machine_learning

November 21, 2020

1 Machine Learning

Recurrent Neural Networks (RNN) with Keras

Recurrent neural networks (RNN) are a class of neural networks that is powerful for modeling sequence data such as time series or natural language. It is prominent in the field of NLP(Natural language processing). Recurrent Neural Network(RNN) are a type of Neural Network where the output from previous step are fed as input to the current step. In traditional neural networks, all the inputs and outputs are independent of each other, but in cases like when it is required to predict the next word of a sentence, the previous words are required and hence there is a need to remember the previous words. Thus RNN came into existence, which solved this issue with the help of a Hidden Layer. The main and most important feature of RNN is Hidden state, which remembers some information about a sequence.

Importing nessassary libraries

[3]:
```
import numpy as np
import pandas as pd
from keras.models import Sequential
from keras.layers import LSTM,Dense ,Dropout, Bidirectional
from sklearn.preprocessing import MinMaxScaler
```

[4]:
```
from sklearn.preprocessing import OneHotEncoder
```

Importing the datasets into pandas data frame

[5]:
```
#this csv file contains the readings for entire india
data = pd.read_csv(r"District91_TempAnalysis_1980_20.csv")
```

[6]:
```
#this csv file contains the readings for banglore which was done seepartaly␣
↪with a different shape file
banglore_temp = pd.read_csv(r"Temp_Analysis_Bangalore_1980_2020.csv")
```

1.1 Predicting Bangalore Mean Temperatures

Here we use explicity the banglore dataset for the prediction.

[332]:
```
banglore_temp.head()
```

[332]:
```
                                          DISPLAY_NA  MOVEMENT_I  \
0  Raghva Niwas, 38th Cross Road, 4th T Block Eas…         162
1  100 16 A Main Road, Canara Bank Colony, Jayana…         163
2  725-44, TMC Layout, 1st Phase, JP Nagar, Benga…         164
3  State Highway 35, Devasthanagalu, Gunjur Villa…         165
4  Bellandur - Doddakannelli Road, Adarsh Palm Re…         166

          WARD_NAME  WARD_NO                 date  \
0  Pattabhiram Nagar      168  1980-01-01T00:00:00
1         Byrasandra      169  1980-01-01T00:00:00
2    Shakambari Nagar      179  1980-01-01T00:00:00
3           Varthuru      149  1980-01-01T00:00:00
4         Bellanduru      150  1980-01-01T00:00:00

   maximum_2m_air_temperature  minimum_2m_air_temperature
0                  305.679810                  288.141510
1                  305.679810                  288.141510
2                  305.679810                  288.141510
3                  305.614028                  288.051396
4                  305.679810                  288.141510
```

[333]:
```python
banglore_temp.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 31878 entries, 0 to 31877
Data columns (total 7 columns):
 #   Column                      Non-Null Count  Dtype
---  ------                      --------------  -----
 0   DISPLAY_NA                  31878 non-null  object
 1   MOVEMENT_I                  31878 non-null  int64
 2   WARD_NAME                   31878 non-null  object
 3   WARD_NO                     31878 non-null  int64
 4   date                        31878 non-null  object
 5   maximum_2m_air_temperature  31878 non-null  float64
 6   minimum_2m_air_temperature  31878 non-null  float64
dtypes: float64(2), int64(2), object(3)
memory usage: 1.7+ MB
```

[7]:
```python
#we group by date to find the mean
banglore_temp=banglore_temp.groupby('date').mean()
```

[335]:
```python
banglore_temp.head()
```

[335]:
```
                     MOVEMENT_I  WARD_NO  maximum_2m_air_temperature  \
date
1980-01-01T00:00:00        99.5     99.5                  305.580205
1980-04-01T00:00:00        99.5     99.5                  306.536743
1980-07-01T00:00:00        99.5     99.5                  301.647714
```

```
1980-10-01T00:00:00        99.5     99.5                     301.881074
1981-01-01T00:00:00        99.5     99.5                     305.691383

                     minimum_2m_air_temperature
date
1980-01-01T00:00:00                  288.117520
1980-04-01T00:00:00                  292.963571
1980-07-01T00:00:00                  291.215594
1980-10-01T00:00:00                  286.977627
1981-01-01T00:00:00                  287.973688
```

we calculate the mean in the below cell

[336]:
```
col = banglore_temp.loc[: , "maximum_2m_air_temperature":
 ↪"minimum_2m_air_temperature"]
```

[337]:
```
banglore_temp['mean_temperature'] = col.mean(axis=1)
```

[338]:
```
banglore_temp.head()
```

[338]:
```
                     MOVEMENT_I  WARD_NO  maximum_2m_air_temperature  \
date
1980-01-01T00:00:00        99.5     99.5                     305.580205
1980-04-01T00:00:00        99.5     99.5                     306.536743
1980-07-01T00:00:00        99.5     99.5                     301.647714
1980-10-01T00:00:00        99.5     99.5                     301.881074
1981-01-01T00:00:00        99.5     99.5                     305.691383

                     minimum_2m_air_temperature  mean_temperature
date
1980-01-01T00:00:00                  288.117520        296.848862
1980-04-01T00:00:00                  292.963571        299.750157
1980-07-01T00:00:00                  291.215594        296.431654
1980-10-01T00:00:00                  286.977627        294.429350
1981-01-01T00:00:00                  287.973688        296.832536
```

[339]:
```
training_set = banglore_temp["mean_temperature"]
```

[340]:
```
training_set.reset_index(drop=True,inplace=True)
```

[341]:
```
training_set.head()
```

[341]:
```
0    296.848862
1    299.750157
2    296.431654
3    294.429350
4    296.832536
Name: mean_temperature, dtype: float64
```

[342]:
```python
len(training_set)
```

[342]: 161

[343]:
```python
training_set = np.asarray(training_set)
```

[344]:
```python
training_set = training_set.reshape((-1,1))
```

[345]:
```python
training_set=np.round_(training_set, decimals=2)
```

[367]:
```python
test_set_sample = training_set[-1:-35:-1]
train_set = training_set[0:137]
```

[368]:
```python
print(len(train_set))
print(len(test_set_sample))
```

```
137
34
```

We scale the data, for the purpose of feeding it to the model

[369]:
```python
sc = MinMaxScaler(feature_range=(0,1))
training_set_scaled = sc.fit_transform(train_set)
```

Preparing the data to be fed to the model

[370]:
```python
x_train = []
y_train = []
n_future = 4 # next 4 temperature forecast
n_past = 30 # Past 30
for i in range(0,len(training_set_scaled)-n_past-n_future+1):
    x_train.append(training_set_scaled[i : i + n_past , 0])
    y_train.append(training_set_scaled[i + n_past : i + n_past + n_future , 0 ])
x_train , y_train = np.array(x_train), np.array(y_train)
x_train = np.reshape(x_train, (x_train.shape[0] , x_train.shape[1], 1) )
```

Making the RNN model, and fiting the data, and training the model

[372]:
```python
regressor = Sequential()
regressor.add(Bidirectional(LSTM(units=30, return_sequences=True, input_shape =␣
 ↪(x_train.shape[1],1) ) ))
regressor.add(Dropout(0.2))
regressor.add(LSTM(units= 30 , return_sequences=True))
regressor.add(Dropout(0.2))
regressor.add(LSTM(units= 30 , return_sequences=True))
regressor.add(Dropout(0.2))
regressor.add(LSTM(units= 30))
regressor.add(Dropout(0.2))
regressor.add(Dense(units = n_future,activation='linear'))
```

```python
regressor.compile(optimizer='adam', loss='mean_squared_error',metrics=['acc'])
regressor.fit(x_train, y_train, epochs=800,batch_size=32 )
```

```
Epoch 1/800
4/4 [==============================] - 0s 31ms/step - loss: 0.2768 - acc: 0.2596
Epoch 2/800
4/4 [==============================] - 0s 20ms/step - loss: 0.1660 - acc: 0.3269
Epoch 3/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0895 - acc: 0.2500
Epoch 4/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0816 - acc: 0.2885
Epoch 5/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0774 - acc: 0.1923
Epoch 6/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0763 - acc: 0.2212
Epoch 7/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0782 - acc: 0.1923
Epoch 8/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0615 - acc: 0.3462
Epoch 9/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0691 - acc: 0.2692
Epoch 10/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0678 - acc: 0.2500
Epoch 11/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0681 - acc: 0.2404
Epoch 12/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0678 - acc: 0.1827
Epoch 13/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0620 - acc: 0.2885
Epoch 14/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0679 - acc: 0.2019
Epoch 15/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0661 - acc: 0.2692
Epoch 16/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0676 - acc: 0.2308
Epoch 17/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0635 - acc: 0.2788
Epoch 18/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0619 - acc: 0.2788
Epoch 19/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0617 - acc: 0.2692
Epoch 20/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0624 - acc: 0.2115
Epoch 21/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0634 - acc: 0.1635
Epoch 22/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0661 - acc: 0.2500
Epoch 23/800
```

```
4/4 [==============================] - 0s 20ms/step - loss: 0.0640 - acc: 0.1827
Epoch 24/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0636 - acc: 0.2308
Epoch 25/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0616 - acc: 0.2500
Epoch 26/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0623 - acc: 0.2308
Epoch 27/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0612 - acc: 0.2308
Epoch 28/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0614 - acc: 0.2692
Epoch 29/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0613 - acc: 0.2692
Epoch 30/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0608 - acc: 0.2885
Epoch 31/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0614 - acc: 0.2404
Epoch 32/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0600 - acc: 0.2692
Epoch 33/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0601 - acc: 0.1923
Epoch 34/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0580 - acc: 0.2788
Epoch 35/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0594 - acc: 0.2885
Epoch 36/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0627 - acc: 0.1635
Epoch 37/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0599 - acc: 0.2692
Epoch 38/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0602 - acc: 0.2788
Epoch 39/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0608 - acc: 0.2404
Epoch 40/800
4/4 [==============================] - 0s 25ms/step - loss: 0.0622 - acc: 0.2308
Epoch 41/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0597 - acc: 0.2404
Epoch 42/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0576 - acc: 0.2500
Epoch 43/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0623 - acc: 0.2308
Epoch 44/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0606 - acc: 0.2212
Epoch 45/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0597 - acc: 0.2212
Epoch 46/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0593 - acc: 0.2692
Epoch 47/800
```

```
4/4 [==============================] - 0s 20ms/step - loss: 0.0608 - acc: 0.2212
Epoch 48/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0622 - acc: 0.2500
Epoch 49/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0582 - acc: 0.2212
Epoch 50/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0589 - acc: 0.2212
Epoch 51/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0621 - acc: 0.2981
Epoch 52/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0583 - acc: 0.3077
Epoch 53/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0605 - acc: 0.2692
Epoch 54/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0586 - acc: 0.2019
Epoch 55/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0608 - acc: 0.2308
Epoch 56/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0587 - acc: 0.2212
Epoch 57/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0613 - acc: 0.2692
Epoch 58/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0606 - acc: 0.2308
Epoch 59/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0586 - acc: 0.3558
Epoch 60/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0593 - acc: 0.2404
Epoch 61/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0588 - acc: 0.1827
Epoch 62/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0595 - acc: 0.2019
Epoch 63/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0602 - acc: 0.2500
Epoch 64/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0591 - acc: 0.1827
Epoch 65/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0596 - acc: 0.2212
Epoch 66/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0576 - acc: 0.3462
Epoch 67/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0586 - acc: 0.2788
Epoch 68/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0581 - acc: 0.2500
Epoch 69/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0573 - acc: 0.2788
Epoch 70/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0593 - acc: 0.2692
Epoch 71/800
```

```
4/4 [==============================] - 0s 21ms/step - loss: 0.0588 - acc: 0.2500
Epoch 72/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0586 - acc: 0.2404
Epoch 73/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0586 - acc: 0.2788
Epoch 74/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0603 - acc: 0.1635
Epoch 75/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0572 - acc: 0.2692
Epoch 76/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0570 - acc: 0.3173
Epoch 77/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0587 - acc: 0.2692
Epoch 78/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0597 - acc: 0.2115
Epoch 79/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0598 - acc: 0.2308
Epoch 80/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0605 - acc: 0.2115
Epoch 81/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0587 - acc: 0.1538
Epoch 82/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0592 - acc: 0.1923
Epoch 83/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0596 - acc: 0.2500
Epoch 84/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0589 - acc: 0.2596
Epoch 85/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0581 - acc: 0.2500
Epoch 86/800
4/4 [==============================] - 0s 25ms/step - loss: 0.0593 - acc: 0.2308
Epoch 87/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0569 - acc: 0.2788
Epoch 88/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0583 - acc: 0.2404
Epoch 89/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0576 - acc: 0.2596
Epoch 90/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0593 - acc: 0.2308
Epoch 91/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0599 - acc: 0.2788
Epoch 92/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0585 - acc: 0.2500
Epoch 93/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0590 - acc: 0.2115
Epoch 94/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0582 - acc: 0.1827
Epoch 95/800
```

```
4/4 [==============================] - 0s 21ms/step - loss: 0.0556 - acc: 0.3462
Epoch 96/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0604 - acc: 0.2308
Epoch 97/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0563 - acc: 0.2692
Epoch 98/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0571 - acc: 0.2692
Epoch 99/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0590 - acc: 0.2596
Epoch 100/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0575 - acc: 0.2885
Epoch 101/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0587 - acc: 0.2212
Epoch 102/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0591 - acc: 0.2019
Epoch 103/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0584 - acc: 0.2212
Epoch 104/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0585 - acc: 0.2212
Epoch 105/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0571 - acc: 0.3173
Epoch 106/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0570 - acc: 0.2500
Epoch 107/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0582 - acc: 0.2692
Epoch 108/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0575 - acc: 0.2308
Epoch 109/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0576 - acc: 0.2308
Epoch 110/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0578 - acc: 0.2500
Epoch 111/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0608 - acc: 0.1442
Epoch 112/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0559 - acc: 0.2692
Epoch 113/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0574 - acc: 0.2019
Epoch 114/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0572 - acc: 0.2596
Epoch 115/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0575 - acc: 0.2308
Epoch 116/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0558 - acc: 0.2981
Epoch 117/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0560 - acc: 0.3269
Epoch 118/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0575 - acc: 0.2692
Epoch 119/800
```

```
4/4 [==============================] - 0s 21ms/step - loss: 0.0569 - acc: 0.3558
Epoch 120/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0566 - acc: 0.2500
Epoch 121/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0580 - acc: 0.1923
Epoch 122/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0565 - acc: 0.2019
Epoch 123/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0577 - acc: 0.2212
Epoch 124/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0550 - acc: 0.3269
Epoch 125/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0591 - acc: 0.2596
Epoch 126/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0550 - acc: 0.2885
Epoch 127/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0573 - acc: 0.3077
Epoch 128/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0569 - acc: 0.2596
Epoch 129/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0582 - acc: 0.2212
Epoch 130/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0574 - acc: 0.2404
Epoch 131/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0579 - acc: 0.1827
Epoch 132/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0572 - acc: 0.2115
Epoch 133/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0566 - acc: 0.2885
Epoch 134/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0584 - acc: 0.2115
Epoch 135/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0565 - acc: 0.2692
Epoch 136/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0564 - acc: 0.2596
Epoch 137/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0564 - acc: 0.2981
Epoch 138/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0562 - acc: 0.3077
Epoch 139/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0560 - acc: 0.2885
Epoch 140/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0577 - acc: 0.2404
Epoch 141/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0579 - acc: 0.2115
Epoch 142/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0593 - acc: 0.2115
Epoch 143/800
```

```
4/4 [==============================] - 0s 24ms/step - loss: 0.0565 - acc: 0.2500
Epoch 144/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0588 - acc: 0.2115
Epoch 145/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0577 - acc: 0.2981
Epoch 146/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0573 - acc: 0.2019
Epoch 147/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0559 - acc: 0.2692
Epoch 148/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0566 - acc: 0.3173
Epoch 149/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0549 - acc: 0.2308
Epoch 150/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0568 - acc: 0.2212
Epoch 151/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0564 - acc: 0.2692
Epoch 152/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0564 - acc: 0.2596
Epoch 153/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0566 - acc: 0.2308
Epoch 154/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0569 - acc: 0.2404
Epoch 155/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0576 - acc: 0.2788
Epoch 156/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0579 - acc: 0.2788
Epoch 157/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0568 - acc: 0.2500
Epoch 158/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0557 - acc: 0.2885
Epoch 159/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0563 - acc: 0.2500
Epoch 160/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0555 - acc: 0.3173
Epoch 161/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0563 - acc: 0.2788
Epoch 162/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0559 - acc: 0.2885
Epoch 163/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0554 - acc: 0.2981
Epoch 164/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0562 - acc: 0.2692
Epoch 165/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0567 - acc: 0.3077
Epoch 166/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0563 - acc: 0.2500
Epoch 167/800
```

