Stock Market Prediction by: Jason Rogers

This project will use the power of neural networks to predict future stock market movements up to two weeks in advance. This is done by looking at a recent subset of stock data and using the day to day nature of a stock to train how the stock moves. Note that this model is really only going to predict based on technicals and not fundamentals. This is because we did not give the network information such as P/E ratio. Because the inputs are from a specific companies stock, the model will only work for that company and for the given dates. If you want to compute a different company or date range then the model has to be retrained. The data differenced section of the results shows what happens if we subtract the previous day's stock price from the current day's price. This acts as a sort of normalization process that allows for more accurate results. The model is not meant to be 100% accurate as there is no way for this simple network to handle things such as world news, analyst notes, company reports, etc. The best we can really hope for is "close enough"

Stock data gathered on 12/12/18 and this specific model is looking at Apple's stock price (AAPL)

In [0]:
```
from google.colab import drive
drive.mount('/gdrive')
```

```
Go to this URL in a browser: https://accounts.google.com/o/oauth2/auth?client
_id=947318989803-6bn6qk8qdgf4n4g3pfee6491hc0brc4i.apps.googleusercontent.com&
redirect_uri=urn%3Aietf%3Awg%3Aoauth%3A2.0%3Aoob&scope=email%20https%3A%2F%2F
www.googleapis.com%2Fauth%2Fdocs.test%20https%3A%2F%2Fwww.googleapis.com%2Fau
th%2Fdrive%20https%3A%2F%2Fwww.googleapis.com%2Fauth%2Fdrive.photos.readonly%
20https%3A%2F%2Fwww.googleapis.com%2Fauth%2Fpeopleapi.readonly&response_type=
code

Enter your authorization code:
..........
Mounted at /gdrive
```

In [0]:
```
drive.mount("/gdrive", force_remount=True)
```

```
Mounted at /gdrive
```

In [0]:
```
import matplotlib.pyplot as plt
import pandas as pd
import datetime as dt
import urllib.request, json
import os
import numpy as np
import tensorflow as tf # This code has been tested with TensorFlow 1.6
from pandas_datareader import data
from sklearn.preprocessing import MinMaxScaler
```

You will have to change these to wherever you store your csv files. Note: if you use the Kaggle source for your data, you will have to convert from .txt to .csv AND remove the volume and open interest cols.

In [0]:
```
base_dir = '/gdrive/My Drive/Project/'

stocks_dir = os.path.join(base_dir, '/Stocks/Stocks/')
```

In [0]:
```
!ls /gdrive/"My Drive"/Project/
```

```
aapl.csv  Stocks
```

In [0]:
```
#----------------------------------------------------------------DEBUGGING-----
-------------------------------------------------------
fname= base_dir + "aapl.csv"
print(fname)
sname = stocks_dir + "aapl.us.txt"
print(sname)
```

```
/gdrive/My Drive/Project/aapl.csv
/Stocks/Stocks/aapl.us.txt
```

In [0]:
```
#----------------------------------------------------------------DEBUGGING-----
-------------------------------------------------------
os.path.isfile(fname)
```

Out[0]:
```
True
```

The training set of data is composed of the first 120 days of data on a specific stock. In this case we chose Apple (AAPL). The validation data is the 30 days of data that follow next. The training consists of looking at both the dollar difference and the standard closing price. The drawback to this is that the model is tightly coupled to the stock that it was trained on. This is something that I want to work on in future interations. I believe that if instead of using dollar differencing I can instead rely on a moving average of percent gain or loss. This way it can be more stock agnostic. With this then I could classify stocks by their volatility and make say three different models based on their volatility. The three classes of high, medium, and low volatility are pretty well known and agreed upon amongst various brokerages and banks.

In [0]:
```
import numpy as np
import pandas as pd
from sklearn import preprocessing

import matplotlib.pyplot as plt
import matplotlib.ticker as mtick

from keras.regularizers import L1L2

data_csv = pd.read_csv (fname)

#---------------------------------------------------------- ADJUSTABLE PARAMETE
RS 80/20 ------------------------------------------------------------

#how many data points we will use
# (should not be more than dataset length )
data_to_use= 150

# number of training data points
# should be less than data_to_use
train_end =120
```

```
Using TensorFlow backend.
```

The following code is there to interpret the .csv file and grab the data from the close column in order for it to be feed into the model. This code block is not unique to the project.

In [0]:
```
#---------------------------------------------------------- THIS IS FROM ONLIN
E SOURCES ----------------------------------------------------------
#---------------------------------------------------------- April 3, 2018 by
 owygs156 ----------------------------------------------------------
#---------------------------------------------------------------- CSV DATA HANDL
ING ----------------------------------------------------------------


total_data=len(data_csv)

#most recent data is in the end
#so need offset
start=total_data - data_to_use


yt = data_csv.iloc [start:total_data ,4]    #Close price
yt_ = yt.shift (-1)

print (yt_)

data = pd.concat ([yt, yt_], axis =1)
data. columns = ['yt', 'yt_']


N=18
cols =['yt']
for i in range (N):

    data['yt'+str(i)] = list(yt.shift(i+1))
    cols.append ('yt'+str(i))

data = data.dropna()
data_original = data
data=data.diff()
data = data.dropna()


# target variable - closed price
# after shifting
y = data ['yt_']
x = data [cols]


scaler_x = preprocessing.MinMaxScaler ( feature_range =( -1, 1))
x = np. array (x).reshape ((len( x) ,len(cols)))
x = scaler_x.fit_transform (x)

scaler_y = preprocessing. MinMaxScaler ( feature_range =( -1, 1))
y = np.array (y).reshape ((len( y), 1))
y = scaler_y.fit_transform (y)


x_train = x [0: train_end,]
x_test = x[ train_end +1:len(x),]
y_train = y [0: train_end]
y_test = y[ train_end +1:len(y)]
```

```
x_train = x_train.reshape (x_train. shape + (1,))
x_test = x_test.reshape (x_test. shape + (1,))
```

Model building

The model has two activation layers and a dropout layer of .30. The dropout layer of .30 is more of an artificial way of lowering the learning rate while still preventing overfitting. I did not want the model to exactly try to mimic was happened but to instead learn from the volatile nature that is the market these days and generate its own curves. One of the things I am showcasing in this project is how the number of epochs affects the end result in terms of prediction. This first model uses 400 epochs to give a "rough estimate" and to also see what happens when the network is not given a lot of resources to solve and predict the market.

