_accuracy: 0.8982 - val_loss: 0.3699
Epoch 559/600
150/150            20s 100ms/step -
accuracy: 0.9503 - loss: 0.1531 - val_accuracy: 0.8974 - val_loss: 0.3198
Epoch 560/600
150/150            21s 103ms/step -
accuracy: 0.9312 - loss: 0.2001 - val_accuracy: 0.9041 - val_loss: 0.3322
Epoch 561/600
150/150            15s 101ms/step -
accuracy: 0.9430 - loss: 0.1596 - val_accuracy: 0.8490 - val_loss: 0.4756
Epoch 562/600
150/150            16s 103ms/step -
accuracy: 0.9482 - loss: 0.1642 - val_accuracy: 0.9041 - val_loss: 0.3634
Epoch 563/600
150/150            15s 100ms/step -
accuracy: 0.9521 - loss: 0.1311 - val_accuracy: 0.9016 - val_loss: 0.3672
Epoch 564/600
150/150            15s 102ms/step -
accuracy: 0.9571 - loss: 0.1242 - val_accuracy: 0.8565 - val_loss: 0.5331
Epoch 565/600
150/150            15s 100ms/step -
accuracy: 0.9536 - loss: 0.1439 - val_accuracy: 0.8957 - val_loss: 0.3638
Epoch 566/600
150/150            15s 102ms/step -
accuracy: 0.9418 - loss: 0.1750 - val_accuracy: 0.9024 - val_loss: 0.3507
Epoch 567/600
```

```
150/150            15s 100ms/step -
accuracy: 0.9505 - loss: 0.1545 - val_accuracy: 0.8791 - val_loss: 0.4505
Epoch 568/600
150/150            21s 103ms/step -
accuracy: 0.9276 - loss: 0.2039 - val_accuracy: 0.8841 - val_loss: 0.3996
Epoch 569/600
150/150            15s 100ms/step -
accuracy: 0.9443 - loss: 0.1583 - val_accuracy: 0.8691 - val_loss: 0.4751
Epoch 570/600
150/150            16s 103ms/step -
accuracy: 0.9405 - loss: 0.1764 - val_accuracy: 0.8999 - val_loss: 0.3657
Epoch 571/600
150/150            15s 101ms/step -
accuracy: 0.9449 - loss: 0.1702 - val_accuracy: 0.9033 - val_loss: 0.3458
Epoch 572/600
150/150            21s 103ms/step -
accuracy: 0.9555 - loss: 0.1424 - val_accuracy: 0.9066 - val_loss: 0.3560
Epoch 573/600
150/150            20s 100ms/step -
accuracy: 0.9499 - loss: 0.1461 - val_accuracy: 0.8982 - val_loss: 0.3834
Epoch 574/600
150/150            15s 100ms/step -
accuracy: 0.9492 - loss: 0.1563 - val_accuracy: 0.8924 - val_loss: 0.3746
Epoch 575/600
150/150            15s 100ms/step -
accuracy: 0.9496 - loss: 0.1783 - val_accuracy: 0.9058 - val_loss: 0.3690
Epoch 576/600
150/150            15s 102ms/step -
accuracy: 0.9674 - loss: 0.0995 - val_accuracy: 0.9116 - val_loss: 0.3091
Epoch 577/600
150/150            15s 100ms/step -
accuracy: 0.9409 - loss: 0.1882 - val_accuracy: 0.9133 - val_loss: 0.3114
Epoch 578/600
150/150            15s 102ms/step -
accuracy: 0.9534 - loss: 0.1424 - val_accuracy: 0.9133 - val_loss: 0.3568
Epoch 579/600
150/150            20s 100ms/step -
accuracy: 0.9587 - loss: 0.1291 - val_accuracy: 0.9066 - val_loss: 0.3108
Epoch 580/600
150/150            16s 103ms/step -
accuracy: 0.9612 - loss: 0.1097 - val_accuracy: 0.9133 - val_loss: 0.3307
Epoch 581/600
150/150            15s 101ms/step -
accuracy: 0.9611 - loss: 0.1359 - val_accuracy: 0.8999 - val_loss: 0.3669
Epoch 582/600
150/150            16s 103ms/step -
accuracy: 0.9302 - loss: 0.2201 - val_accuracy: 0.8757 - val_loss: 0.4097
Epoch 583/600
```