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4/4 [==============================] - 0s 21ms/step - loss: 0.0561 - acc: 0.2885
Epoch 168/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0550 - acc: 0.3269
Epoch 169/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0557 - acc: 0.3173
Epoch 170/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0580 - acc: 0.2019
Epoch 171/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0565 - acc: 0.3077
Epoch 172/800
4/4 [==============================] - 0s 25ms/step - loss: 0.0573 - acc: 0.1538
Epoch 173/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0554 - acc: 0.2308
Epoch 174/800
4/4 [==============================] - 0s 25ms/step - loss: 0.0553 - acc: 0.2212
Epoch 175/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0561 - acc: 0.1923
Epoch 176/800
4/4 [==============================] - 0s 25ms/step - loss: 0.0565 - acc: 0.2212
Epoch 177/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0559 - acc: 0.2500
Epoch 178/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0554 - acc: 0.2981
Epoch 179/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0551 - acc: 0.2692
Epoch 180/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0570 - acc: 0.2212
Epoch 181/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0565 - acc: 0.2212
Epoch 182/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0560 - acc: 0.2788
Epoch 183/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0562 - acc: 0.1923
Epoch 184/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0562 - acc: 0.2404
Epoch 185/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0554 - acc: 0.2308
Epoch 186/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0551 - acc: 0.2981
Epoch 187/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0552 - acc: 0.2404
Epoch 188/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0569 - acc: 0.2596
Epoch 189/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0561 - acc: 0.2596
Epoch 190/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0575 - acc: 0.1442
Epoch 191/800
```

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4/4 [==============================] - 0s 21ms/step - loss: 0.0555 - acc: 0.2596
Epoch 192/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0548 - acc: 0.2596
Epoch 193/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0568 - acc: 0.2981
Epoch 194/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0551 - acc: 0.2115
Epoch 195/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0563 - acc: 0.2692
Epoch 196/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0548 - acc: 0.2692
Epoch 197/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0567 - acc: 0.2308
Epoch 198/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0568 - acc: 0.2212
Epoch 199/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0569 - acc: 0.1923
Epoch 200/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0552 - acc: 0.2885
Epoch 201/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0549 - acc: 0.2788
Epoch 202/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0565 - acc: 0.2308
Epoch 203/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0551 - acc: 0.3462
Epoch 204/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0551 - acc: 0.2404
Epoch 205/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0534 - acc: 0.3750
Epoch 206/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0547 - acc: 0.2500
Epoch 207/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0578 - acc: 0.2019
Epoch 208/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0564 - acc: 0.2019
Epoch 209/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0562 - acc: 0.3173
Epoch 210/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0578 - acc: 0.2308
Epoch 211/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0549 - acc: 0.3269
Epoch 212/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0562 - acc: 0.2308
Epoch 213/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0543 - acc: 0.2692
Epoch 214/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0561 - acc: 0.2404
Epoch 215/800
```

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4/4 [==============================] - 0s 21ms/step - loss: 0.0554 - acc: 0.2788
Epoch 216/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0562 - acc: 0.2788
Epoch 217/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0544 - acc: 0.3558
Epoch 218/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0557 - acc: 0.2404
Epoch 219/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0556 - acc: 0.1731
Epoch 220/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0554 - acc: 0.2692
Epoch 221/800
4/4 [==============================] - 0s 25ms/step - loss: 0.0547 - acc: 0.2500
Epoch 222/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0570 - acc: 0.1923
Epoch 223/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0546 - acc: 0.2788
Epoch 224/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0553 - acc: 0.2692
Epoch 225/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0559 - acc: 0.2885
Epoch 226/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0548 - acc: 0.2981
Epoch 227/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0554 - acc: 0.2596
Epoch 228/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0537 - acc: 0.3269
Epoch 229/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0560 - acc: 0.1923
Epoch 230/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0550 - acc: 0.2500
Epoch 231/800
4/4 [==============================] - 0s 25ms/step - loss: 0.0577 - acc: 0.2788
Epoch 232/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0559 - acc: 0.2404
Epoch 233/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0546 - acc: 0.2308
Epoch 234/800
4/4 [==============================] - 0s 25ms/step - loss: 0.0548 - acc: 0.2308
Epoch 235/800
4/4 [==============================] - 0s 25ms/step - loss: 0.0549 - acc: 0.2885
Epoch 236/800
4/4 [==============================] - 0s 25ms/step - loss: 0.0555 - acc: 0.2308
Epoch 237/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0551 - acc: 0.2788
Epoch 238/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0541 - acc: 0.2885
Epoch 239/800
```

```
4/4 [==============================] - 0s 21ms/step - loss: 0.0560 - acc: 0.2981
Epoch 240/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0552 - acc: 0.2596
Epoch 241/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0542 - acc: 0.3558
Epoch 242/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0549 - acc: 0.2788
Epoch 243/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0556 - acc: 0.2788
Epoch 244/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0548 - acc: 0.2692
Epoch 245/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0549 - acc: 0.2404
Epoch 246/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0545 - acc: 0.3269
Epoch 247/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0531 - acc: 0.3077
Epoch 248/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0542 - acc: 0.2981
Epoch 249/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0534 - acc: 0.2788
Epoch 250/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0543 - acc: 0.3558
Epoch 251/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0550 - acc: 0.2692
Epoch 252/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0516 - acc: 0.3846
Epoch 253/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0508 - acc: 0.3558
Epoch 254/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0483 - acc: 0.4519
Epoch 255/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0448 - acc: 0.4135
Epoch 256/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0446 - acc: 0.3269
Epoch 257/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0461 - acc: 0.4423
Epoch 258/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0457 - acc: 0.4327
Epoch 259/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0393 - acc: 0.5192
Epoch 260/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0387 - acc: 0.4231
Epoch 261/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0388 - acc: 0.4038
Epoch 262/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0398 - acc: 0.5192
Epoch 263/800
```

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4/4 [==============================] - 0s 21ms/step - loss: 0.0368 - acc: 0.4423
Epoch 264/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0385 - acc: 0.4615
Epoch 265/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0380 - acc: 0.4808
Epoch 266/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0376 - acc: 0.5000
Epoch 267/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0382 - acc: 0.4327
Epoch 268/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0489 - acc: 0.4231
Epoch 269/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0402 - acc: 0.4712
Epoch 270/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0376 - acc: 0.5000
Epoch 271/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0379 - acc: 0.5096
Epoch 272/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0394 - acc: 0.3750
Epoch 273/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0377 - acc: 0.4904
Epoch 274/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0386 - acc: 0.4712
Epoch 275/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0350 - acc: 0.5385
Epoch 276/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0379 - acc: 0.5288
Epoch 277/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0363 - acc: 0.5192
Epoch 278/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0368 - acc: 0.5288
Epoch 279/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0450 - acc: 0.4231
Epoch 280/800
4/4 [==============================] - 0s 25ms/step - loss: 0.0380 - acc: 0.5385
Epoch 281/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0433 - acc: 0.4615
Epoch 282/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0380 - acc: 0.4904
Epoch 283/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0364 - acc: 0.4904
Epoch 284/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0379 - acc: 0.4615
Epoch 285/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0374 - acc: 0.4904
Epoch 286/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0352 - acc: 0.4904
Epoch 287/800
```

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4/4 [==============================] - 0s 22ms/step - loss: 0.0355 - acc: 0.4904
Epoch 288/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0350 - acc: 0.5385
Epoch 289/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0362 - acc: 0.4519
Epoch 290/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0348 - acc: 0.5192
Epoch 291/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0348 - acc: 0.5096
Epoch 292/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0350 - acc: 0.4135
Epoch 293/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0343 - acc: 0.5865
Epoch 294/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0349 - acc: 0.5865
Epoch 295/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0340 - acc: 0.4712
Epoch 296/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0401 - acc: 0.4327
Epoch 297/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0362 - acc: 0.5288
Epoch 298/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0388 - acc: 0.4231
Epoch 299/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0340 - acc: 0.5192
Epoch 300/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0410 - acc: 0.4519
Epoch 301/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0416 - acc: 0.5096
Epoch 302/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0357 - acc: 0.4519
Epoch 303/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0343 - acc: 0.5192
Epoch 304/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0340 - acc: 0.4904
Epoch 305/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0354 - acc: 0.4423
Epoch 306/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0327 - acc: 0.4615
Epoch 307/800
4/4 [==============================] - 0s 25ms/step - loss: 0.0345 - acc: 0.4423
Epoch 308/800
4/4 [==============================] - 0s 25ms/step - loss: 0.0345 - acc: 0.4712
Epoch 309/800
4/4 [==============================] - 0s 31ms/step - loss: 0.0344 - acc: 0.4904
Epoch 310/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0322 - acc: 0.5962
Epoch 311/800
```

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4/4 [==============================] - 0s 24ms/step - loss: 0.0337 - acc: 0.5769
Epoch 312/800
4/4 [==============================] - 0s 25ms/step - loss: 0.0337 - acc: 0.4808
Epoch 313/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0355 - acc: 0.5192
Epoch 314/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0348 - acc: 0.4808
Epoch 315/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0350 - acc: 0.4615
Epoch 316/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0343 - acc: 0.5577
Epoch 317/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0338 - acc: 0.5481
Epoch 318/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0395 - acc: 0.4712
Epoch 319/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0541 - acc: 0.3942
Epoch 320/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0656 - acc: 0.2692
Epoch 321/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0573 - acc: 0.2404
Epoch 322/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0548 - acc: 0.2788
Epoch 323/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0562 - acc: 0.2692
Epoch 324/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0568 - acc: 0.1923
Epoch 325/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0567 - acc: 0.2500
Epoch 326/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0547 - acc: 0.2500
Epoch 327/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0547 - acc: 0.2981
Epoch 328/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0547 - acc: 0.3077
Epoch 329/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0546 - acc: 0.2692
Epoch 330/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0545 - acc: 0.3077
Epoch 331/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0559 - acc: 0.1538
Epoch 332/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0544 - acc: 0.2692
Epoch 333/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0528 - acc: 0.3077
Epoch 334/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0534 - acc: 0.3462
Epoch 335/800
```

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4/4 [==============================] - 0s 22ms/step - loss: 0.0538 - acc: 0.2788
Epoch 336/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0536 - acc: 0.3269
Epoch 337/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0545 - acc: 0.2500
Epoch 338/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0532 - acc: 0.3173
Epoch 339/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0547 - acc: 0.2596
Epoch 340/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0537 - acc: 0.3558
Epoch 341/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0544 - acc: 0.3269
Epoch 342/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0539 - acc: 0.3173
Epoch 343/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0542 - acc: 0.2788
Epoch 344/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0534 - acc: 0.3173
Epoch 345/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0538 - acc: 0.2788
Epoch 346/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0524 - acc: 0.3654
Epoch 347/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0531 - acc: 0.3269
Epoch 348/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0540 - acc: 0.2885
Epoch 349/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0533 - acc: 0.2885
Epoch 350/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0526 - acc: 0.2981
Epoch 351/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0523 - acc: 0.3654
Epoch 352/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0528 - acc: 0.3269
Epoch 353/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0532 - acc: 0.2500
Epoch 354/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0513 - acc: 0.3846
Epoch 355/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0526 - acc: 0.3365
Epoch 356/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0520 - acc: 0.2885
Epoch 357/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0510 - acc: 0.3750
Epoch 358/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0505 - acc: 0.3654
Epoch 359/800
```

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4/4 [==============================] - 0s 21ms/step - loss: 0.0499 - acc: 0.3942
Epoch 360/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0509 - acc: 0.3654
Epoch 361/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0494 - acc: 0.3750
Epoch 362/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0490 - acc: 0.3654
Epoch 363/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0478 - acc: 0.4615
Epoch 364/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0477 - acc: 0.4135
Epoch 365/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0474 - acc: 0.4231
Epoch 366/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0433 - acc: 0.4423
Epoch 367/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0426 - acc: 0.4712
Epoch 368/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0454 - acc: 0.4519
Epoch 369/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0438 - acc: 0.4615
Epoch 370/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0431 - acc: 0.5192
Epoch 371/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0462 - acc: 0.4038
Epoch 372/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0413 - acc: 0.5192
Epoch 373/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0404 - acc: 0.4808
Epoch 374/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0391 - acc: 0.5577
Epoch 375/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0387 - acc: 0.5673
Epoch 376/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0390 - acc: 0.4904
Epoch 377/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0388 - acc: 0.5192
Epoch 378/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0382 - acc: 0.5481
Epoch 379/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0380 - acc: 0.5481
Epoch 380/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0384 - acc: 0.5096
Epoch 381/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0382 - acc: 0.5577
Epoch 382/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0365 - acc: 0.5385
Epoch 383/800
```