In [0]:

```
#-----------------------------------------*MODEL BUILDING 400*-------------
-----------------------------------------------
from keras.models import Sequential
from keras.layers.core import Dense
from keras.layers.recurrent import LSTM
from keras.layers import  Dropout
from keras import optimizers

from numpy.random import seed
seed(1)
from tensorflow import set_random_seed
set_random_seed(2)

from keras import regularizers


model = Sequential ()
model.add (LSTM ( 400,  activation = 'relu', inner_activation = 'hard_sigmoid'
 , bias_regularizer=L1L2(l1=0.01, l2=0.01),  input_shape =(len(cols), 1), retu
rn_sequences = False ))
model.add(Dropout(0.3))
model.add (Dense (output_dim =1, activation = 'linear', activity_regularizer=r
egularizers.l1(0.01)))
adam=optimizers.Adam(lr=0.01, beta_1=0.89, beta_2=0.999, epsilon=None, decay=
0.0, amsgrad=True)
model.compile (loss ="mean_squared_error" , optimizer = "adam")
history=model.fit (x_train, y_train, batch_size =1, nb_epoch =400, shuffle = F
alse, validation_split=0.15)


y_train_back=scaler_y.inverse_transform (np. array (y_train). reshape ((len( y
_train), 1)))
plt.figure(1)
plt.plot (y_train_back)
```

Plot Graphs

For some reason one or two epochs will have a loss in the 4-5 digit range which completley renders this graph useless as it sets the max y-axis value to that extreme value. Have not been able to figure out why this occurs. The difference between the dollar difference and the "without differencing" data graphs is what happens when you just look at the day by day change of the stock. The data differencing makes a noticeable in the end result. Dollar differencing seems to be a little more accurate than non differenced data, however, the non differenced graph will show how the stock chart will actually look.

In [0]:
```
#-----------------------------------------------------PLOT LOSS --------------
-------------------------------------------------
fmt = '%.1f'
tick = mtick.FormatStrFormatter(fmt)
ax = plt.axes()
ax.yaxis.set_major_formatter(tick)
print (model.summary())
print(history.history.keys())

plt.figure(2)
plt.plot(history.history['loss'])
plt.plot(history.history['val_loss'])
plt.title('model loss')
plt.ylabel('loss')
plt.xlabel('epoch')
plt.legend(['train', 'test'], loc='upper left')
fmt = '%.1f'
tick = mtick.FormatStrFormatter(fmt)
ax = plt.axes()
ax.yaxis.set_major_formatter(tick)

score_train = model.evaluate (x_train, y_train, batch_size =1)
score_test = model.evaluate (x_test, y_test, batch_size =1)
print (" in train MSE = ", round( score_train ,4))
print (" in test MSE = ", score_test )

pred1 = model.predict (x_test)
pred1 = scaler_y.inverse_transform (np. array (pred1). reshape ((len( pred1),
1)))

prediction_data = pred1[-1]
model.summary()
print ("Inputs: {}".format(model.input_shape))
print ("Outputs: {}".format(model.output_shape))
print ("Actual input: {}".format(x_test.shape))
print ("Actual output: {}".format(y_test.shape))

print ("prediction data:")
print (prediction_data)

y_test = scaler_y.inverse_transform (np. array (y_test). reshape ((len( y_test
), 1)))
print ("y_test:")
print (y_test)

act_data = np.array([row[0] for row in y_test])

fmt = '%.1f'
tick = mtick.FormatStrFormatter(fmt)
ax = plt.axes()
ax.yaxis.set_major_formatter(tick)
```

In [0]:
```
#------------------------------------------------------------- PLOT DOLLAR
 DIFFERENCE PREDICTIONS ----------------------------------------------------
-
plt.figure(3)
plt.plot( y_test, label="actual")
plt.plot(pred1, label="predictions")

print ("act_data:")
print (act_data)

print ("pred1:")
print (pred1)

plt.legend(loc='upper center', bbox_to_anchor=(0.5, -0.05),
          fancybox=True, shadow=True, ncol=2)


fmt = '$%.1f'
tick = mtick.FormatStrFormatter(fmt)
ax = plt.axes()
ax.yaxis.set_major_formatter(tick)
```

In [0]:
```
#------------------------------------------------------------ THIS IS FROM AN
 ONLINE SOURCE ------------------------------------------------------------
def moving_test_window_preds(n_future_preds):

    ''' n_future_preds - Represents the number of future predictions we want t
o make
                        This coincides with the number of windows that we wil
l <span id="IL_AD1" class="IL_AD">move</span> forward
                        on the test data
    '''
    preds_moving = []                                       # Store the predictio
n made on each test window
    moving_test_window = [x_test[0,:].tolist()]          # First test window
    moving_test_window = np.array(moving_test_window)

    for i in range(n_future_preds):


        preds_one_step = model.predict(moving_test_window)
        preds_moving.append(preds_one_step[0,0])

        preds_one_step = preds_one_step.reshape(1,1,1)
        moving_test_window = np.concatenate((moving_test_window[:,1:,:], preds
_one_step), axis=1) # new moving test window, where the first element from the
 window has been removed and the prediction  has been appended to the end


    print ("pred moving before scaling:")
    print (preds_moving)

    preds_moving = scaler_y.inverse_transform((np.array(preds_moving)).reshape
(-1, 1))

    print ("pred moving after scaling:")
    print (preds_moving)
    return preds_moving

print ("do moving test predictions for next 22 days:")
preds_moving = moving_test_window_preds(22)


count_correct=0
error =0
for i in range (len(y_test)):
    error=error + ((y_test[i]-preds_moving[i])**2) / y_test[i]


    if y_test[i] >=0 and preds_moving[i] >=0 :
        count_correct=count_correct+1
    if y_test[i] < 0 and preds_moving[i] < 0 :
        count_correct=count_correct+1

accuracy_in_change =  count_correct / (len(y_test) )
```