```
150/150            15s 100ms/step -
accuracy: 0.9477 - loss: 0.1384 - val_accuracy: 0.8799 - val_loss: 0.4412
Epoch 584/600
150/150            15s 103ms/step -
accuracy: 0.9483 - loss: 0.1559 - val_accuracy: 0.9041 - val_loss: 0.3597
Epoch 585/600
150/150            15s 100ms/step -
accuracy: 0.9450 - loss: 0.1610 - val_accuracy: 0.8991 - val_loss: 0.3292
Epoch 586/600
150/150            21s 102ms/step -
accuracy: 0.9581 - loss: 0.1204 - val_accuracy: 0.9074 - val_loss: 0.3323
Epoch 587/600
150/150            15s 100ms/step -
accuracy: 0.9318 - loss: 0.2115 - val_accuracy: 0.8974 - val_loss: 0.3142
Epoch 588/600
150/150            15s 102ms/step -
accuracy: 0.9579 - loss: 0.1259 - val_accuracy: 0.9008 - val_loss: 0.3283
Epoch 589/600
150/150            15s 100ms/step -
accuracy: 0.9460 - loss: 0.1587 - val_accuracy: 0.9133 - val_loss: 0.2778
Epoch 590/600
150/150            16s 103ms/step -
accuracy: 0.9579 - loss: 0.1343 - val_accuracy: 0.8974 - val_loss: 0.3462
Epoch 591/600
150/150            15s 100ms/step -
accuracy: 0.9575 - loss: 0.1433 - val_accuracy: 0.9124 - val_loss: 0.3279
Epoch 592/600
150/150            15s 103ms/step -
accuracy: 0.9551 - loss: 0.1366 - val_accuracy: 0.8974 - val_loss: 0.3736
Epoch 593/600
150/150            20s 100ms/step -
accuracy: 0.9522 - loss: 0.1452 - val_accuracy: 0.9158 - val_loss: 0.3174
Epoch 594/600
150/150            15s 102ms/step -
accuracy: 0.9499 - loss: 0.1729 - val_accuracy: 0.8966 - val_loss: 0.3405
Epoch 595/600
150/150            20s 101ms/step -
accuracy: 0.9224 - loss: 0.2465 - val_accuracy: 0.8999 - val_loss: 0.3301
Epoch 596/600
150/150            16s 104ms/step -
accuracy: 0.9423 - loss: 0.1808 - val_accuracy: 0.8882 - val_loss: 0.3954
Epoch 597/600
150/150            20s 101ms/step -
accuracy: 0.9512 - loss: 0.1478 - val_accuracy: 0.8999 - val_loss: 0.3177
Epoch 598/600
150/150            20s 100ms/step -
accuracy: 0.9579 - loss: 0.1355 - val_accuracy: 0.9074 - val_loss: 0.3437
Epoch 599/600
```

```
150/150             21s 104ms/step -
accuracy: 0.9284 - loss: 0.2192 - val_accuracy: 0.8891 - val_loss: 0.3333
Epoch 600/600
150/150             15s 101ms/step -
accuracy: 0.9619 - loss: 0.1216 - val_accuracy: 0.9166 - val_loss: 0.3030
GRU Model Validation Accuracy: 0.9166
```

[45]:
```
model_gru.save("/kaggle/working/gru_trained.h5")
loss, tf_keras_val_accuracy = model_gru.evaluate(x_val, y_val_encoded,␣
 ↪verbose=0)
print(f'TensorFlow/Keras Model Validation Accuracy: {tf_keras_val_accuracy:.
 ↪4f}')

y_pred = model_gru.predict(x_val)
y_pred_classes = np.argmax(y_pred, axis=1)

print(classification_report(y_val_encoded, y_pred_classes,␣
 ↪target_names=label_encoder.classes_))
```

```
TensorFlow/Keras Model Validation Accuracy: 0.9166
38/38             4s 62ms/step
              precision    recall  f1-score   support

     1. loud       0.94      0.91      0.93       253
    2. quiet       0.97      0.97      0.97       236
    3. happy       0.90      0.95      0.93       229
      4. sad       0.94      0.94      0.94        95
5. Beautiful       0.77      0.93      0.84        99
     6. Ugly       0.88      0.79      0.83       119
     7. Deaf       0.95      0.84      0.89        87
    8. Blind       0.91      0.93      0.92        81

    accuracy                           0.92      1199
   macro avg       0.91      0.91      0.91      1199
weighted avg       0.92      0.92      0.92      1199
```

[47]:
```
train_accuracy = history_gru.history['accuracy']
val_accuracy = history_gru.history['val_accuracy']
epochs = range(1, len(train_accuracy) + 1)

plt.figure(figsize=(10, 5))
plt.plot(epochs, train_accuracy, label='Training Accuracy', color='blue')
plt.plot(epochs, val_accuracy, label='Validation Accuracy', color='orange')

plt.title('Training and Validation Accuracy over Epochs')
plt.xlabel('Epochs')
```

```
plt.ylabel('Accuracy')
plt.legend()

plt.show()
```