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4/4 [==============================] - 0s 22ms/step - loss: 0.0373 - acc: 0.5192
Epoch 384/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0374 - acc: 0.5192
Epoch 385/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0371 - acc: 0.5385
Epoch 386/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0375 - acc: 0.5865
Epoch 387/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0353 - acc: 0.5288
Epoch 388/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0373 - acc: 0.5096
Epoch 389/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0337 - acc: 0.5385
Epoch 390/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0349 - acc: 0.5481
Epoch 391/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0350 - acc: 0.5673
Epoch 392/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0343 - acc: 0.5481
Epoch 393/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0332 - acc: 0.5192
Epoch 394/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0340 - acc: 0.6250
Epoch 395/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0336 - acc: 0.6154
Epoch 396/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0327 - acc: 0.5962
Epoch 397/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0341 - acc: 0.5865
Epoch 398/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0338 - acc: 0.6250
Epoch 399/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0342 - acc: 0.5481
Epoch 400/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0341 - acc: 0.6058
Epoch 401/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0338 - acc: 0.5673
Epoch 402/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0336 - acc: 0.5962
Epoch 403/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0355 - acc: 0.5865
Epoch 404/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0338 - acc: 0.5577
Epoch 405/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0332 - acc: 0.5769
Epoch 406/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0324 - acc: 0.5385
Epoch 407/800
```

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4/4 [==============================] - 0s 23ms/step - loss: 0.0346 - acc: 0.5769
Epoch 408/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0330 - acc: 0.5769
Epoch 409/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0330 - acc: 0.6058
Epoch 410/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0346 - acc: 0.6154
Epoch 411/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0352 - acc: 0.5865
Epoch 412/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0334 - acc: 0.5673
Epoch 413/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0339 - acc: 0.5769
Epoch 414/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0334 - acc: 0.6250
Epoch 415/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0334 - acc: 0.6058
Epoch 416/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0324 - acc: 0.5962
Epoch 417/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0328 - acc: 0.5769
Epoch 418/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0325 - acc: 0.5962
Epoch 419/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0322 - acc: 0.5962
Epoch 420/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0337 - acc: 0.5385
Epoch 421/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0348 - acc: 0.5577
Epoch 422/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0335 - acc: 0.5288
Epoch 423/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0323 - acc: 0.5865
Epoch 424/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0333 - acc: 0.5769
Epoch 425/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0318 - acc: 0.5865
Epoch 426/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0328 - acc: 0.5673
Epoch 427/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0310 - acc: 0.5673
Epoch 428/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0337 - acc: 0.5288
Epoch 429/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0313 - acc: 0.5865
Epoch 430/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0324 - acc: 0.6250
Epoch 431/800
```

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4/4 [==============================] - 0s 22ms/step - loss: 0.0329 - acc: 0.5962
Epoch 432/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0337 - acc: 0.6058
Epoch 433/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0333 - acc: 0.5673
Epoch 434/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0311 - acc: 0.6058
Epoch 435/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0330 - acc: 0.5769
Epoch 436/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0345 - acc: 0.5385
Epoch 437/800
4/4 [==============================] - 0s 26ms/step - loss: 0.0323 - acc: 0.6058
Epoch 438/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0312 - acc: 0.5769
Epoch 439/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0322 - acc: 0.5673
Epoch 440/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0311 - acc: 0.5577
Epoch 441/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0324 - acc: 0.5385
Epoch 442/800
4/4 [==============================] - 0s 25ms/step - loss: 0.0314 - acc: 0.5673
Epoch 443/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0331 - acc: 0.5962
Epoch 444/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0314 - acc: 0.5962
Epoch 445/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0324 - acc: 0.5769
Epoch 446/800
4/4 [==============================] - 0s 26ms/step - loss: 0.0319 - acc: 0.5673
Epoch 447/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0306 - acc: 0.6058
Epoch 448/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0301 - acc: 0.6058
Epoch 449/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0312 - acc: 0.5673
Epoch 450/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0307 - acc: 0.5577
Epoch 451/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0334 - acc: 0.6058
Epoch 452/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0315 - acc: 0.5192
Epoch 453/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0313 - acc: 0.6442
Epoch 454/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0310 - acc: 0.6442
Epoch 455/800
```

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4/4 [==============================] - 0s 22ms/step - loss: 0.0310 - acc: 0.5865
Epoch 456/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0306 - acc: 0.6442
Epoch 457/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0330 - acc: 0.5769
Epoch 458/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0322 - acc: 0.5769
Epoch 459/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0307 - acc: 0.5865
Epoch 460/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0295 - acc: 0.6154
Epoch 461/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0323 - acc: 0.5865
Epoch 462/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0305 - acc: 0.5865
Epoch 463/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0312 - acc: 0.6058
Epoch 464/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0308 - acc: 0.6058
Epoch 465/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0328 - acc: 0.5769
Epoch 466/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0318 - acc: 0.5865
Epoch 467/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0316 - acc: 0.6538
Epoch 468/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0340 - acc: 0.6058
Epoch 469/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0321 - acc: 0.5962
Epoch 470/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0322 - acc: 0.6250
Epoch 471/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0346 - acc: 0.5577
Epoch 472/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0324 - acc: 0.5577
Epoch 473/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0319 - acc: 0.6442
Epoch 474/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0324 - acc: 0.5577
Epoch 475/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0328 - acc: 0.5673
Epoch 476/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0324 - acc: 0.6058
Epoch 477/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0321 - acc: 0.5673
Epoch 478/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0313 - acc: 0.5577
Epoch 479/800
```

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4/4 [==============================] - 0s 22ms/step - loss: 0.0312 - acc: 0.6346
Epoch 480/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0303 - acc: 0.6154
Epoch 481/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0306 - acc: 0.6250
Epoch 482/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0321 - acc: 0.5865
Epoch 483/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0317 - acc: 0.5577
Epoch 484/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0311 - acc: 0.5673
Epoch 485/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0310 - acc: 0.6058
Epoch 486/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0328 - acc: 0.6058
Epoch 487/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0309 - acc: 0.5577
Epoch 488/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0305 - acc: 0.5769
Epoch 489/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0339 - acc: 0.5288
Epoch 490/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0310 - acc: 0.5481
Epoch 491/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0308 - acc: 0.6058
Epoch 492/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0316 - acc: 0.5962
Epoch 493/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0309 - acc: 0.5962
Epoch 494/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0313 - acc: 0.6154
Epoch 495/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0310 - acc: 0.5962
Epoch 496/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0370 - acc: 0.5288
Epoch 497/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0308 - acc: 0.6058
Epoch 498/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0308 - acc: 0.5673
Epoch 499/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0323 - acc: 0.5962
Epoch 500/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0307 - acc: 0.6058
Epoch 501/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0314 - acc: 0.5288
Epoch 502/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0300 - acc: 0.5577
Epoch 503/800
```

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4/4 [==============================] - 0s 23ms/step - loss: 0.0298 - acc: 0.6058
Epoch 504/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0294 - acc: 0.5673
Epoch 505/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0292 - acc: 0.5962
Epoch 506/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0336 - acc: 0.6154
Epoch 507/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0490 - acc: 0.4519
Epoch 508/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0429 - acc: 0.4615
Epoch 509/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0390 - acc: 0.5577
Epoch 510/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0371 - acc: 0.5673
Epoch 511/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0338 - acc: 0.6154
Epoch 512/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0331 - acc: 0.5962
Epoch 513/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0324 - acc: 0.5673
Epoch 514/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0311 - acc: 0.5769
Epoch 515/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0306 - acc: 0.6058
Epoch 516/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0311 - acc: 0.6058
Epoch 517/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0310 - acc: 0.5385
Epoch 518/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0310 - acc: 0.5962
Epoch 519/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0307 - acc: 0.7115
Epoch 520/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0323 - acc: 0.5673
Epoch 521/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0295 - acc: 0.6442
Epoch 522/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0293 - acc: 0.5962
Epoch 523/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0296 - acc: 0.5962
Epoch 524/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0290 - acc: 0.6058
Epoch 525/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0299 - acc: 0.5769
Epoch 526/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0296 - acc: 0.6731
Epoch 527/800
```

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4/4 [==============================] - 0s 22ms/step - loss: 0.0304 - acc: 0.6058
Epoch 528/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0295 - acc: 0.6154
Epoch 529/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0298 - acc: 0.6058
Epoch 530/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0285 - acc: 0.5385
Epoch 531/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0303 - acc: 0.5769
Epoch 532/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0294 - acc: 0.6538
Epoch 533/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0304 - acc: 0.5962
Epoch 534/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0292 - acc: 0.5962
Epoch 535/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0300 - acc: 0.5673
Epoch 536/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0297 - acc: 0.5865
Epoch 537/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0289 - acc: 0.6250
Epoch 538/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0291 - acc: 0.6442
Epoch 539/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0280 - acc: 0.5769
Epoch 540/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0289 - acc: 0.6250
Epoch 541/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0283 - acc: 0.6346
Epoch 542/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0281 - acc: 0.5962
Epoch 543/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0271 - acc: 0.6635
Epoch 544/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0296 - acc: 0.5865
Epoch 545/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0284 - acc: 0.6346
Epoch 546/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0272 - acc: 0.5962
Epoch 547/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0274 - acc: 0.6442
Epoch 548/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0282 - acc: 0.6442
Epoch 549/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0284 - acc: 0.6154
Epoch 550/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0287 - acc: 0.6346
Epoch 551/800
```

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4/4 [==============================] - 0s 22ms/step - loss: 0.0299 - acc: 0.6346
Epoch 552/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0292 - acc: 0.6250
Epoch 553/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0288 - acc: 0.5962
Epoch 554/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0284 - acc: 0.6250
Epoch 555/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0293 - acc: 0.6442
Epoch 556/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0278 - acc: 0.5962
Epoch 557/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0299 - acc: 0.6635
Epoch 558/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0289 - acc: 0.6731
Epoch 559/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0284 - acc: 0.6154
Epoch 560/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0300 - acc: 0.6154
Epoch 561/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0273 - acc: 0.6538
Epoch 562/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0269 - acc: 0.6731
Epoch 563/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0298 - acc: 0.6346
Epoch 564/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0291 - acc: 0.6346
Epoch 565/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0284 - acc: 0.5962
Epoch 566/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0293 - acc: 0.6635
Epoch 567/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0291 - acc: 0.6250
Epoch 568/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0280 - acc: 0.6154
Epoch 569/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0275 - acc: 0.6731
Epoch 570/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0267 - acc: 0.6346
Epoch 571/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0289 - acc: 0.6250
Epoch 572/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0272 - acc: 0.6442
Epoch 573/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0283 - acc: 0.6154
Epoch 574/800
4/4 [==============================] - 0s 28ms/step - loss: 0.0279 - acc: 0.6538
Epoch 575/800
```

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4/4 [==============================] - 0s 25ms/step - loss: 0.0283 - acc: 0.6154
Epoch 576/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0403 - acc: 0.5481
Epoch 577/800
4/4 [==============================] - 0s 25ms/step - loss: 0.0654 - acc: 0.3269
Epoch 578/800
4/4 [==============================] - 0s 25ms/step - loss: 0.0539 - acc: 0.3558
Epoch 579/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0485 - acc: 0.4712
Epoch 580/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0476 - acc: 0.4231
Epoch 581/800
4/4 [==============================] - 0s 26ms/step - loss: 0.0445 - acc: 0.4904
Epoch 582/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0443 - acc: 0.4712
Epoch 583/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0430 - acc: 0.4519
Epoch 584/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0418 - acc: 0.5000
Epoch 585/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0395 - acc: 0.5192
Epoch 586/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0381 - acc: 0.4615
Epoch 587/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0378 - acc: 0.5385
Epoch 588/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0364 - acc: 0.5096
Epoch 589/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0355 - acc: 0.5096
Epoch 590/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0338 - acc: 0.5385
Epoch 591/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0346 - acc: 0.5000
Epoch 592/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0330 - acc: 0.5673
Epoch 593/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0343 - acc: 0.6346
Epoch 594/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0327 - acc: 0.5769
Epoch 595/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0333 - acc: 0.5769
Epoch 596/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0318 - acc: 0.5962
Epoch 597/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0329 - acc: 0.5962
Epoch 598/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0324 - acc: 0.6346
Epoch 599/800
```

```
4/4 [==============================] - 0s 22ms/step - loss: 0.0306 - acc: 0.6250
Epoch 600/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0313 - acc: 0.5769
Epoch 601/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0308 - acc: 0.5673
Epoch 602/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0299 - acc: 0.5769
Epoch 603/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0303 - acc: 0.6154
Epoch 604/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0307 - acc: 0.6058
Epoch 605/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0303 - acc: 0.6346
Epoch 606/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0295 - acc: 0.6538
Epoch 607/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0300 - acc: 0.5673
Epoch 608/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0303 - acc: 0.6058
Epoch 609/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0288 - acc: 0.6635
Epoch 610/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0289 - acc: 0.6442
Epoch 611/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0301 - acc: 0.6346
Epoch 612/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0291 - acc: 0.6250
Epoch 613/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0285 - acc: 0.6154
Epoch 614/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0278 - acc: 0.6154
Epoch 615/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0284 - acc: 0.6250
Epoch 616/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0277 - acc: 0.6538
Epoch 617/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0278 - acc: 0.6635
Epoch 618/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0277 - acc: 0.7404
Epoch 619/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0278 - acc: 0.6442
Epoch 620/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0285 - acc: 0.6538
Epoch 621/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0293 - acc: 0.6058
Epoch 622/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0282 - acc: 0.6731
Epoch 623/800
```

```
4/4 [==============================] - 0s 22ms/step - loss: 0.0279 - acc: 0.6731
Epoch 624/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0283 - acc: 0.6731
Epoch 625/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0278 - acc: 0.6827
Epoch 626/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0293 - acc: 0.6731
Epoch 627/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0282 - acc: 0.6635
Epoch 628/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0274 - acc: 0.6731
Epoch 629/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0278 - acc: 0.6058
Epoch 630/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0276 - acc: 0.6635
Epoch 631/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0273 - acc: 0.7019
Epoch 632/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0274 - acc: 0.6442
Epoch 633/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0293 - acc: 0.6346
Epoch 634/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0266 - acc: 0.6731
Epoch 635/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0276 - acc: 0.6827
Epoch 636/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0269 - acc: 0.6635
Epoch 637/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0271 - acc: 0.6731
Epoch 638/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0268 - acc: 0.6250
Epoch 639/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0258 - acc: 0.6923
Epoch 640/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0258 - acc: 0.6827
Epoch 641/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0261 - acc: 0.6827
Epoch 642/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0274 - acc: 0.6923
Epoch 643/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0267 - acc: 0.6538
Epoch 644/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0274 - acc: 0.6923
Epoch 645/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0264 - acc: 0.6731
Epoch 646/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0256 - acc: 0.6346
Epoch 647/800
```