In [0]:
```
 # ------------------------------------------------------- PLOT DIFFERENCE
D DATA ------------------------------------------------------------------------
---
plt.figure(4)
plt.title("Forecast vs Actual, (data is differenced)")
plt.plot(preds_moving, label="predictions")
plt.plot(y_test, label="actual")
plt.legend(loc='upper center', bbox_to_anchor=(0.5, -0.05),
          fancybox=True, shadow=True, ncol=2)


print ("accuracy_in_change:")
print (accuracy_in_change)

ind=data_original.index.values[0] + data_original.shape[0] -len(y_test)-1
prev_starting_price = data_original.loc[ind,"yt_"]
preds_moving_before_diff =  [0 for x in range(len(preds_moving))]

for i in range (len(preds_moving)):
    if (i==0):
        preds_moving_before_diff[i]=prev_starting_price + preds_moving[i]
    else:
        preds_moving_before_diff[i]=preds_moving_before_diff[i-1]+preds_moving
[i]


y_test_before_diff = [0 for x in range(len(y_test))]

for i in range (len(y_test)):
    if (i==0):
        y_test_before_diff[i]=prev_starting_price + y_test[i]
    else:
        y_test_before_diff[i]=y_test_before_diff[i-1]+y_test[i]
 # ------------------------------------------------------------- PLOT NON D
IFFERENCED DATA ---------------------------------------------------------------
-----
plt.figure(5)
plt.title("Forecast vs Actual (non differenced data)")
plt.plot(preds_moving_before_diff, label="predictions")
plt.plot(y_test_before_diff, label="actual")
plt.legend(loc='upper center', bbox_to_anchor=(0.5, -0.05),
          fancybox=True, shadow=True, ncol=2)
plt.show()
```

```
8214    140.17
8215    139.42
8216    140.20
8217    139.57
8218    139.05
8219    140.79
8220    140.63
8221    141.98
8222    142.87
8223    142.02
8224    142.13
8225    141.99
8226    144.89
8227    145.81
8228    145.37
8229    144.84
8230    147.24
8231    151.24
8232    152.21
8233    151.49
8234    152.80
8235    154.93
8236    154.53
8237    154.31
8238    149.12
8239    151.40
8240    151.91
8241    152.84
8242    152.65
8243    152.19
         ...
8334    153.92
8335    152.93
8336    154.83
8337    154.74
8338    155.28
8339    155.34
8340    155.99
8341    155.44
8342    156.43
8343    159.31
8344    159.90
8345    159.19
8346    155.42
8347    155.69
8348    155.61
8349    156.54
8350    155.85
8351    156.85
8352    162.47
8353    166.12
8354    168.43
8355    166.29
8356    167.51
8357    171.88
8358    173.63
8359    174.18
```

```
8360    175.61
8361    175.25
8362    174.67
8363       NaN
Name: Close, Length: 150, dtype: float64
```

```
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:93: UserWarning:
Update your `LSTM` call to the Keras 2 API: `LSTM(400, activation="relu", bia
s_regularizer=<keras.reg..., input_shape=(19, 1), return_sequences=False, rec
urrent_activation="hard_sigmoid")`
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:95: UserWarning:
Update your `Dense` call to the Keras 2 API: `Dense(activation="linear", acti
vity_regularizer=<keras.reg..., units=1)`
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:98: UserWarning:
The `nb_epoch` argument in `fit` has been renamed `epochs`.
```

```
Train on 102 samples, validate on 18 samples
Epoch 1/400
102/102 [==============================] - 7s 68ms/step - loss: 7.4998 - val_
loss: 6.9158
Epoch 2/400
102/102 [==============================] - 6s 61ms/step - loss: 6.3869 - val_
loss: 5.8631
Epoch 3/400
102/102 [==============================] - 6s 60ms/step - loss: 5.3893 - val_
loss: 4.9210
Epoch 4/400
102/102 [==============================] - 6s 60ms/step - loss: 4.4972 - val_
loss: 4.0812
Epoch 5/400
102/102 [==============================] - 6s 60ms/step - loss: 3.7037 - val_
loss: 3.3345
Epoch 6/400
102/102 [==============================] - 6s 59ms/step - loss: 3.0007 - val_
loss: 2.6760
Epoch 7/400
102/102 [==============================] - 6s 60ms/step - loss: 2.3822 - val_
loss: 2.0975
Epoch 8/400
102/102 [==============================] - 6s 59ms/step - loss: 1.8401 - val_
loss: 1.5942
Epoch 9/400
102/102 [==============================] - 6s 59ms/step - loss: 5366.0983 - v
al_loss: 1.5579
Epoch 10/400
102/102 [==============================] - 6s 59ms/step - loss: 1.5297 - val_
loss: 1.5053
Epoch 11/400
102/102 [==============================] - 6s 62ms/step - loss: 1.4800 - val_
loss: 1.4615
Epoch 12/400
102/102 [==============================] - 6s 62ms/step - loss: 1.4365 - val_
loss: 1.4249
Epoch 13/400
102/102 [==============================] - 6s 60ms/step - loss: 1.4069 - val_
loss: 1.4081
Epoch 14/400
102/102 [==============================] - 6s 60ms/step - loss: 1.3992 - val_
loss: 1.4052
Epoch 15/400
102/102 [==============================] - 6s 59ms/step - loss: 1.3965 - val_
loss: 1.4017
Epoch 16/400
102/102 [==============================] - 6s 60ms/step - loss: 1.3928 - val_
loss: 1.3987
Epoch 17/400
102/102 [==============================] - 6s 60ms/step - loss: 1.3908 - val_
loss: 1.3957
Epoch 18/400
102/102 [==============================] - 6s 59ms/step - loss: 1.3874 - val_
loss: 1.3931
Epoch 19/400
102/102 [==============================] - 6s 58ms/step - loss: 1.3820 - val_
```

```
loss: 1.3905
Epoch 20/400
102/102 [==============================] - 6s 58ms/step - loss: 1.3803 - val_
loss: 1.3874
Epoch 21/400
102/102 [==============================] - 6s 59ms/step - loss: 1.3766 - val_
loss: 1.3852
Epoch 22/400
102/102 [==============================] - 6s 59ms/step - loss: 1.3718 - val_
loss: 1.3807
Epoch 23/400
102/102 [==============================] - 6s 59ms/step - loss: 1.3687 - val_
loss: 1.3782
Epoch 24/400
102/102 [==============================] - 6s 61ms/step - loss: 1.3657 - val_