```
4/4 [==============================] - 0s 21ms/step - loss: 0.0277 - acc: 0.6923
Epoch 648/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0256 - acc: 0.7115
Epoch 649/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0261 - acc: 0.6923
Epoch 650/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0263 - acc: 0.6731
Epoch 651/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0281 - acc: 0.6635
Epoch 652/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0269 - acc: 0.6731
Epoch 653/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0269 - acc: 0.6731
Epoch 654/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0264 - acc: 0.6731
Epoch 655/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0266 - acc: 0.7212
Epoch 656/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0270 - acc: 0.6346
Epoch 657/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0257 - acc: 0.7115
Epoch 658/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0257 - acc: 0.7500
Epoch 659/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0257 - acc: 0.7308
Epoch 660/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0264 - acc: 0.7308
Epoch 661/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0274 - acc: 0.6346
Epoch 662/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0268 - acc: 0.6827
Epoch 663/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0268 - acc: 0.6635
Epoch 664/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0290 - acc: 0.6923
Epoch 665/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0273 - acc: 0.6442
Epoch 666/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0265 - acc: 0.6731
Epoch 667/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0270 - acc: 0.6731
Epoch 668/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0286 - acc: 0.6827
Epoch 669/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0275 - acc: 0.6731
Epoch 670/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0276 - acc: 0.6827
Epoch 671/800
```

```
4/4 [==============================] - 0s 22ms/step - loss: 0.0270 - acc: 0.6058
Epoch 672/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0253 - acc: 0.7212
Epoch 673/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0281 - acc: 0.6923
Epoch 674/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0261 - acc: 0.6923
Epoch 675/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0276 - acc: 0.7212
Epoch 676/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0265 - acc: 0.7308
Epoch 677/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0283 - acc: 0.6635
Epoch 678/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0270 - acc: 0.7019
Epoch 679/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0252 - acc: 0.6731
Epoch 680/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0277 - acc: 0.6442
Epoch 681/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0278 - acc: 0.6923
Epoch 682/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0257 - acc: 0.7308
Epoch 683/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0278 - acc: 0.6538
Epoch 684/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0265 - acc: 0.6827
Epoch 685/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0245 - acc: 0.7404
Epoch 686/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0260 - acc: 0.7019
Epoch 687/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0259 - acc: 0.6923
Epoch 688/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0251 - acc: 0.7115
Epoch 689/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0253 - acc: 0.6923
Epoch 690/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0244 - acc: 0.7019
Epoch 691/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0243 - acc: 0.7308
Epoch 692/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0249 - acc: 0.7115
Epoch 693/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0257 - acc: 0.6923
Epoch 694/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0237 - acc: 0.7404
Epoch 695/800
```

```
4/4 [==============================] - 0s 21ms/step - loss: 0.0245 - acc: 0.7308
Epoch 696/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0253 - acc: 0.7115
Epoch 697/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0254 - acc: 0.7115
Epoch 698/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0256 - acc: 0.7019
Epoch 699/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0237 - acc: 0.7308
Epoch 700/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0231 - acc: 0.7404
Epoch 701/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0247 - acc: 0.6827
Epoch 702/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0259 - acc: 0.6442
Epoch 703/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0267 - acc: 0.6923
Epoch 704/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0245 - acc: 0.7019
Epoch 705/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0245 - acc: 0.7019
Epoch 706/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0250 - acc: 0.7019
Epoch 707/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0243 - acc: 0.7212
Epoch 708/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0241 - acc: 0.7404
Epoch 709/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0239 - acc: 0.7308
Epoch 710/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0241 - acc: 0.7212
Epoch 711/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0256 - acc: 0.6827
Epoch 712/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0244 - acc: 0.7308
Epoch 713/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0254 - acc: 0.7308
Epoch 714/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0242 - acc: 0.6923
Epoch 715/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0248 - acc: 0.7308
Epoch 716/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0236 - acc: 0.7212
Epoch 717/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0226 - acc: 0.7212
Epoch 718/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0247 - acc: 0.7212
Epoch 719/800
```

```
4/4 [==============================] - 0s 21ms/step - loss: 0.0253 - acc: 0.7019
Epoch 720/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0235 - acc: 0.7115
Epoch 721/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0236 - acc: 0.7596
Epoch 722/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0248 - acc: 0.7212
Epoch 723/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0231 - acc: 0.7404
Epoch 724/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0239 - acc: 0.7115
Epoch 725/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0244 - acc: 0.7115
Epoch 726/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0234 - acc: 0.7596
Epoch 727/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0247 - acc: 0.7019
Epoch 728/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0240 - acc: 0.6827
Epoch 729/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0236 - acc: 0.7212
Epoch 730/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0257 - acc: 0.7308
Epoch 731/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0241 - acc: 0.7308
Epoch 732/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0238 - acc: 0.7500
Epoch 733/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0222 - acc: 0.7596
Epoch 734/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0230 - acc: 0.7212
Epoch 735/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0238 - acc: 0.7308
Epoch 736/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0239 - acc: 0.7500
Epoch 737/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0241 - acc: 0.7212
Epoch 738/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0229 - acc: 0.7115
Epoch 739/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0227 - acc: 0.7500
Epoch 740/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0230 - acc: 0.7308
Epoch 741/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0227 - acc: 0.7788
Epoch 742/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0233 - acc: 0.7308
Epoch 743/800
```

```
4/4 [==============================] - 0s 23ms/step - loss: 0.0249 - acc: 0.6731
Epoch 744/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0218 - acc: 0.7404
Epoch 745/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0228 - acc: 0.7692
Epoch 746/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0225 - acc: 0.7788
Epoch 747/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0206 - acc: 0.7885
Epoch 748/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0228 - acc: 0.7404
Epoch 749/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0224 - acc: 0.7212
Epoch 750/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0240 - acc: 0.7308
Epoch 751/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0226 - acc: 0.7308
Epoch 752/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0229 - acc: 0.7404
Epoch 753/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0225 - acc: 0.7308
Epoch 754/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0240 - acc: 0.7500
Epoch 755/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0228 - acc: 0.7596
Epoch 756/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0235 - acc: 0.7404
Epoch 757/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0229 - acc: 0.7500
Epoch 758/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0230 - acc: 0.7981
Epoch 759/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0241 - acc: 0.7788
Epoch 760/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0231 - acc: 0.7500
Epoch 761/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0217 - acc: 0.7115
Epoch 762/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0217 - acc: 0.7692
Epoch 763/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0230 - acc: 0.7692
Epoch 764/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0236 - acc: 0.7019
Epoch 765/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0219 - acc: 0.7404
Epoch 766/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0242 - acc: 0.7692
Epoch 767/800
```

```
4/4 [==============================] - 0s 21ms/step - loss: 0.0239 - acc: 0.7308
Epoch 768/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0219 - acc: 0.7500
Epoch 769/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0213 - acc: 0.7500
Epoch 770/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0226 - acc: 0.7981
Epoch 771/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0227 - acc: 0.7788
Epoch 772/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0213 - acc: 0.7596
Epoch 773/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0222 - acc: 0.7500
Epoch 774/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0226 - acc: 0.7404
Epoch 775/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0227 - acc: 0.7596
Epoch 776/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0229 - acc: 0.7212
Epoch 777/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0219 - acc: 0.7692
Epoch 778/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0222 - acc: 0.7788
Epoch 779/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0215 - acc: 0.7788
Epoch 780/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0207 - acc: 0.7404
Epoch 781/800
4/4 [==============================] - 0s 25ms/step - loss: 0.0211 - acc: 0.8173
Epoch 782/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0218 - acc: 0.7692
Epoch 783/800
4/4 [==============================] - 0s 26ms/step - loss: 0.0210 - acc: 0.7404
Epoch 784/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0223 - acc: 0.7212
Epoch 785/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0212 - acc: 0.7981
Epoch 786/800
4/4 [==============================] - 0s 24ms/step - loss: 0.0203 - acc: 0.7692
Epoch 787/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0219 - acc: 0.7212
Epoch 788/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0230 - acc: 0.7404
Epoch 789/800
4/4 [==============================] - 0s 23ms/step - loss: 0.0200 - acc: 0.7981
Epoch 790/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0224 - acc: 0.7788
Epoch 791/800
```

```
4/4 [==============================] - 0s 21ms/step - loss: 0.0222 - acc: 0.7692
Epoch 792/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0213 - acc: 0.7981
Epoch 793/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0208 - acc: 0.7885
Epoch 794/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0221 - acc: 0.7788
Epoch 795/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0216 - acc: 0.7981
Epoch 796/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0212 - acc: 0.7788
Epoch 797/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0215 - acc: 0.7885
Epoch 798/800
4/4 [==============================] - 0s 20ms/step - loss: 0.0209 - acc: 0.7788
Epoch 799/800
4/4 [==============================] - 0s 22ms/step - loss: 0.0231 - acc: 0.7212
Epoch 800/800
4/4 [==============================] - 0s 21ms/step - loss: 0.0245 - acc: 0.7596
```

[372]:
```
<tensorflow.python.keras.callbacks.History at 0x20bf20a0b50>
```

[375]:
```
testing_sample_scaled = sc.fit_transform(test_set_sample[0:30])
```

Predicting for sample test data prepared

[376]:
```
testing_sample_scaled = np.reshape(testing_sample_scaled,(testing_sample_scaled.
 ↪shape[1],testing_sample_scaled.shape[0],1))

predicted_temperature = regressor.predict(testing_sample_scaled)
```

[377]:
```
predicted_temperature = sc.inverse_transform(predicted_temperature)
```

The below are the predicted values

[396]:
```
print(predicted_temperature[0])
```

```
[298.21646 299.73602 297.93655 296.91956]
```

Now lets see the actual values

[397]:
```
acutal_value = (test_set_sample[30:34])
```

[398]:
```
acutal_value
```

[398]:
```
array([[297.59],
       [300.38],
       [296.74],
       [294.47]])
```

Now finding the error between actual and predicted data

[399]:
```
error1 = predicted_temperature[0] - acutal_value[0]
```

[400]:
```
print(error1)
```

```
[ 0.62646118  2.14602295  0.34655396 -0.67044434]
```

The above error indicates that our model performs very well, now lets use it to predict future temperature

Predicting future temperature for next 4 quartely month

[401]:
```
testing_sample_scaled = sc.fit_transform(test_set_sample[4:34])
```

[402]:
```
testing_sample_scaled = np.reshape(testing_sample_scaled,(testing_sample_scaled.
 ↪shape[1],testing_sample_scaled.shape[0],1))

predicted_temperature = regressor.predict(testing_sample_scaled)
```

[403]:
```
predicted_temperature = sc.inverse_transform(predicted_temperature)
```

[404]:
```
print(predicted_temperature[0])
```

```
[297.91928 299.58896 297.62598 296.5048 ]
```

The above are the predicted mean values for the next quarterly months for banglore

1.2 Predicting Kerala Mean temperature

Here we are using the main ERA5 dataset for this prediction. We predict the mean temperature for kerala state

[184]:
```
kerala_data = data[data['STATE_UT']=='KERALA']
```

[185]:
```
kerala_data.head()
```

[185]:
```
    DIST91_ID        NAME STATE_UT       date  maximum_2m_air_temperature  \
72      171.0     WAYANAD   KERALA 1980-01-01                  304.328384
73      170.0      KANNUR   KERALA 1980-01-01                  304.485970
74      172.0   KOZHIKODE   KERALA 1980-01-01                  303.993400
75      176.0   ERNAKULAM   KERALA 1980-01-01                  307.160080
76      173.0  MALAPPURAM   KERALA 1980-01-01                  304.929867

    minimum_2m_air_temperature  mean_temperature
72                  286.505651        295.417017
73                  292.209197        298.347583
74                  292.673536        298.333468
75                  293.908322        300.534201
76                  290.547602        297.738735
```

[186]:
```
kerala_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 6720 entries, 72 to 313351
Data columns (total 7 columns):
 #   Column                      Non-Null Count  Dtype
---  ------                      --------------  -----
 0   DIST91_ID                   6720 non-null   float64
 1   NAME                        6720 non-null   object
 2   STATE_UT                    6720 non-null   object
 3   date                        6720 non-null   datetime64[ns]
 4   maximum_2m_air_temperature  6720 non-null   float64
 5   minimum_2m_air_temperature  6720 non-null   float64
 6   mean_temperature            6720 non-null   float64
dtypes: datetime64[ns](1), float64(4), object(2)
memory usage: 420.0+ KB
```

Calculating the mean

[187]:
```
col = kerala_data.loc[: , "maximum_2m_air_temperature":
 ↪"minimum_2m_air_temperature"]
```

[188]:
```
kerala_data['mean_temperature'] = col.mean(axis=1)
```

```
<ipython-input-188-ada6cff453e5>:1: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: https://pandas.pydata.org/pandas-
docs/stable/user_guide/indexing.html#returning-a-view-versus-a-copy
  kerala_data['mean_temperature'] = col.mean(axis=1)
```

[189]:
```
kerala_data.head()
```

[189]:
```
    DIST91_ID        NAME STATE_UT       date  maximum_2m_air_temperature  \
72      171.0     WAYANAD   KERALA 1980-01-01                  304.328384
73      170.0      KANNUR   KERALA 1980-01-01                  304.485970
74      172.0   KOZHIKODE   KERALA 1980-01-01                  303.993400
75      176.0   ERNAKULAM   KERALA 1980-01-01                  307.160080
76      173.0  MALAPPURAM   KERALA 1980-01-01                  304.929867

    minimum_2m_air_temperature  mean_temperature
72                  286.505651        295.417017
73                  292.209197        298.347583
74                  292.673536        298.333468
75                  293.908322        300.534201
76                  290.547602        297.738735
```

[190]:
```
training_set = kerala_data["mean_temperature"]
```

[191]:
```
training_set.reset_index(drop=True,inplace=True)
```

[192]:
```
training_set.head()
```

[192]:
```
0    295.417017
1    298.347583
2    298.333468
3    300.534201
4    297.738735
Name: mean_temperature, dtype: float64
```

[193]:
```
training_set = np.asarray(training_set)
```

[194]:
```
training_set = training_set.reshape((-1,1))
```

[195]:
```
len(training_set)
```

[195]:
```
6720
```

[200]:
```
training_set=np.round_(training_set, decimals=2)
```

[201]:
```
training_set
```

[201]:
```
array([[295.42],
       [298.35],
       [298.33],
       …,
       [299.9 ],
       [302.9 ],
       [300.3 ]])
```

[202]:
```
test_set_sample = training_set[-1:-100:-1]
train_set = training_set[0:6621]
```

[203]:
```
len(train_set)
```

[203]:
```
6621
```

[204]:
```
len(test_set_sample)
```

[204]:
```
99
```

Scaling the dataset for feeding it to the model

[205]:
```
sc = MinMaxScaler(feature_range=(0,1))
training_set_scaled = sc.fit_transform(train_set)
```

Preparing the data to be fed to the model

[206]:
```
x_train = []
y_train = []
```

```python
n_future = 4 # next 4 days temperature forecast
n_past = 30 # Past 30 days
for i in range(0,len(training_set_scaled)-n_past-n_future+1):
    x_train.append(training_set_scaled[i : i + n_past , 0])
    y_train.append(training_set_scaled[i + n_past : i + n_past + n_future , 0 ])
x_train , y_train = np.array(x_train), np.array(y_train)
x_train = np.reshape(x_train, (x_train.shape[0] , x_train.shape[1], 1) )
```

Making the RNN model, and fiting the data, and training the model

[207]:

```python
regressor = Sequential()
regressor.add(Bidirectional(LSTM(units=30, return_sequences=True, input_shape =␣
↪(x_train.shape[1],1) ) ))
regressor.add(Dropout(0.2))
regressor.add(LSTM(units= 30 , return_sequences=True))
regressor.add(Dropout(0.2))
regressor.add(LSTM(units= 30 , return_sequences=True))
regressor.add(Dropout(0.2))
regressor.add(LSTM(units= 30))
regressor.add(Dropout(0.2))
regressor.add(Dense(units = n_future,activation='linear'))
regressor.compile(optimizer='adam', loss='mean_squared_error',metrics=['acc'])
regressor.fit(x_train, y_train, epochs=500,batch_size=32 )
```

```
Epoch 1/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0345 - acc:
0.2495
Epoch 2/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0176 - acc:
0.2521
Epoch 3/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0157 - acc:
0.2464
Epoch 4/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0142 - acc:
0.2577
Epoch 5/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0137 - acc:
0.2412
Epoch 6/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0130 - acc:
0.2485
Epoch 7/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0125 - acc:
0.2491: 1s - loss
Epoch 8/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0122 - acc:
0.2400:
```

```
Epoch 9/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0119 - acc:
0.2523
Epoch 10/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0117 - acc:
0.2498
Epoch 11/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0114 - acc:
0.2523
Epoch 12/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0113 - acc:
0.2461
Epoch 13/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0112 - acc:
0.2457
Epoch 14/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0110 - acc:
0.2530
Epoch 15/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0108 - acc:
0.2500
Epoch 16/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0106 - acc:
0.2673
Epoch 17/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0104 - acc:
0.2702
Epoch 18/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0102 - acc:
0.2641
Epoch 19/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0100 - acc:
0.2741
Epoch 20/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0099 - acc:
0.2794
Epoch 21/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0097 - acc:
0.2939
Epoch 22/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0096 - acc:
0.2893
Epoch 23/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0095 - acc:
0.2961
Epoch 24/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0092 - acc:
0.3109
```

```
Epoch 25/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0090 - acc:
0.3148
Epoch 26/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0088 - acc:
0.3279
Epoch 27/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0084 - acc:
0.3338
Epoch 28/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0081 - acc:
0.3713
Epoch 29/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0074 - acc:
0.4168
Epoch 30/500
206/206 [==============================] - 7s 34ms/step - loss: 0.0067 - acc:
0.4355
Epoch 31/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0061 - acc:
0.4391
Epoch 32/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0056 - acc:
0.4762
Epoch 33/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0052 - acc:
0.4836
Epoch 34/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0050 - acc:
0.4964
Epoch 35/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0048 - acc:
0.5121
Epoch 36/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0045 - acc:
0.5162
Epoch 37/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0045 - acc:
0.5217
Epoch 38/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0043 - acc:
0.5264
Epoch 39/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0042 - acc:
0.5354
Epoch 40/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0041 - acc:
0.5436
```

```
Epoch 41/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0039 - acc:
0.5540
Epoch 42/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0038 - acc:
0.5612
Epoch 43/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0036 - acc:
0.5651
Epoch 44/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0035 - acc:
0.5709
Epoch 45/500
206/206 [==============================] - 7s 36ms/step - loss: 0.0034 - acc:
0.5776
Epoch 46/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0034 - acc:
0.5747
Epoch 47/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0033 - acc:
0.5889
Epoch 48/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0032 - acc:
0.5932
Epoch 49/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0030 - acc:
0.6003
Epoch 50/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0029 - acc:
0.6140: 1
Epoch 51/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0029 - acc:
0.6340
Epoch 52/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0028 - acc:
0.6368
Epoch 53/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0027 - acc:
0.6468
Epoch 54/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0027 - acc:
0.6457
Epoch 55/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0027 - acc:
0.6451
Epoch 56/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0026 - acc:
0.6571: 0s - loss: 0.002
```

```
Epoch 57/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0026 - acc:
0.6655
Epoch 58/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0026 - acc:
0.6705
Epoch 59/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0025 - acc:
0.6729
Epoch 60/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0024 - acc:
0.6773
Epoch 61/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0025 - acc:
0.6721
Epoch 62/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0026 - acc:
0.6670
Epoch 63/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0024 - acc:
0.6808: 0s - loss: 0.0024 -
Epoch 64/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0023 - acc:
0.6777
Epoch 65/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0023 - acc:
0.6873
Epoch 66/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0023 - acc:
0.6864
Epoch 67/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0022 - acc:
0.6982
Epoch 68/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0022 - acc:
0.6884
Epoch 69/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0023 - acc:
0.6878
Epoch 70/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0023 - acc:
0.6850
Epoch 71/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0022 - acc:
0.6831
Epoch 72/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0022 - acc:
0.6949
```

```
Epoch 73/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0022 - acc:
0.7023
Epoch 74/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0022 - acc:
0.6964
Epoch 75/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0022 - acc:
0.7042
Epoch 76/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0022 - acc:
0.6925
Epoch 77/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0023 - acc:
0.6872
Epoch 78/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0021 - acc:
0.6982
Epoch 79/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0021 - acc:
0.6978
Epoch 80/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0021 - acc:
0.7001
Epoch 81/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0021 - acc:
0.7020
Epoch 82/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0021 - acc:
0.7055
Epoch 83/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0021 - acc:
0.7089
Epoch 84/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0021 - acc:
0.7002
Epoch 85/500
206/206 [==============================] - 7s 34ms/step - loss: 0.0022 - acc:
0.7034
Epoch 86/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0021 - acc:
0.7001
Epoch 87/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0020 - acc:
0.7025
Epoch 88/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0020 - acc:
0.7032
```

```
Epoch 89/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0020 - acc:
0.7148
Epoch 90/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0020 - acc:
0.7031
Epoch 91/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0020 - acc:
0.7119
Epoch 92/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0020 - acc:
0.7072
Epoch 93/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0020 - acc:
0.7081
Epoch 94/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0020 - acc:
0.7113
Epoch 95/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0020 - acc:
0.7121
Epoch 96/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0020 - acc:
0.7143
Epoch 97/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0019 - acc:
0.7107
Epoch 98/500
206/206 [==============================] - 7s 34ms/step - loss: 0.0020 - acc:
0.7090
Epoch 99/500
206/206 [==============================] - 7s 35ms/step - loss: 0.0021 - acc:
0.7014
Epoch 100/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0020 - acc:
0.7023
Epoch 101/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0019 - acc:
0.7117: 1s - loss: 0.0020 - acc: 0 - ETA: 1s - loss:
Epoch 102/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0019 - acc:
0.7152
Epoch 103/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0019 - acc:
0.7116
Epoch 104/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0020 - acc:
0.7037
```

```
Epoch 105/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0019 - acc:
0.7136
Epoch 106/500
206/206 [==============================] - 6s 32ms/step - loss: 0.0019 - acc:
0.7234
Epoch 107/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0019 - acc:
0.7125
Epoch 108/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0019 - acc:
0.7175
Epoch 109/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0019 - acc:
0.7101
Epoch 110/500
206/206 [==============================] - 7s 34ms/step - loss: 0.0018 - acc:
0.7186
Epoch 111/500
206/206 [==============================] - 7s 35ms/step - loss: 0.0019 - acc:
0.7181
Epoch 112/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0019 - acc:
0.7189
Epoch 113/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0019 - acc:
0.7221
Epoch 114/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0019 - acc:
0.7104
Epoch 115/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0019 - acc:
0.7107
Epoch 116/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0018 - acc:
0.7162
Epoch 117/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0018 - acc:
0.7149
Epoch 118/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0018 - acc:
0.7172
Epoch 119/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0018 - acc:
0.7190
Epoch 120/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0018 - acc:
0.7248
```

```
Epoch 121/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0019 - acc:
0.7242
Epoch 122/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0020 - acc:
0.7101
Epoch 123/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0019 - acc:
0.7165
Epoch 124/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0018 - acc:
0.7192
Epoch 125/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0018 - acc:
0.7193
Epoch 126/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0018 - acc:
0.7256
Epoch 127/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0018 - acc:
0.7172
Epoch 128/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0018 - acc:
0.7310
Epoch 129/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0018 - acc:
0.7240
Epoch 130/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0018 - acc:
0.7310
Epoch 131/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0018 - acc:
0.7231
Epoch 132/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0018 - acc:
0.7237
Epoch 133/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0018 - acc:
0.7192
Epoch 134/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0018 - acc:
0.7184
Epoch 135/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0017 - acc:
0.7231
Epoch 136/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0018 - acc:
0.7286
```

```
Epoch 137/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0018 - acc:
0.7231
Epoch 138/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0018 - acc:
0.7259
Epoch 139/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0018 - acc:
0.7221
Epoch 140/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0017 - acc:
0.7247
Epoch 141/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0017 - acc:
0.7333
Epoch 142/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0017 - acc:
0.7224
Epoch 143/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0017 - acc:
0.7209
Epoch 144/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0018 - acc:
0.7155
Epoch 145/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0017 - acc:
0.7298
Epoch 146/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0017 - acc:
0.7248
Epoch 147/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0017 - acc:
0.7218
Epoch 148/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0017 - acc:
0.7301
Epoch 149/500
206/206 [==============================] - 5s 27ms/step - loss: 0.0017 - acc:
0.7262
Epoch 150/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0017 - acc:
0.7204
Epoch 151/500
206/206 [==============================] - 5s 27ms/step - loss: 0.0020 - acc:
0.7116
Epoch 152/500
206/206 [==============================] - 5s 26ms/step - loss: 0.0017 - acc:
0.7257
```

```
Epoch 153/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0018 - acc:
0.7231
Epoch 154/500
206/206 [==============================] - 5s 27ms/step - loss: 0.0017 - acc:
0.7245
Epoch 155/500
206/206 [==============================] - 5s 27ms/step - loss: 0.0017 - acc:
0.7286
Epoch 156/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0017 - acc:
0.7315
Epoch 157/500
206/206 [==============================] - 5s 26ms/step - loss: 0.0017 - acc:
0.7309
Epoch 158/500
206/206 [==============================] - 5s 26ms/step - loss: 0.0017 - acc:
0.7327
Epoch 159/500
206/206 [==============================] - 5s 27ms/step - loss: 0.0017 - acc:
0.7284
Epoch 160/500
206/206 [==============================] - 5s 26ms/step - loss: 0.0017 - acc:
0.7325
Epoch 161/500
206/206 [==============================] - 5s 26ms/step - loss: 0.0018 - acc:
0.7195
Epoch 162/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0017 - acc:
0.7312
Epoch 163/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0017 - acc:
0.7268
Epoch 164/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0017 - acc:
0.7339
Epoch 165/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0017 - acc:
0.7298
Epoch 166/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0017 - acc:
0.7236
Epoch 167/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0017 - acc:
0.7263
Epoch 168/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0017 - acc:
0.7186
```

```
Epoch 169/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0018 - acc:
0.7204
Epoch 170/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0018 - acc:
0.7271
Epoch 171/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0017 - acc:
0.7291
Epoch 172/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0016 - acc:
0.7328
Epoch 173/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0017 - acc:
0.7386
Epoch 174/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0017 - acc:
0.7277
Epoch 175/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0016 - acc:
0.7269
Epoch 176/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0017 - acc:
0.7351
Epoch 177/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0017 - acc:
0.7248
Epoch 178/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0018 - acc:
0.7322
Epoch 179/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0016 - acc:
0.7309
Epoch 180/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0016 - acc:
0.7298
Epoch 181/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0016 - acc:
0.7338
Epoch 182/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0016 - acc:
0.7325
Epoch 183/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0016 - acc:
0.7301
Epoch 184/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0017 - acc:
0.7295
```

```
Epoch 185/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0016 - acc:
0.7259
Epoch 186/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0016 - acc:
0.7325
Epoch 187/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0017 - acc:
0.7325
Epoch 188/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0017 - acc:
0.7239
Epoch 189/500
206/206 [==============================] - 7s 34ms/step - loss: 0.0016 - acc:
0.7332
Epoch 190/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0016 - acc:
0.7269
Epoch 191/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0016 - acc:
0.7313: 0s - loss: 0.0016 - acc
Epoch 192/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0016 - acc:
0.7251
Epoch 193/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0016 - acc:
0.7300
Epoch 194/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0016 - acc:
0.7322
Epoch 195/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0016 - acc:
0.7335
Epoch 196/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0016 - acc:
0.7348
Epoch 197/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0016 - acc:
0.7306
Epoch 198/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0016 - acc:
0.7335
Epoch 199/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0016 - acc:
0.7366
Epoch 200/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0016 - acc:
0.7351
```

```
Epoch 201/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0016 - acc:
0.7341
Epoch 202/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0016 - acc:
0.7266
Epoch 203/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0016 - acc:
0.7312
Epoch 204/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0016 - acc:
0.7266
Epoch 205/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0016 - acc:
0.7362
Epoch 206/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0016 - acc:
0.7356
Epoch 207/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0016 - acc:
0.7407: 0s - loss: 0.0016 -
Epoch 208/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0016 - acc:
0.7383
Epoch 209/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0016 - acc:
0.7336
Epoch 210/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0016 - acc:
0.7313
Epoch 211/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0016 - acc:
0.7289
Epoch 212/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0016 - acc:
0.7225
Epoch 213/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0015 - acc:
0.7312
Epoch 214/500
206/206 [==============================] - 7s 35ms/step - loss: 0.0016 - acc:
0.7292
Epoch 215/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0015 - acc:
0.7398
Epoch 216/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0016 - acc:
0.7292
```

```
Epoch 217/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0015 - acc:
0.7256
Epoch 218/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0015 - acc:
0.7322
Epoch 219/500
206/206 [==============================] - 7s 34ms/step - loss: 0.0016 - acc:
0.7330
Epoch 220/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0017 - acc:
0.7192
Epoch 221/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0016 - acc:
0.7298
Epoch 222/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0015 - acc:
0.7400
Epoch 223/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0015 - acc:
0.7347
Epoch 224/500
206/206 [==============================] - 7s 34ms/step - loss: 0.0016 - acc:
0.7336
Epoch 225/500
206/206 [==============================] - 7s 34ms/step - loss: 0.0015 - acc:
0.7418
Epoch 226/500
206/206 [==============================] - 7s 35ms/step - loss: 0.0015 - acc:
0.7403
Epoch 227/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0016 - acc:
0.7423
Epoch 228/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0015 - acc:
0.7372
Epoch 229/500
206/206 [==============================] - 7s 35ms/step - loss: 0.0015 - acc:
0.7376
Epoch 230/500
206/206 [==============================] - 7s 35ms/step - loss: 0.0015 - acc:
0.7407
Epoch 231/500
206/206 [==============================] - 7s 34ms/step - loss: 0.0016 - acc:
0.7321
Epoch 232/500
206/206 [==============================] - 7s 34ms/step - loss: 0.0015 - acc:
0.7403
```