loss: 1.3757
Epoch 25/400
102/102 [==============================] - 6s 59ms/step - loss: 1.3634 - val_
loss: 1.3732
Epoch 26/400
102/102 [==============================] - 6s 59ms/step - loss: 1.3614 - val_
loss: 1.3666
Epoch 27/400
102/102 [==============================] - 6s 59ms/step - loss: 1.3619 - val_
loss: 1.3670
Epoch 28/400
102/102 [==============================] - 6s 59ms/step - loss: 1.3533 - val_
loss: 1.3628
Epoch 29/400
102/102 [==============================] - 6s 60ms/step - loss: 1.3504 - val_
loss: 1.3621
Epoch 30/400
102/102 [==============================] - 6s 59ms/step - loss: 1.3453 - val_
loss: 1.3571
Epoch 31/400
102/102 [==============================] - 6s 60ms/step - loss: 1.3387 - val_
loss: 1.3523
Epoch 32/400
102/102 [==============================] - 6s 59ms/step - loss: 1.3377 - val_
loss: 1.3495
Epoch 33/400
102/102 [==============================] - 6s 59ms/step - loss: 1.3360 - val_
loss: 1.3518
Epoch 34/400
102/102 [==============================] - 6s 60ms/step - loss: 1.3318 - val_
loss: 1.3409
Epoch 35/400
102/102 [==============================] - 6s 59ms/step - loss: 1.3273 - val_
loss: 1.3406
Epoch 36/400
102/102 [==============================] - 6s 59ms/step - loss: 1.3249 - val_
loss: 1.3357
Epoch 37/400
102/102 [==============================] - 6s 59ms/step - loss: 1.3276 - val_
loss: 1.3356
Epoch 38/400
102/102 [==============================] - 6s 59ms/step - loss: 1.3165 - val_
```

```
loss: 1.3313
Epoch 39/400
102/102 [==============================] - 6s 59ms/step - loss: 1.3131 - val_
loss: 1.3275
Epoch 40/400
102/102 [==============================] - 6s 59ms/step - loss: 1.3070 - val_
loss: 1.3227
Epoch 41/400
102/102 [==============================] - 6s 59ms/step - loss: 1.3068 - val_
loss: 1.3199
Epoch 42/400
102/102 [==============================] - 6s 59ms/step - loss: 1.3011 - val_
loss: 1.3158
Epoch 43/400
102/102 [==============================] - 6s 59ms/step - loss: 1.3003 - val_
loss: 1.3162
Epoch 44/400
102/102 [==============================] - 6s 59ms/step - loss: 1.2961 - val_
loss: 1.3118
Epoch 45/400
102/102 [==============================] - 6s 59ms/step - loss: 1.2895 - val_
loss: 1.3053
Epoch 46/400
102/102 [==============================] - 6s 59ms/step - loss: 1.2867 - val_
loss: 1.3040
Epoch 47/400
102/102 [==============================] - 6s 60ms/step - loss: 1.2848 - val_
loss: 1.3008
Epoch 48/400
102/102 [==============================] - 6s 59ms/step - loss: 1.2829 - val_
loss: 1.2984
Epoch 49/400
102/102 [==============================] - 6s 59ms/step - loss: 1.2804 - val_
loss: 1.2970
Epoch 50/400
102/102 [==============================] - 6s 59ms/step - loss: 1.2728 - val_
loss: 1.2899
Epoch 51/400
102/102 [==============================] - 6s 59ms/step - loss: 1.2690 - val_
loss: 1.2856
Epoch 52/400
102/102 [==============================] - 6s 59ms/step - loss: 1.2670 - val_
loss: 1.2879
Epoch 53/400
102/102 [==============================] - 6s 59ms/step - loss: 1.2598 - val_
loss: 1.2830
Epoch 54/400
102/102 [==============================] - 6s 60ms/step - loss: 1.2582 - val_
loss: 1.2809
Epoch 55/400
102/102 [==============================] - 6s 60ms/step - loss: 1.2520 - val_
loss: 1.2823
Epoch 56/400
102/102 [==============================] - 6s 59ms/step - loss: 1.2527 - val_
loss: 1.2779
Epoch 57/400
102/102 [==============================] - 6s 60ms/step - loss: 1.2506 - val_
```

```
loss: 1.2683
Epoch 58/400
102/102 [==============================] - 6s 61ms/step - loss: 1.2464 - val_
loss: 1.2686
Epoch 59/400
102/102 [==============================] - 6s 60ms/step - loss: 1.2356 - val_
loss: 1.2676
Epoch 60/400
102/102 [==============================] - 6s 59ms/step - loss: 1.2310 - val_
loss: 1.2710
Epoch 61/400
102/102 [==============================] - 6s 59ms/step - loss: 1.2280 - val_
loss: 1.2552
Epoch 62/400
102/102 [==============================] - 6s 61ms/step - loss: 1.2299 - val_
loss: 1.2486
Epoch 63/400
102/102 [==============================] - 7s 64ms/step - loss: 1.2190 - val_
loss: 1.2550
Epoch 64/400
102/102 [==============================] - 6s 62ms/step - loss: 1.2194 - val_
loss: 1.2503
Epoch 65/400
102/102 [==============================] - 6s 62ms/step - loss: 1.2102 - val_
loss: 1.2445
Epoch 66/400
102/102 [==============================] - 6s 62ms/step - loss: 1.2320 - val_
loss: 1.2376
Epoch 67/400
102/102 [==============================] - 6s 61ms/step - loss: 1.2179 - val_
loss: 1.2313
Epoch 68/400
102/102 [==============================] - 6s 62ms/step - loss: 1.2126 - val_
loss: 1.2259
Epoch 69/400
102/102 [==============================] - 6s 62ms/step - loss: 1.2071 - val_
loss: 1.2204
Epoch 70/400
102/102 [==============================] - 6s 62ms/step - loss: 1.2005 - val_
loss: 1.2177
Epoch 71/400
102/102 [==============================] - 6s 62ms/step - loss: 1.1968 - val_
loss: 1.2159
Epoch 72/400
102/102 [==============================] - 6s 62ms/step - loss: 1.1909 - val_
loss: 1.2124
Epoch 73/400
102/102 [==============================] - 7s 64ms/step - loss: 1.1833 - val_
loss: 1.2084
Epoch 74/400
102/102 [==============================] - 7s 66ms/step - loss: 1.1744 - val_
loss: 1.2156
Epoch 75/400
102/102 [==============================] - 6s 63ms/step - loss: 1.1740 - val_
loss: 1.2089
Epoch 76/400
102/102 [==============================] - 6s 63ms/step - loss: 1.1699 - val_
```

```
loss: 1.2002
Epoch 77/400
102/102 [==============================] - 6s 62ms/step - loss: 1.1624 - val_
loss: 1.2053
Epoch 78/400
102/102 [==============================] - 6s 62ms/step - loss: 1.1577 - val_
loss: 1.1891
Epoch 79/400
102/102 [==============================] - 6s 63ms/step - loss: 1.1781 - val_
loss: 1.2057
Epoch 80/400
102/102 [==============================] - 6s 63ms/step - loss: 1.1801 - val_
loss: 1.1927
Epoch 81/400
102/102 [==============================] - 6s 62ms/step - loss: 1.1640 - val_
loss: 1.1828
Epoch 82/400
102/102 [==============================] - 6s 62ms/step - loss: 1.1504 - val_
loss: 1.1795
Epoch 83/400
102/102 [==============================] - 6s 63ms/step - loss: 1.1395 - val_
loss: 1.1712
Epoch 84/400
102/102 [==============================] - 7s 65ms/step - loss: 1.1310 - val_
loss: 1.1654
Epoch 85/400
102/102 [==============================] - 7s 64ms/step - loss: 1.1214 - val_
loss: 1.1622
Epoch 86/400
102/102 [==============================] - 6s 62ms/step - loss: 1.1161 - val_
loss: 1.1586
Epoch 87/400
102/102 [==============================] - 6s 62ms/step - loss: 1.1127 - val_
loss: 1.1529
Epoch 88/400
102/102 [==============================] - 6s 63ms/step - loss: 1.1064 - val_
loss: 1.1460
Epoch 89/400
102/102 [==============================] - 6s 63ms/step - loss: 1.1000 - val_
loss: 1.1370
Epoch 90/400
102/102 [==============================] - 6s 63ms/step - loss: 1.0949 - val_
loss: 1.1330
Epoch 91/400
102/102 [==============================] - 6s 63ms/step - loss: 1.0851 - val_
loss: 1.1272
Epoch 92/400
102/102 [==============================] - 6s 62ms/step - loss: 1.0757 - val_
loss: 1.1188
Epoch 93/400
102/102 [==============================] - 6s 63ms/step - loss: 1.0772 - val_
loss: 1.1483
Epoch 94/400
102/102 [==============================] - 6s 63ms/step - loss: 1.0775 - val_
loss: 1.1204
Epoch 95/400
102/102 [==============================] - 6s 63ms/step - loss: 1.0622 - val_
```

```
loss: 1.1219
Epoch 96/400
102/102 [==============================] - 6s 63ms/step - loss: 1.0611 - val_
loss: 1.0963
Epoch 97/400
102/102 [==============================] - 6s 63ms/step - loss: 1.0672 - val_
loss: 1.0964
Epoch 98/400
102/102 [==============================] - 6s 63ms/step - loss: 1.0483 - val_
loss: 1.0884
Epoch 99/400
102/102 [==============================] - 6s 63ms/step - loss: 1.0376 - val_
loss: 1.0844
Epoch 100/400
102/102 [==============================] - 6s 63ms/step - loss: 1.0216 - val_
loss: 1.0850
Epoch 101/400
102/102 [==============================] - 6s 63ms/step - loss: 1.0185 - val_
loss: 1.0581
Epoch 102/400
102/102 [==============================] - 6s 63ms/step - loss: 1.0340 - val_
loss: 1.0543
Epoch 103/400
102/102 [==============================] - 6s 63ms/step - loss: 1.0207 - val_
loss: 1.0450
Epoch 104/400
102/102 [==============================] - 6s 63ms/step - loss: 1.0037 - val_
loss: 1.0409
Epoch 105/400
102/102 [==============================] - 6s 63ms/step - loss: 0.9920 - val_
loss: 1.0297
Epoch 106/400
102/102 [==============================] - 6s 64ms/step - loss: 0.9826 - val_
loss: 1.0214
Epoch 107/400
102/102 [==============================] - 7s 64ms/step - loss: 0.9686 - val_
loss: 1.0159
Epoch 108/400
102/102 [==============================] - 7s 64ms/step - loss: 0.9585 - val_
loss: 1.0129
Epoch 109/400
102/102 [==============================] - 6s 63ms/step - loss: 0.9484 - val_
loss: 1.0163
Epoch 110/400
102/102 [==============================] - 6s 61ms/step - loss: 0.9412 - val_
loss: 0.9869
Epoch 111/400
102/102 [==============================] - 7s 65ms/step - loss: 0.9368 - val_
loss: 0.9849
Epoch 112/400
102/102 [==============================] - 7s 65ms/step - loss: 215569429.063
8 - val_loss: 1.1551
Epoch 113/400
102/102 [==============================] - 6s 62ms/step - loss: 1.3950 - val_
loss: 1.1624
Epoch 114/400
102/102 [==============================] - 6s 62ms/step - loss: 1.1376 - val_
```

```
loss: 1.1538
Epoch 115/400
102/102 [==============================] - 6s 62ms/step - loss: 1.1340 - val_
loss: 1.1467
Epoch 116/400
102/102 [==============================] - 6s 62ms/step - loss: 1.1249 - val_
loss: 1.1406
Epoch 117/400
102/102 [==============================] - 6s 61ms/step - loss: 1.1194 - val_
loss: 1.1347
Epoch 118/400
102/102 [==============================] - 6s 61ms/step - loss: 1.1174 - val_
loss: 1.1292
Epoch 119/400
102/102 [==============================] - 6s 61ms/step - loss: 1.1111 - val_
loss: 1.1245
Epoch 120/400
102/102 [==============================] - 6s 62ms/step - loss: 1.1034 - val_
loss: 1.1198
Epoch 121/400
102/102 [==============================] - 6s 62ms/step - loss: 1.1045 - val_
loss: 1.1147
Epoch 122/400
102/102 [==============================] - 7s 65ms/step - loss: 1.0912 - val_
loss: 1.1097
Epoch 123/400
102/102 [==============================] - 6s 61ms/step - loss: 1.0914 - val_
loss: 1.1040
Epoch 124/400
102/102 [==============================] - 6s 61ms/step - loss: 1.0837 - val_
loss: 1.0983
Epoch 125/400
102/102 [==============================] - 6s 61ms/step - loss: 1.0805 - val_
loss: 1.0928
Epoch 126/400
102/102 [==============================] - 6s 60ms/step - loss: 1.0727 - val_
loss: 1.0863
Epoch 127/400
102/102 [==============================] - 6s 61ms/step - loss: 1.0643 - val_
loss: 1.0809
Epoch 128/400
102/102 [==============================] - 6s 62ms/step - loss: 1.0602 - val_
loss: 1.0757
Epoch 129/400
102/102 [==============================] - 6s 61ms/step - loss: 1.0501 - val_
loss: 1.0709
Epoch 130/400
102/102 [==============================] - 6s 62ms/step - loss: 1.0467 - val_
loss: 1.0643
Epoch 131/400
102/102 [==============================] - 6s 62ms/step - loss: 1.0409 - val_
loss: 1.0586
Epoch 132/400
102/102 [==============================] - 6s 61ms/step - loss: 1.0326 - val_
loss: 1.0539
Epoch 133/400