```
Epoch 233/500
206/206 [==============================] - 7s 35ms/step - loss: 0.0015 - acc:
0.7376
Epoch 234/500
206/206 [==============================] - 7s 34ms/step - loss: 0.0015 - acc:
0.7412
Epoch 235/500
206/206 [==============================] - 8s 37ms/step - loss: 0.0015 - acc:
0.7335
Epoch 236/500
206/206 [==============================] - 8s 37ms/step - loss: 0.0016 - acc:
0.7230
Epoch 237/500
206/206 [==============================] - 8s 37ms/step - loss: 0.0016 - acc:
0.7260
Epoch 238/500
206/206 [==============================] - 7s 34ms/step - loss: 0.0016 - acc:
0.7283
Epoch 239/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0015 - acc:
0.7354
Epoch 240/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0015 - acc:
0.7388
Epoch 241/500
206/206 [==============================] - 7s 35ms/step - loss: 0.0015 - acc:
0.7341
Epoch 242/500
206/206 [==============================] - 7s 35ms/step - loss: 0.0015 - acc:
0.7366
Epoch 243/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0015 - acc:
0.7394
Epoch 244/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0015 - acc:
0.7336
Epoch 245/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0015 - acc:
0.7406
Epoch 246/500
206/206 [==============================] - 7s 34ms/step - loss: 0.0017 - acc:
0.7286
Epoch 247/500
206/206 [==============================] - 7s 35ms/step - loss: 0.0015 - acc:
0.7389
Epoch 248/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0015 - acc:
0.7436
```

```
Epoch 249/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0015 - acc:
0.7406
Epoch 250/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0015 - acc:
0.7362
Epoch 251/500
206/206 [==============================] - 7s 35ms/step - loss: 0.0015 - acc:
0.7412
Epoch 252/500
206/206 [==============================] - 7s 36ms/step - loss: 0.0015 - acc:
0.7427
Epoch 253/500
206/206 [==============================] - 7s 35ms/step - loss: 0.0014 - acc:
0.7438
Epoch 254/500
206/206 [==============================] - 7s 36ms/step - loss: 0.0015 - acc:
0.7348
Epoch 255/500
206/206 [==============================] - 7s 35ms/step - loss: 0.0016 - acc:
0.7345
Epoch 256/500
206/206 [==============================] - 8s 37ms/step - loss: 0.0015 - acc:
0.7310
Epoch 257/500
206/206 [==============================] - 8s 37ms/step - loss: 0.0015 - acc:
0.7397
Epoch 258/500
206/206 [==============================] - 8s 37ms/step - loss: 0.0015 - acc:
0.7304
Epoch 259/500
206/206 [==============================] - 8s 37ms/step - loss: 0.0015 - acc:
0.7327
Epoch 260/500
206/206 [==============================] - 8s 38ms/step - loss: 0.0015 - acc:
0.7433
Epoch 261/500
206/206 [==============================] - 8s 38ms/step - loss: 0.0015 - acc:
0.7420
Epoch 262/500
206/206 [==============================] - 8s 39ms/step - loss: 0.0015 - acc:
0.7453
Epoch 263/500
206/206 [==============================] - 8s 38ms/step - loss: 0.0015 - acc:
0.7365
Epoch 264/500
206/206 [==============================] - 8s 39ms/step - loss: 0.0015 - acc:
0.7359
```

```
Epoch 265/500
206/206 [==============================] - 8s 38ms/step - loss: 0.0015 - acc:
0.7403
Epoch 266/500
206/206 [==============================] - 8s 40ms/step - loss: 0.0015 - acc:
0.7391
Epoch 267/500
206/206 [==============================] - 8s 40ms/step - loss: 0.0015 - acc:
0.7368
Epoch 268/500
206/206 [==============================] - ETA: 0s - loss: 0.0015 - acc: 0.742 -
8s 40ms/step - loss: 0.0015 - acc: 0.7423
Epoch 269/500
206/206 [==============================] - 8s 38ms/step - loss: 0.0015 - acc:
0.7365
Epoch 270/500
206/206 [==============================] - 8s 39ms/step - loss: 0.0015 - acc:
0.7335
Epoch 271/500
206/206 [==============================] - 8s 37ms/step - loss: 0.0015 - acc:
0.7415
Epoch 272/500
206/206 [==============================] - 8s 38ms/step - loss: 0.0015 - acc:
0.7406
Epoch 273/500
206/206 [==============================] - 7s 35ms/step - loss: 0.0015 - acc:
0.7377
Epoch 274/500
206/206 [==============================] - 8s 38ms/step - loss: 0.0015 - acc:
0.7409
Epoch 275/500
206/206 [==============================] - 8s 37ms/step - loss: 0.0015 - acc:
0.7389
Epoch 276/500
206/206 [==============================] - 8s 37ms/step - loss: 0.0014 - acc:
0.7459
Epoch 277/500
206/206 [==============================] - 7s 35ms/step - loss: 0.0015 - acc:
0.7441
Epoch 278/500
206/206 [==============================] - 7s 35ms/step - loss: 0.0015 - acc:
0.7389
Epoch 279/500
206/206 [==============================] - 7s 34ms/step - loss: 0.0014 - acc:
0.7410
Epoch 280/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0015 - acc:
0.7427
```

```
Epoch 281/500
206/206 [==============================] - 7s 34ms/step - loss: 0.0015 - acc:
0.7415: 1s
Epoch 282/500
206/206 [==============================] - 7s 34ms/step - loss: 0.0014 - acc:
0.7401
Epoch 283/500
206/206 [==============================] - 7s 36ms/step - loss: 0.0015 - acc:
0.7433
Epoch 284/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0015 - acc:
0.7388
Epoch 285/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0015 - acc:
0.7435
Epoch 286/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0016 - acc:
0.7401
Epoch 287/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0015 - acc:
0.7435
Epoch 288/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0015 - acc:
0.7345
Epoch 289/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0015 - acc:
0.7413
Epoch 290/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0014 - acc:
0.7441
Epoch 291/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0014 - acc:
0.7424
Epoch 292/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0014 - acc:
0.7450
Epoch 293/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0014 - acc:
0.7423
Epoch 294/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0014 - acc:
0.7377
Epoch 295/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0014 - acc:
0.7435
Epoch 296/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0014 - acc:
0.7413
```

```
Epoch 297/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0014 - acc:
0.7392
Epoch 298/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0014 - acc:
0.7468
Epoch 299/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0014 - acc:
0.7435
Epoch 300/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0014 - acc:
0.7441
Epoch 301/500
206/206 [==============================] - 8s 40ms/step - loss: 0.0014 - acc:
0.7457
Epoch 302/500
206/206 [==============================] - 8s 41ms/step - loss: 0.0014 - acc:
0.7362: 1s - lo
Epoch 303/500
206/206 [==============================] - 8s 39ms/step - loss: 0.0014 - acc:
0.7391
Epoch 304/500
206/206 [==============================] - 8s 39ms/step - loss: 0.0014 - acc:
0.7442
Epoch 305/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0015 - acc:
0.7441
Epoch 306/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0014 - acc:
0.7480
Epoch 307/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0014 - acc:
0.7462
Epoch 308/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0015 - acc:
0.7404
Epoch 309/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0015 - acc:
0.7417
Epoch 310/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0014 - acc:
0.7454
Epoch 311/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0014 - acc:
0.7363
Epoch 312/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0014 - acc:
0.7453
```

```
Epoch 313/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0014 - acc:
0.7480
Epoch 314/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0014 - acc:
0.7477
Epoch 315/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0014 - acc:
0.7518
Epoch 316/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0014 - acc:
0.7418
Epoch 317/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0014 - acc:
0.7388
Epoch 318/500
206/206 [==============================] - 7s 35ms/step - loss: 0.0014 - acc:
0.7497
Epoch 319/500
206/206 [==============================] - 8s 39ms/step - loss: 0.0014 - acc:
0.7500
Epoch 320/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0014 - acc:
0.7464: 1s - loss:
Epoch 321/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0014 - acc:
0.7412
Epoch 322/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0014 - acc:
0.7453
Epoch 323/500
206/206 [==============================] - 7s 36ms/step - loss: 0.0014 - acc:
0.7436
Epoch 324/500
206/206 [==============================] - 7s 34ms/step - loss: 0.0014 - acc:
0.7400
Epoch 325/500
206/206 [==============================] - 7s 35ms/step - loss: 0.0014 - acc:
0.7459
Epoch 326/500
206/206 [==============================] - 8s 37ms/step - loss: 0.0014 - acc:
0.7409
Epoch 327/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0014 - acc:
0.7442
Epoch 328/500
206/206 [==============================] - 9s 42ms/step - loss: 0.0014 - acc:
0.7470
```

```
Epoch 329/500
206/206 [==============================] - 7s 36ms/step - loss: 0.0015 - acc:
0.7477
Epoch 330/500
206/206 [==============================] - 7s 34ms/step - loss: 0.0014 - acc:
0.7445
Epoch 331/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0014 - acc:
0.7453
Epoch 332/500
206/206 [==============================] - 7s 35ms/step - loss: 0.0015 - acc:
0.7371
Epoch 333/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0014 - acc:
0.7479
Epoch 334/500
206/206 [==============================] - 6s 32ms/step - loss: 0.0014 - acc:
0.7457
Epoch 335/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0014 - acc:
0.7492: 1s
Epoch 336/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0014 - acc:
0.7430
Epoch 337/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0014 - acc:
0.7491
Epoch 338/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0014 - acc:
0.7459
Epoch 339/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0014 - acc:
0.7447: 0s - loss: 0.0014 - acc
Epoch 340/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0014 - acc:
0.7435
Epoch 341/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0014 - acc:
0.7418
Epoch 342/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0015 - acc:
0.7404
Epoch 343/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0014 - acc:
0.7462
Epoch 344/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0014 - acc:
0.7459
```

```
Epoch 345/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7453
Epoch 346/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0014 - acc:
0.7407
Epoch 347/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0014 - acc:
0.7539
Epoch 348/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0014 - acc:
0.7415
Epoch 349/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7497
Epoch 350/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0014 - acc:
0.7436
Epoch 351/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0014 - acc:
0.7447
Epoch 352/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7429
Epoch 353/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0014 - acc:
0.7485
Epoch 354/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0013 - acc:
0.7479
Epoch 355/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0014 - acc:
0.7520
Epoch 356/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0014 - acc:
0.7495
Epoch 357/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0014 - acc:
0.7543
Epoch 358/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0014 - acc:
0.7445
Epoch 359/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0014 - acc:
0.7512
Epoch 360/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0013 - acc:
0.7465
```

```
Epoch 361/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0014 - acc:
0.7494
Epoch 362/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7502
Epoch 363/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0014 - acc:
0.7436
Epoch 364/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0014 - acc:
0.7471
Epoch 365/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0013 - acc:
0.7453
Epoch 366/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0015 - acc:
0.7363
Epoch 367/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0014 - acc:
0.7570
Epoch 368/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0013 - acc:
0.7489
Epoch 369/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0014 - acc:
0.7476
Epoch 370/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0014 - acc:
0.7418
Epoch 371/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0013 - acc:
0.7511
Epoch 372/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0013 - acc:
0.7511
Epoch 373/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0014 - acc:
0.7457: 0s - loss: 0.0014 - acc: 0.7
Epoch 374/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0013 - acc:
0.7464
Epoch 375/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0014 - acc:
0.7426
Epoch 376/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0014 - acc:
0.7456
```

```
Epoch 377/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0014 - acc:
0.7564
Epoch 378/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7480
Epoch 379/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0013 - acc:
0.7526
Epoch 380/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0013 - acc:
0.7485
Epoch 381/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0013 - acc:
0.7514
Epoch 382/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0014 - acc:
0.7474
Epoch 383/500
206/206 [==============================] - 5s 27ms/step - loss: 0.0013 - acc:
0.7398
Epoch 384/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0014 - acc:
0.7523
Epoch 385/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0014 - acc:
0.7429
Epoch 386/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0013 - acc:
0.7543
Epoch 387/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0014 - acc:
0.7459
Epoch 388/500
206/206 [==============================] - 5s 26ms/step - loss: 0.0017 - acc:
0.7266
Epoch 389/500
206/206 [==============================] - 5s 27ms/step - loss: 0.0014 - acc:
0.7445
Epoch 390/500
206/206 [==============================] - 5s 27ms/step - loss: 0.0014 - acc:
0.7424: 0s - loss: 0.0014 - acc:
Epoch 391/500
206/206 [==============================] - 5s 27ms/step - loss: 0.0013 - acc:
0.7539
Epoch 392/500
206/206 [==============================] - 5s 27ms/step - loss: 0.0013 - acc:
0.7502
```

```
Epoch 393/500
206/206 [==============================] - 5s 26ms/step - loss: 0.0013 - acc:
0.7480
Epoch 394/500
206/206 [==============================] - 5s 26ms/step - loss: 0.0013 - acc:
0.7500
Epoch 395/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0013 - acc:
0.7524
Epoch 396/500
206/206 [==============================] - 5s 26ms/step - loss: 0.0013 - acc:
0.7441
Epoch 397/500
206/206 [==============================] - 6s 27ms/step - loss: 0.0013 - acc:
0.7471
Epoch 398/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0013 - acc:
0.7517
Epoch 399/500
206/206 [==============================] - 7s 35ms/step - loss: 0.0013 - acc:
0.7464
Epoch 400/500
206/206 [==============================] - 7s 34ms/step - loss: 0.0013 - acc:
0.7470
Epoch 401/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0014 - acc:
0.7467
Epoch 402/500
206/206 [==============================] - 7s 32ms/step - loss: 0.0013 - acc:
0.7445
Epoch 403/500
206/206 [==============================] - 7s 33ms/step - loss: 0.0013 - acc:
0.7482
Epoch 404/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7518
Epoch 405/500
206/206 [==============================] - 6s 31ms/step - loss: 0.0013 - acc:
0.7486
Epoch 406/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7512
Epoch 407/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7439
Epoch 408/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0014 - acc:
0.7429
```

```
Epoch 409/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7517: 1s - loss
Epoch 410/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7517
Epoch 411/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7477: 0s - loss: 0.0013 - acc:
Epoch 412/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7483
Epoch 413/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7485
Epoch 414/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7450
Epoch 415/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7424
Epoch 416/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7474
Epoch 417/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7477
Epoch 418/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7482
Epoch 419/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0014 - acc:
0.7442
Epoch 420/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0014 - acc:
0.7444
Epoch 421/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7456
Epoch 422/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7476
Epoch 423/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7482
Epoch 424/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0014 - acc:
0.7524
```

```
Epoch 425/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7470
Epoch 426/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7482
Epoch 427/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7462
Epoch 428/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7497
Epoch 429/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7488
Epoch 430/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7555
Epoch 431/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7482
Epoch 432/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7562
Epoch 433/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7492
Epoch 434/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7415
Epoch 435/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7468
Epoch 436/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7582
Epoch 437/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0014 - acc:
0.7397
Epoch 438/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7492
Epoch 439/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7514
Epoch 440/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7467
```

```
Epoch 441/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7442
Epoch 442/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7502
Epoch 443/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7550
Epoch 444/500
206/206 [==============================] - 6s 30ms/step - loss: 0.0013 - acc:
0.7471
Epoch 445/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7594
Epoch 446/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7580
Epoch 447/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7533
Epoch 448/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7498
Epoch 449/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7410: 1s - los
Epoch 450/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7380
Epoch 451/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0014 - acc:
0.7354
Epoch 452/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7564
Epoch 453/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7508
Epoch 454/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7562
Epoch 455/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7489
Epoch 456/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7526: 0s - loss: 0.0013 - acc:
```

```
Epoch 457/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0012 - acc:
0.7535
Epoch 458/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7597
Epoch 459/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7474
Epoch 460/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7451
Epoch 461/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7500: 0s - loss: 0.00
Epoch 462/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7565
Epoch 463/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0012 - acc:
0.7509
Epoch 464/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7520
Epoch 465/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0012 - acc:
0.7568
Epoch 466/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7512
Epoch 467/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7520
Epoch 468/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7517
Epoch 469/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0012 - acc:
0.7580
Epoch 470/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0012 - acc:
0.7550
Epoch 471/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7477
Epoch 472/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0012 - acc:
0.7523
```

```
Epoch 473/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0013 - acc:
0.7539
Epoch 474/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7479
Epoch 475/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7521
Epoch 476/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7456
Epoch 477/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7521
Epoch 478/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7462
Epoch 479/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0012 - acc:
0.7546
Epoch 480/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7543
Epoch 481/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0012 - acc:
0.7438
Epoch 482/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0015 - acc:
0.7372
Epoch 483/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7488
Epoch 484/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0012 - acc:
0.7555
Epoch 485/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0012 - acc:
0.7559
Epoch 486/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7470: 1s - loss: 0
Epoch 487/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0012 - acc:
0.7533
Epoch 488/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7536- ETA: 0s - loss: 0.0013 - acc:
```

```
Epoch 489/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7536
Epoch 490/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0012 - acc:
0.7539
Epoch 491/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0012 - acc:
0.7585
Epoch 492/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0012 - acc:
0.7488
Epoch 493/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7489
Epoch 494/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7506
Epoch 495/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0012 - acc:
0.7514
Epoch 496/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0012 - acc:
0.7453
Epoch 497/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7523
Epoch 498/500
206/206 [==============================] - 6s 29ms/step - loss: 0.0012 - acc:
0.7561
Epoch 499/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0013 - acc:
0.7538
Epoch 500/500
206/206 [==============================] - 6s 28ms/step - loss: 0.0012 - acc:
0.7549
```

[207]:
```
<tensorflow.python.keras.callbacks.History at 0x20b70a2e070>
```

[213]:
```python
testing_sample_scaled = sc.fit_transform(test_set_sample[0:30])
```

Predicting for sample test data prepared

[214]:
```python
testing_sample_scaled = np.reshape(testing_sample_scaled,(testing_sample_scaled.
 ↪shape[1],testing_sample_scaled.shape[0],1))

predicted_temperature = regressor.predict(testing_sample_scaled)
```

[215]:
```
predicted_temperature = sc.inverse_transform(predicted_temperature)
```

The below are the predicted values

[216]:
```
predicted_temperature
```

[216]:
```
array([[300.18274, 300.5763 , 300.68668, 298.6599 ]], dtype=float32)
```

Seeing the actual value to compare

[217]:
```
test_set_sample[30:34]
```

[217]:
```
array([[299.37],
       [299.94],
       [300.47],
       [297.62]])
```

Finding the error

[218]:
```
error = predicted_temperature[0] - test_set_sample[30:34][0]
```

[452]:
```
print(error)
```

```
[0.81274 0.6363  0.21668 1.0399 ]
```

As the above error on the test data increase that, our model performs very well, now lets predict the future

Predicting future temperature with the current data

[220]:
```
testing_sample_scaled = sc.fit_transform(test_set_sample[70:100])
```

[221]:
```
testing_sample_scaled = np.reshape(testing_sample_scaled,(testing_sample_scaled.
 ↪shape[1],testing_sample_scaled.shape[0],1))

predicted_temperature = regressor.predict(testing_sample_scaled)
```

[222]:
```
predicted_temperature = sc.inverse_transform(predicted_temperature)
```

[245]:
```
print(predicted_temperature[0])
```

```
[300.33813 301.1022  300.9345  299.91898]
```

The above values are the predicted mean temperature of Kerala for next 4 months, the values are in kelvin scale

1.3 Predicting INDORE Maximum temperature

Here we are using the main ERA5 dataset for this prediction, here we predict the mean temperature for INDORE district

[518]:
```
indore_data = data[data['NAME']=='INDORE']
```

[519]:
```
indore_data.head()
```

[519]:
```
      DIST91_ID    NAME        STATE_UT                 date  \
393       205.0  INDORE  MADHYA_PRADESH  1980-01-01T00:00:00
1047      205.0  INDORE  MADHYA_PRADESH  1980-02-01T00:00:00
1701      205.0  INDORE  MADHYA_PRADESH  1980-03-01T00:00:00
2355      205.0  INDORE  MADHYA_PRADESH  1980-04-01T00:00:00
3009      205.0  INDORE  MADHYA_PRADESH  1980-05-01T00:00:00

      maximum_2m_air_temperature  minimum_2m_air_temperature
393                   302.225027                  283.010331
1047                  307.376971                  281.841915
1701                  309.569063                  285.828591
2355                  314.550475                  292.911056
3009                  315.050293                  297.359887
```

[520]:
```
indore_data.info()
```

```
<class 'pandas.core.frame.DataFrame'>
Int64Index: 480 entries, 393 to 313659
Data columns (total 6 columns):
 #   Column                      Non-Null Count  Dtype
---  ------                      --------------  -----
 0   DIST91_ID                   480 non-null    float64
 1   NAME                        480 non-null    object
 2   STATE_UT                    480 non-null    object
 3   date                        480 non-null    object
 4   maximum_2m_air_temperature  480 non-null    float64
 5   minimum_2m_air_temperature  480 non-null    float64
dtypes: float64(3), object(3)
memory usage: 26.2+ KB
```

Preparing the dataset

[521]:
```
training_set = indore_data["maximum_2m_air_temperature"]
```

[522]:
```
training_set.reset_index(drop=True,inplace=True)
```

[523]:
```
training_set = np.asarray(training_set)
```

[524]:
```
training_set = training_set.reshape((-1,1))
```

[525]:
```
len(training_set)
```

[525]: 480

[526]:
```
test_set_sample = training_set[-1:-61:-1]
train_set = training_set[0:420]
```

[527]:
```
len(test_set_sample)
```

[527]: 60

Scaling the data

[528]:
```
sc = MinMaxScaler(feature_range=(0,1))
training_set_scaled = sc.fit_transform(train_set)
```

[529]:
```
x_train = []
y_train = []
n_future = 4 # next 4 days temperature forecast
n_past = 30 # Past 30 days
for i in range(0,len(training_set_scaled)-n_past-n_future+1):
    x_train.append(training_set_scaled[i : i + n_past , 0])
    y_train.append(training_set_scaled[i + n_past : i + n_past + n_future , 0 ])
x_train , y_train = np.array(x_train), np.array(y_train)
x_train = np.reshape(x_train, (x_train.shape[0] , x_train.shape[1], 1) )
```

Building the model

[531]:
```
regressor = Sequential()
regressor.add(Bidirectional(LSTM(units=30, return_sequences=True, input_shape =␣
 ↪(x_train.shape[1],1) ) ))
regressor.add(Dropout(0.2))
regressor.add(LSTM(units= 30 , return_sequences=True))
regressor.add(Dropout(0.2))
regressor.add(LSTM(units= 30 , return_sequences=True))
regressor.add(Dropout(0.2))
regressor.add(LSTM(units= 30))
regressor.add(Dropout(0.2))
regressor.add(Dense(units = n_future,activation='linear'))
regressor.compile(optimizer='adam', loss='mean_squared_error',metrics=['acc'])
regressor.fit(x_train, y_train, epochs=300,batch_size=32 )
```

```
Epoch 1/300
13/13 [==============================] - 0s 32ms/step - loss: 0.1658 - acc:
0.2610
Epoch 2/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0859 - acc:
0.2842
Epoch 3/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0729 - acc:
0.2481
Epoch 4/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0712 - acc:
0.2661
Epoch 5/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0724 - acc:
```

```
0.2041
Epoch 6/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0684 - acc:
0.2558
Epoch 7/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0698 - acc:
0.2584
Epoch 8/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0690 - acc:
0.2661
Epoch 9/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0681 - acc:
0.2119
Epoch 10/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0662 - acc:
0.2429
Epoch 11/300
13/13 [==============================] - 0s 25ms/step - loss: 0.0685 - acc:
0.2584
Epoch 12/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0649 - acc:
0.2532
Epoch 13/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0647 - acc:
0.2713
Epoch 14/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0664 - acc:
0.2248
Epoch 15/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0639 - acc:
0.2403
Epoch 16/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0654 - acc:
0.2222
Epoch 17/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0622 - acc:
0.2248
Epoch 18/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0662 - acc:
0.2739
Epoch 19/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0623 - acc:
0.2868
Epoch 20/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0606 - acc:
0.2791
Epoch 21/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0530 - acc:
```

```
0.3023
Epoch 22/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0471 - acc:
0.2972
Epoch 23/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0446 - acc:
0.2868
Epoch 24/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0442 - acc:
0.3049
Epoch 25/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0456 - acc:
0.3230
Epoch 26/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0451 - acc:
0.3566
Epoch 27/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0398 - acc:
0.3540
Epoch 28/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0392 - acc:
0.4238
Epoch 29/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0381 - acc:
0.4444
Epoch 30/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0359 - acc:
0.3928
Epoch 31/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0352 - acc:
0.4651
Epoch 32/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0335 - acc:
0.4264
Epoch 33/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0314 - acc:
0.4987
Epoch 34/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0319 - acc:
0.4729
Epoch 35/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0353 - acc:
0.4780
Epoch 36/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0308 - acc:
0.4910
Epoch 37/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0299 - acc:
```

```
0.4987
Epoch 38/300
13/13 [==============================] - 0s 29ms/step - loss: 0.0291 - acc:
0.4574
Epoch 39/300
13/13 [==============================] - 0s 31ms/step - loss: 0.0266 - acc:
0.4832
Epoch 40/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0291 - acc:
0.5039
Epoch 41/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0267 - acc:
0.5194
Epoch 42/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0258 - acc:
0.5013
Epoch 43/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0260 - acc:
0.4858
Epoch 44/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0255 - acc:
0.5039
Epoch 45/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0265 - acc:
0.5297
Epoch 46/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0267 - acc:
0.5013
Epoch 47/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0246 - acc:
0.5090
Epoch 48/300
13/13 [==============================] - 0s 25ms/step - loss: 0.0260 - acc:
0.5271
Epoch 49/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0266 - acc:
0.5375
Epoch 50/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0239 - acc:
0.5245
Epoch 51/300
13/13 [==============================] - 0s 25ms/step - loss: 0.0213 - acc:
0.5271
Epoch 52/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0233 - acc:
0.5220
Epoch 53/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0222 - acc:
```

```
0.5478
Epoch 54/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0216 - acc:
0.5685
Epoch 55/300
13/13 [==============================] - 0s 28ms/step - loss: 0.0215 - acc:
0.5530
Epoch 56/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0211 - acc:
0.5556
Epoch 57/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0211 - acc:
0.5504
Epoch 58/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0207 - acc:
0.5788
Epoch 59/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0214 - acc:
0.5762
Epoch 60/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0204 - acc:
0.5788
Epoch 61/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0189 - acc:
0.5659
Epoch 62/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0193 - acc:
0.5659
Epoch 63/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0185 - acc:
0.5866
Epoch 64/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0182 - acc:
0.5943
Epoch 65/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0183 - acc:
0.5659
Epoch 66/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0173 - acc:
0.5711
Epoch 67/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0169 - acc:
0.5969
Epoch 68/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0166 - acc:
0.5995
Epoch 69/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0173 - acc:
```

```
0.5969
Epoch 70/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0180 - acc:
0.5995
Epoch 71/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0180 - acc:
0.6279
Epoch 72/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0195 - acc:
0.6098
Epoch 73/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0186 - acc:
0.5659
Epoch 74/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0170 - acc:
0.5788
Epoch 75/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0171 - acc:
0.6150
Epoch 76/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0180 - acc:
0.5866
Epoch 77/300
13/13 [==============================] - 0s 29ms/step - loss: 0.0160 - acc:
0.6098
Epoch 78/300
13/13 [==============================] - 0s 33ms/step - loss: 0.0159 - acc:
0.6047
Epoch 79/300
13/13 [==============================] - 0s 30ms/step - loss: 0.0157 - acc:
0.5891
Epoch 80/300
13/13 [==============================] - 0s 32ms/step - loss: 0.0148 - acc:
0.6098
Epoch 81/300
13/13 [==============================] - 0s 29ms/step - loss: 0.0153 - acc:
0.6305
Epoch 82/300
13/13 [==============================] - 0s 29ms/step - loss: 0.0151 - acc:
0.6305
Epoch 83/300
13/13 [==============================] - 0s 28ms/step - loss: 0.0145 - acc:
0.6150
Epoch 84/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0150 - acc:
0.6305
Epoch 85/300
13/13 [==============================] - 0s 28ms/step - loss: 0.0143 - acc:
```

```
0.6512
Epoch 86/300
13/13 [==============================] - 0s 25ms/step - loss: 0.0138 - acc:
0.6434
Epoch 87/300
13/13 [==============================] - 0s 28ms/step - loss: 0.0136 - acc:
0.6460
Epoch 88/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0152 - acc:
0.6408
Epoch 89/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0142 - acc:
0.6357
Epoch 90/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0148 - acc:
0.6460
Epoch 91/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0134 - acc:
0.6331
Epoch 92/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0133 - acc:
0.6641
Epoch 93/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0129 - acc:
0.6486
Epoch 94/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0137 - acc:
0.6021
Epoch 95/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0134 - acc:
0.6512
Epoch 96/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0136 - acc:
0.6253
Epoch 97/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0141 - acc:
0.5917
Epoch 98/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0139 - acc:
0.6873
Epoch 99/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0137 - acc:
0.6279
Epoch 100/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0141 - acc:
0.6279
Epoch 101/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0136 - acc:
```