102/102 [==============================] - 6s 61ms/step - loss: 1.0274 - val_
```

```
loss: 1.0489
Epoch 134/400
102/102 [==============================] - 6s 60ms/step - loss: 1.0199 - val_
loss: 1.0433
Epoch 135/400
102/102 [==============================] - 6s 61ms/step - loss: 1.0179 - val_
loss: 1.0363
Epoch 136/400
102/102 [==============================] - 6s 61ms/step - loss: 1.0072 - val_
loss: 1.0294
Epoch 137/400
102/102 [==============================] - 6s 62ms/step - loss: 0.9995 - val_
loss: 1.0235
Epoch 138/400
102/102 [==============================] - 6s 61ms/step - loss: 0.9966 - val_
loss: 1.0178
Epoch 139/400
102/102 [==============================] - 6s 60ms/step - loss: 0.9928 - val_
loss: 1.0122
Epoch 140/400
102/102 [==============================] - 6s 61ms/step - loss: 0.9801 - val_
loss: 1.0059
Epoch 141/400
102/102 [==============================] - 6s 61ms/step - loss: 0.9749 - val_
loss: 1.0003
Epoch 142/400
102/102 [==============================] - 6s 61ms/step - loss: 0.9767 - val_
loss: 0.9952
Epoch 143/400
102/102 [==============================] - 6s 61ms/step - loss: 0.9613 - val_
loss: 0.9883
Epoch 144/400
102/102 [==============================] - 6s 60ms/step - loss: 0.9576 - val_
loss: 0.9818
Epoch 145/400
102/102 [==============================] - 6s 60ms/step - loss: 0.9457 - val_
loss: 0.9748
Epoch 146/400
102/102 [==============================] - 6s 60ms/step - loss: 0.9390 - val_
loss: 0.9682
Epoch 147/400
102/102 [==============================] - 6s 60ms/step - loss: 0.9350 - val_
loss: 0.9649
Epoch 148/400
102/102 [==============================] - 6s 61ms/step - loss: 0.9269 - val_
loss: 0.9573
Epoch 149/400
102/102 [==============================] - 6s 60ms/step - loss: 0.9192 - val_
loss: 0.9546
Epoch 150/400
102/102 [==============================] - 6s 60ms/step - loss: 0.9276 - val_
loss: 0.9498
Epoch 151/400
102/102 [==============================] - 6s 61ms/step - loss: 0.9142 - val_
loss: 0.9427
Epoch 152/400
102/102 [==============================] - 6s 61ms/step - loss: 0.9073 - val_
```

```
loss: 0.9390
Epoch 153/400
102/102 [==============================] - 6s 61ms/step - loss: 0.8994 - val_
loss: 0.9321
Epoch 154/400
102/102 [==============================] - 6s 62ms/step - loss: 0.8913 - val_
loss: 0.9281
Epoch 155/400
102/102 [==============================] - 6s 63ms/step - loss: 0.8842 - val_
loss: 0.9208
Epoch 156/400
102/102 [==============================] - 6s 62ms/step - loss: 0.8757 - val_
loss: 0.9162
Epoch 157/400
102/102 [==============================] - 6s 62ms/step - loss: 0.8733 - val_
loss: 0.9113
Epoch 158/400
102/102 [==============================] - 6s 62ms/step - loss: 0.8644 - val_
loss: 0.9028
Epoch 159/400
102/102 [==============================] - 6s 62ms/step - loss: 0.8605 - val_
loss: 0.8994
Epoch 160/400
102/102 [==============================] - 6s 62ms/step - loss: 0.8533 - val_
loss: 0.9065
Epoch 161/400
102/102 [==============================] - 7s 65ms/step - loss: 0.8478 - val_
loss: 0.8904
Epoch 162/400
102/102 [==============================] - 6s 62ms/step - loss: 0.8417 - val_
loss: 0.8863
Epoch 163/400
102/102 [==============================] - 6s 62ms/step - loss: 0.8344 - val_
loss: 0.8884
Epoch 164/400
102/102 [==============================] - 6s 61ms/step - loss: 0.8362 - val_
loss: 0.8840
Epoch 165/400
102/102 [==============================] - 6s 61ms/step - loss: 0.8307 - val_
loss: 0.8737
Epoch 166/400
102/102 [==============================] - 6s 61ms/step - loss: 0.8245 - val_
loss: 0.8768
Epoch 167/400
102/102 [==============================] - 6s 60ms/step - loss: 0.8140 - val_
loss: 0.8735
Epoch 168/400
102/102 [==============================] - 6s 61ms/step - loss: 0.8094 - val_
loss: 0.8705
Epoch 169/400
102/102 [==============================] - 6s 61ms/step - loss: 0.8102 - val_
loss: 0.8546
Epoch 170/400
102/102 [==============================] - 6s 62ms/step - loss: 0.8135 - val_
loss: 0.8569
Epoch 171/400
102/102 [==============================] - 6s 64ms/step - loss: 0.8001 - val_
```

```
loss: 0.8558
Epoch 172/400
102/102 [==============================] - 6s 61ms/step - loss: 0.7897 - val_
loss: 0.8772
Epoch 173/400
102/102 [==============================] - 6s 61ms/step - loss: 0.7927 - val_
loss: 0.8621
Epoch 174/400
102/102 [==============================] - 6s 61ms/step - loss: 0.7927 - val_
loss: 0.8445
Epoch 175/400
102/102 [==============================] - 6s 61ms/step - loss: 0.8011 - val_
loss: 0.8404
Epoch 176/400
102/102 [==============================] - 6s 61ms/step - loss: 0.7801 - val_
loss: 0.8517
Epoch 177/400
102/102 [==============================] - 6s 62ms/step - loss: 0.7781 - val_
loss: 0.8498
Epoch 178/400
102/102 [==============================] - 6s 61ms/step - loss: 0.7704 - val_
loss: 0.8754
Epoch 179/400
102/102 [==============================] - 6s 61ms/step - loss: 0.7754 - val_
loss: 0.8560
Epoch 180/400
102/102 [==============================] - 6s 61ms/step - loss: 0.7629 - val_
loss: 0.8363
Epoch 181/400
102/102 [==============================] - 6s 62ms/step - loss: 0.7721 - val_
loss: 0.8722
Epoch 182/400
102/102 [==============================] - 6s 62ms/step - loss: 0.7864 - val_
loss: 0.8229
Epoch 183/400
102/102 [==============================] - 6s 62ms/step - loss: 0.7693 - val_
loss: 0.8203
Epoch 184/400
102/102 [==============================] - 6s 62ms/step - loss: 0.7676 - val_
loss: 0.8197
Epoch 185/400
102/102 [==============================] - 6s 61ms/step - loss: 0.7592 - val_
loss: 0.8430
Epoch 186/400
102/102 [==============================] - 6s 61ms/step - loss: 0.7564 - val_
loss: 0.8295