```
0.6563
Epoch 102/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0122 - acc:
0.6667
Epoch 103/300
13/13 [==============================] - 0s 25ms/step - loss: 0.0126 - acc:
0.6693
Epoch 104/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0132 - acc:
0.6744
Epoch 105/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0134 - acc:
0.6331
Epoch 106/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0142 - acc:
0.6150
Epoch 107/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0136 - acc:
0.6460
Epoch 108/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0131 - acc:
0.6408
Epoch 109/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0124 - acc:
0.6382
Epoch 110/300
13/13 [==============================] - 0s 29ms/step - loss: 0.0126 - acc:
0.6460
Epoch 111/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0126 - acc:
0.6718
Epoch 112/300
13/13 [==============================] - 0s 28ms/step - loss: 0.0124 - acc:
0.6848
Epoch 113/300
13/13 [==============================] - 0s 28ms/step - loss: 0.0120 - acc:
0.6822
Epoch 114/300
13/13 [==============================] - 0s 28ms/step - loss: 0.0132 - acc:
0.6718
Epoch 115/300
13/13 [==============================] - 0s 28ms/step - loss: 0.0115 - acc:
0.6925
Epoch 116/300
13/13 [==============================] - 0s 28ms/step - loss: 0.0120 - acc:
0.6951
Epoch 117/300
13/13 [==============================] - 0s 25ms/step - loss: 0.0122 - acc:
```

```
0.6848
Epoch 118/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0119 - acc:
0.6873
Epoch 119/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0118 - acc:
0.7054
Epoch 120/300
13/13 [==============================] - 0s 25ms/step - loss: 0.0120 - acc:
0.6718
Epoch 121/300
13/13 [==============================] - 0s 28ms/step - loss: 0.0116 - acc:
0.7028
Epoch 122/300
13/13 [==============================] - 0s 30ms/step - loss: 0.0119 - acc:
0.6822
Epoch 123/300
13/13 [==============================] - 0s 29ms/step - loss: 0.0122 - acc:
0.6951
Epoch 124/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0116 - acc:
0.6899
Epoch 125/300
13/13 [==============================] - 0s 28ms/step - loss: 0.0117 - acc:
0.6951
Epoch 126/300
13/13 [==============================] - 0s 29ms/step - loss: 0.0120 - acc:
0.6615
Epoch 127/300
13/13 [==============================] - 0s 29ms/step - loss: 0.0116 - acc:
0.6977
Epoch 128/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0114 - acc:
0.6873
Epoch 129/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0108 - acc:
0.7132
Epoch 130/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0119 - acc:
0.7287
Epoch 131/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0113 - acc:
0.6899
Epoch 132/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0122 - acc:
0.7158
Epoch 133/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0120 - acc:
```

```
0.7054
Epoch 134/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0113 - acc:
0.7028
Epoch 135/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0115 - acc:
0.7080
Epoch 136/300
13/13 [==============================] - 0s 25ms/step - loss: 0.0113 - acc:
0.6873
Epoch 137/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0124 - acc:
0.6770
Epoch 138/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0115 - acc:
0.7003
Epoch 139/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0107 - acc:
0.7003
Epoch 140/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0114 - acc:
0.7287
Epoch 141/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0108 - acc:
0.7003
Epoch 142/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0111 - acc:
0.7183: 0s - loss: 0.0113 - acc: 0.7
Epoch 143/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0111 - acc:
0.6899
Epoch 144/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0112 - acc:
0.7339
Epoch 145/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0107 - acc:
0.7028
Epoch 146/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0109 - acc:
0.6977
Epoch 147/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0107 - acc:
0.7339
Epoch 148/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0111 - acc:
0.6873
Epoch 149/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0107 - acc:
```

```
0.7158
Epoch 150/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0102 - acc:
0.7261
Epoch 151/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0109 - acc:
0.7261
Epoch 152/300
13/13 [==============================] - 0s 29ms/step - loss: 0.0110 - acc:
0.7080
Epoch 153/300
13/13 [==============================] - 0s 30ms/step - loss: 0.0108 - acc:
0.7158
Epoch 154/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0107 - acc:
0.6925
Epoch 155/300
13/13 [==============================] - 0s 28ms/step - loss: 0.0118 - acc:
0.6951
Epoch 156/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0104 - acc:
0.7028
Epoch 157/300
13/13 [==============================] - 0s 28ms/step - loss: 0.0118 - acc:
0.6899
Epoch 158/300
13/13 [==============================] - 0s 29ms/step - loss: 0.0107 - acc:
0.7339
Epoch 159/300
13/13 [==============================] - 0s 29ms/step - loss: 0.0109 - acc:
0.7080
Epoch 160/300
13/13 [==============================] - 0s 28ms/step - loss: 0.0111 - acc:
0.7054
Epoch 161/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0107 - acc:
0.6899
Epoch 162/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0105 - acc:
0.7028
Epoch 163/300
13/13 [==============================] - 0s 28ms/step - loss: 0.0110 - acc:
0.7132
Epoch 164/300
13/13 [==============================] - 0s 31ms/step - loss: 0.0102 - acc:
0.7339
Epoch 165/300
13/13 [==============================] - 0s 28ms/step - loss: 0.0109 - acc:
```

```
0.6951
Epoch 166/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0110 - acc:
0.7235
Epoch 167/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0116 - acc:
0.7209
Epoch 168/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0111 - acc:
0.7028
Epoch 169/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0102 - acc:
0.7313
Epoch 170/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0102 - acc:
0.7209
Epoch 171/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0099 - acc:
0.7106
Epoch 172/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0105 - acc:
0.6951
Epoch 173/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0097 - acc:
0.7339
Epoch 174/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0110 - acc:
0.7209
Epoch 175/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0102 - acc:
0.7261
Epoch 176/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0101 - acc:
0.7313
Epoch 177/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0094 - acc:
0.7209
Epoch 178/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0099 - acc:
0.7003
Epoch 179/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0101 - acc:
0.7106
Epoch 180/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0098 - acc:
0.7364
Epoch 181/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0106 - acc:
```

```
0.6925
Epoch 182/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0114 - acc:
0.7287
Epoch 183/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0105 - acc:
0.6925
Epoch 184/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0110 - acc:
0.6977
Epoch 185/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0103 - acc:
0.7442
Epoch 186/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0097 - acc:
0.7028
Epoch 187/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0103 - acc:
0.7442
Epoch 188/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0106 - acc:
0.7287
Epoch 189/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0103 - acc:
0.7132
Epoch 190/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0104 - acc:
0.6977
Epoch 191/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0106 - acc:
0.6873
Epoch 192/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0103 - acc:
0.7313
Epoch 193/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0095 - acc:
0.7416
Epoch 194/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0099 - acc:
0.7106
Epoch 195/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0095 - acc:
0.7209
Epoch 196/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0099 - acc:
0.7183
Epoch 197/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0099 - acc:
```

```
0.7209
Epoch 198/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0100 - acc:
0.7235
Epoch 199/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0103 - acc:
0.6951
Epoch 200/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0100 - acc:
0.7003
Epoch 201/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0099 - acc:
0.7054
Epoch 202/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0100 - acc:
0.7287
Epoch 203/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0100 - acc:
0.7287
Epoch 204/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0099 - acc:
0.6822
Epoch 205/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0109 - acc:
0.7313
Epoch 206/300
13/13 [==============================] - 0s 29ms/step - loss: 0.0101 - acc:
0.7183
Epoch 207/300
13/13 [==============================] - 0s 29ms/step - loss: 0.0112 - acc:
0.7235
Epoch 208/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0102 - acc:
0.7080
Epoch 209/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0099 - acc:
0.7390
Epoch 210/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0096 - acc:
0.7235
Epoch 211/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0103 - acc:
0.7261
Epoch 212/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0098 - acc:
0.7235
Epoch 213/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0093 - acc:
```

```
0.7416
Epoch 214/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0094 - acc:
0.7390
Epoch 215/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0095 - acc:
0.7235
Epoch 216/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0094 - acc:
0.7287
Epoch 217/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0102 - acc:
0.7183
Epoch 218/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0109 - acc:
0.7183
Epoch 219/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0094 - acc:
0.7158
Epoch 220/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0087 - acc:
0.7158
Epoch 221/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0095 - acc:
0.7080
Epoch 222/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0095 - acc:
0.7494
Epoch 223/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0101 - acc:
0.7313
Epoch 224/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0096 - acc:
0.7235
Epoch 225/300
13/13 [==============================] - 0s 28ms/step - loss: 0.0092 - acc:
0.7416
Epoch 226/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0095 - acc:
0.7287
Epoch 227/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0103 - acc:
0.7158
Epoch 228/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0104 - acc:
0.7442
Epoch 229/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0096 - acc:
```

```
0.7364
Epoch 230/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0091 - acc:
0.7132
Epoch 231/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0091 - acc:
0.7313
Epoch 232/300
13/13 [==============================] - 0s 28ms/step - loss: 0.0093 - acc:
0.7571
Epoch 233/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0090 - acc:
0.7235
Epoch 234/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0094 - acc:
0.7545
Epoch 235/300
13/13 [==============================] - 0s 28ms/step - loss: 0.0094 - acc:
0.7183
Epoch 236/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0098 - acc:
0.7209
Epoch 237/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0091 - acc:
0.7416
Epoch 238/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0096 - acc:
0.7416
Epoch 239/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0098 - acc:
0.7287
Epoch 240/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0095 - acc:
0.7106
Epoch 241/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0095 - acc:
0.7364
Epoch 242/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0090 - acc:
0.7468
Epoch 243/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0094 - acc:
0.7287
Epoch 244/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0105 - acc:
0.7313
Epoch 245/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0096 - acc:
```

```
0.7183
Epoch 246/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0096 - acc:
0.7235
Epoch 247/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0089 - acc:
0.7416
Epoch 248/300
13/13 [==============================] - 0s 29ms/step - loss: 0.0094 - acc:
0.7339: 0s - loss: 0.0098 - acc:
Epoch 249/300
13/13 [==============================] - 0s 30ms/step - loss: 0.0090 - acc:
0.7313
Epoch 250/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0092 - acc:
0.7287
Epoch 251/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0094 - acc:
0.7287
Epoch 252/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0090 - acc:
0.7390
Epoch 253/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0091 - acc:
0.7494
Epoch 254/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0090 - acc:
0.7390
Epoch 255/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0089 - acc:
0.7364
Epoch 256/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0099 - acc:
0.7235
Epoch 257/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0095 - acc:
0.7158
Epoch 258/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0102 - acc:
0.7158
Epoch 259/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0090 - acc:
0.7390
Epoch 260/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0092 - acc:
0.7339
Epoch 261/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0094 - acc:
```

```
0.7364
Epoch 262/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0089 - acc:
0.7183
Epoch 263/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0093 - acc:
0.7313
Epoch 264/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0089 - acc:
0.7235
Epoch 265/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0096 - acc:
0.7183
Epoch 266/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0089 - acc:
0.7494
Epoch 267/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0089 - acc:
0.7519
Epoch 268/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0092 - acc:
0.7313
Epoch 269/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0089 - acc:
0.7339
Epoch 270/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0095 - acc:
0.7442
Epoch 271/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0093 - acc:
0.7261
Epoch 272/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0091 - acc:
0.7183
Epoch 273/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0093 - acc:
0.7287
Epoch 274/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0100 - acc:
0.7054
Epoch 275/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0111 - acc:
0.6693
Epoch 276/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0097 - acc:
0.7364
Epoch 277/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0097 - acc:
```

```
0.7183
Epoch 278/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0094 - acc:
0.7261
Epoch 279/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0097 - acc:
0.7183
Epoch 280/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0091 - acc:
0.7158
Epoch 281/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0091 - acc:
0.7183
Epoch 282/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0091 - acc:
0.7313
Epoch 283/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0091 - acc:
0.7261
Epoch 284/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0089 - acc:
0.6925
Epoch 285/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0092 - acc:
0.7390
Epoch 286/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0090 - acc:
0.7261
Epoch 287/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0093 - acc:
0.7158
Epoch 288/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0086 - acc:
0.7571
Epoch 289/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0093 - acc:
0.7468
Epoch 290/300
13/13 [==============================] - 0s 27ms/step - loss: 0.0088 - acc:
0.7519
Epoch 291/300
13/13 [==============================] - 0s 29ms/step - loss: 0.0085 - acc:
0.7287
Epoch 292/300
13/13 [==============================] - 0s 29ms/step - loss: 0.0088 - acc:
0.7313
Epoch 293/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0086 - acc:
```

```
0.7261
Epoch 294/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0088 - acc:
0.7571
Epoch 295/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0084 - acc:
0.7209
Epoch 296/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0088 - acc:
0.7313
Epoch 297/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0085 - acc:
0.7339
Epoch 298/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0088 - acc:
0.7183
Epoch 299/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0088 - acc:
0.7183
Epoch 300/300
13/13 [==============================] - 0s 26ms/step - loss: 0.0084 - acc:
0.7235
```

[531]:
```
<tensorflow.python.keras.callbacks.History at 0x20c49bc47f0>
```

[571]:
```
testing_sample_scaled = sc.fit_transform(test_set_sample[14:34])
```

Predicting for sample test data

[572]:
```
testing_sample_scaled = np.reshape(testing_sample_scaled,(testing_sample_scaled.
 ↪shape[1],testing_sample_scaled.shape[0],1))

predicted_temperature = regressor.predict(testing_sample_scaled)
```

```
WARNING:tensorflow:7 out of the last 13 calls to <function
Model.make_predict_function.<locals>.predict_function at 0x0000020C509EE310>
triggered tf.function retracing. Tracing is expensive and the excessive number
of tracings could be due to (1) creating @tf.function repeatedly in a loop, (2)
passing tensors with different shapes, (3) passing Python objects instead of
tensors. For (1), please define your @tf.function outside of the loop. For (2),
@tf.function has experimental_relax_shapes=True option that relaxes argument
shapes that can avoid unnecessary retracing. For (3), please refer to https://ww
w.tensorflow.org/tutorials/customization/performance#python_or_tensor_args and
https://www.tensorflow.org/api_docs/python/tf/function for  more details.
```

[573]:
```
predicted_temperature = sc.inverse_transform(predicted_temperature)
```

Show predicted data

[574]:
```
predicted_temperature[0]
```

[574]:
```
array([306.89902, 307.5554 , 307.065  , 305.6764 ], dtype=float32)
```

Actual values

[575]:
```
actual_value = (test_set_sample[34:38])
```

[576]:
```
actual_value
```

[576]:
```
array([[307.522407  ],
       [303.71404966],
       [304.23127174],
       [305.16312889]])
```

Finding the error

[577]:
```
error = predicted_temperature[0] - actual_value[0]
```

[578]:
```
print(error)
```

```
[-0.62338967  0.0329824  -0.45740456 -1.8460154 ]
```

We see that we get good preformance from this model, so now we use it to predict next 4 months maximum temparature

1.3.1 Predicting Future Temperature with current data

[579]:
```
testing_sample_scaled = sc.fit_transform(test_set_sample[31:61])
```

[580]:
```
testing_sample_scaled = np.reshape(testing_sample_scaled,(testing_sample_scaled.
 ↪shape[1],testing_sample_scaled.shape[0],1))

predicted_temperature = regressor.predict(testing_sample_scaled)
```

[581]:
```
predicted_temperature = sc.inverse_transform(predicted_temperature)
```

[582]:
```
predicted_temperature[0]
```

[582]:
```
array([307.0098 , 306.61124, 304.31796, 303.4949 ], dtype=float32)
```

The above values are the predicted temperature values for INDORE district for the next 4 months. The temperature values are in kelvin