Epoch 187/400
102/102 [==============================] - 6s 61ms/step - loss: 0.7506 - val_
loss: 0.8394
Epoch 188/400
102/102 [==============================] - 6s 62ms/step - loss: 0.7632 - val_
loss: 0.8091
Epoch 189/400
102/102 [==============================] - 6s 61ms/step - loss: 0.7847 - val_
loss: 0.8039
Epoch 190/400
102/102 [==============================] - 6s 61ms/step - loss: 0.7718 - val_
```

```
loss: 0.8049
Epoch 191/400
102/102 [==============================] - 6s 61ms/step - loss: 0.7626 - val_
loss: 0.8036
Epoch 192/400
102/102 [==============================] - 6s 62ms/step - loss: 0.7560 - val_
loss: 0.8039
Epoch 193/400
102/102 [==============================] - 6s 62ms/step - loss: 0.7443 - val_
loss: 0.8086
Epoch 194/400
102/102 [==============================] - 6s 62ms/step - loss: 0.7408 - val_
loss: 0.8181
Epoch 195/400
102/102 [==============================] - 6s 62ms/step - loss: 0.7345 - val_
loss: 0.8317
Epoch 196/400
102/102 [==============================] - 6s 62ms/step - loss: 0.7389 - val_
loss: 0.8179
Epoch 197/400
102/102 [==============================] - 6s 62ms/step - loss: 0.7334 - val_
loss: 0.8253
Epoch 198/400
102/102 [==============================] - 6s 62ms/step - loss: 0.7313 - val_
loss: 0.8321
Epoch 199/400
102/102 [==============================] - 6s 63ms/step - loss: 0.7256 - val_
loss: 0.8306
Epoch 200/400
102/102 [==============================] - 6s 62ms/step - loss: 0.7354 - val_
loss: 0.8028
Epoch 201/400
102/102 [==============================] - 6s 60ms/step - loss: 0.7575 - val_
loss: 0.7910
Epoch 202/400
102/102 [==============================] - 6s 61ms/step - loss: 0.7470 - val_
loss: 0.7993
Epoch 203/400
102/102 [==============================] - 6s 60ms/step - loss: 0.7370 - val_
loss: 0.7913
Epoch 204/400
102/102 [==============================] - 6s 61ms/step - loss: 0.7328 - val_
loss: 0.8010
Epoch 205/400
102/102 [==============================] - 6s 61ms/step - loss: 0.7350 - val_
loss: 0.7927
Epoch 206/400
102/102 [==============================] - 6s 62ms/step - loss: 0.7226 - val_
loss: 0.8096
Epoch 207/400
102/102 [==============================] - 6s 61ms/step - loss: 0.7164 - val_
loss: 0.8095
Epoch 208/400
102/102 [==============================] - 6s 61ms/step - loss: 0.7121 - val_
loss: 0.8260
Epoch 209/400
102/102 [==============================] - 6s 61ms/step - loss: 0.7135 - val_
```

```
loss: 0.8423
Epoch 210/400
102/102 [==============================] - 7s 66ms/step - loss: 0.7100 - val_
loss: 0.8820
Epoch 211/400
102/102 [==============================] - 7s 65ms/step - loss: 0.7157 - val_
loss: 0.8086
Epoch 212/400
102/102 [==============================] - 6s 61ms/step - loss: 0.7245 - val_
loss: 0.8051
Epoch 213/400
102/102 [==============================] - 6s 61ms/step - loss: 0.7036 - val_
loss: 0.8282
Epoch 214/400
102/102 [==============================] - 6s 62ms/step - loss: 0.7032 - val_
loss: 0.7948
Epoch 215/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6976 - val_
loss: 0.8173
Epoch 216/400
102/102 [==============================] - 6s 62ms/step - loss: 0.7019 - val_
loss: 0.8149
Epoch 217/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6978 - val_
loss: 0.8095
Epoch 218/400
102/102 [==============================] - 6s 63ms/step - loss: 0.7138 - val_
loss: 0.8425
Epoch 219/400
102/102 [==============================] - 7s 64ms/step - loss: 0.6968 - val_
loss: 0.8180
Epoch 220/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6983 - val_
loss: 0.7661
Epoch 221/400
102/102 [==============================] - 6s 61ms/step - loss: 0.7062 - val_
loss: 0.8056
Epoch 222/400
102/102 [==============================] - 6s 61ms/step - loss: 0.7079 - val_
loss: 0.7950
Epoch 223/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6941 - val_
loss: 0.7944
Epoch 224/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6964 - val_
loss: 0.8442
Epoch 225/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6892 - val_
loss: 0.7840
Epoch 226/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6917 - val_
loss: 0.7843
Epoch 227/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6975 - val_
loss: 0.8105
Epoch 228/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6833 - val_
```

```
loss: 0.8260
Epoch 229/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6792 - val_
loss: 0.7811
Epoch 230/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6800 - val_
loss: 0.8846
Epoch 231/400
102/102 [==============================] - 6s 61ms/step - loss: 0.7028 - val_
loss: 0.8196
Epoch 232/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6863 - val_
loss: 0.8181
Epoch 233/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6861 - val_
loss: 0.8243
Epoch 234/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6746 - val_
loss: 0.8167
Epoch 235/400
102/102 [==============================] - 6s 60ms/step - loss: 0.6766 - val_
loss: 0.8131
Epoch 236/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6828 - val_
loss: 0.7806
Epoch 237/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6875 - val_
loss: 0.8028
Epoch 238/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6852 - val_
loss: 0.8254
Epoch 239/400
102/102 [==============================] - 6s 60ms/step - loss: 0.6745 - val_
loss: 0.8421
Epoch 240/400
102/102 [==============================] - 6s 60ms/step - loss: 0.6883 - val_
loss: 0.7786
Epoch 241/400
102/102 [==============================] - 6s 60ms/step - loss: 0.6863 - val_
loss: 0.8169
Epoch 242/400
102/102 [==============================] - 6s 59ms/step - loss: 0.6849 - val_
loss: 0.8178
Epoch 243/400
102/102 [==============================] - 6s 59ms/step - loss: 0.6774 - val_
loss: 0.8220
Epoch 244/400
102/102 [==============================] - 6s 59ms/step - loss: 0.6860 - val_
loss: 0.7548
Epoch 245/400
102/102 [==============================] - 6s 58ms/step - loss: 0.6977 - val_
loss: 0.7815
Epoch 246/400
102/102 [==============================] - 6s 59ms/step - loss: 0.6802 - val_
loss: 0.8054
Epoch 247/400
102/102 [==============================] - 6s 59ms/step - loss: 0.6741 - val_
```

```
loss: 0.7911
Epoch 248/400
102/102 [==============================] - 6s 59ms/step - loss: 0.6712 - val_
loss: 0.8248
Epoch 249/400
102/102 [==============================] - 6s 59ms/step - loss: 0.6712 - val_
loss: 0.7861
Epoch 250/400
102/102 [==============================] - 6s 60ms/step - loss: 0.6704 - val_
loss: 0.8282
Epoch 251/400
102/102 [==============================] - 6s 60ms/step - loss: 0.6718 - val_
loss: 0.7825
Epoch 252/400
102/102 [==============================] - 6s 60ms/step - loss: 0.6737 - val_
loss: 0.8191
Epoch 253/400
102/102 [==============================] - 6s 60ms/step - loss: 0.6834 - val_
loss: 0.8490
Epoch 254/400
102/102 [==============================] - 6s 60ms/step - loss: 0.6707 - val_
loss: 0.8418
Epoch 255/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6700 - val_
loss: 0.7983
Epoch 256/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6732 - val_
loss: 0.8766
Epoch 257/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6717 - val_
loss: 0.8124
Epoch 258/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6793 - val_
loss: 0.7664
Epoch 259/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6768 - val_
loss: 0.8138
Epoch 260/400
102/102 [==============================] - 7s 65ms/step - loss: 0.6662 - val_
loss: 0.8293
Epoch 261/400
102/102 [==============================] - 7s 65ms/step - loss: 0.6647 - val_
loss: 0.8278
Epoch 262/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6661 - val_
loss: 0.9167
Epoch 263/400
102/102 [==============================] - 6s 60ms/step - loss: 0.6721 - val_
loss: 0.8208
Epoch 264/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6671 - val_
loss: 0.7858
Epoch 265/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6653 - val_
loss: 0.7981
Epoch 266/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6676 - val_
```

```
loss: 0.8333
Epoch 267/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6665 - val_
loss: 0.8274
Epoch 268/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6637 - val_
loss: 0.8139
Epoch 269/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6696 - val_
loss: 0.8040
Epoch 270/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6779 - val_
loss: 0.7837
Epoch 271/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6686 - val_
loss: 0.8345
Epoch 272/400
102/102 [==============================] - 7s 64ms/step - loss: 0.6676 - val_
loss: 0.7785
Epoch 273/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6725 - val_
loss: 0.8103
Epoch 274/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6711 - val_
loss: 0.8091
Epoch 275/400
102/102 [==============================] - 6s 64ms/step - loss: 0.6738 - val_
loss: 0.8594
Epoch 276/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6796 - val_
loss: 0.8203
Epoch 277/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6748 - val_
loss: 0.7763
Epoch 278/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6701 - val_
loss: 0.7796
Epoch 279/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6683 - val_
loss: 0.7856
Epoch 280/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6678 - val_
loss: 0.8432
Epoch 281/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6626 - val_
loss: 0.8312
Epoch 282/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6609 - val_
loss: 0.8493
Epoch 283/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6658 - val_
loss: 0.7881
Epoch 284/400
102/102 [==============================] - 6s 64ms/step - loss: 0.6666 - val_
loss: 0.8475
Epoch 285/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6658 - val_
```

```
loss: 0.8114
Epoch 286/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6636 - val_
loss: 0.8433
Epoch 287/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6640 - val_
loss: 0.8075
Epoch 288/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6661 - val_
loss: 0.8379
Epoch 289/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6624 - val_
loss: 0.8175
Epoch 290/400
102/102 [==============================] - 7s 64ms/step - loss: 0.6636 - val_
loss: 0.8290
Epoch 291/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6615 - val_
loss: 0.8131
Epoch 292/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6627 - val_
loss: 0.8102
Epoch 293/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6674 - val_
loss: 0.8042
Epoch 294/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6691 - val_
loss: 0.7920
Epoch 295/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6670 - val_
loss: 0.8176
Epoch 296/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6628 - val_
loss: 0.8068
Epoch 297/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6601 - val_
loss: 0.7898
Epoch 298/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6632 - val_
loss: 0.8503
Epoch 299/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6650 - val_
loss: 0.8108
Epoch 300/400
102/102 [==============================] - 7s 64ms/step - loss: 0.6699 - val_
loss: 0.7860
Epoch 301/400
102/102 [==============================] - 7s 64ms/step - loss: 0.6657 - val_
loss: 0.7882
Epoch 302/400
102/102 [==============================] - 7s 64ms/step - loss: 0.6662 - val_
loss: 0.8075
Epoch 303/400
102/102 [==============================] - 7s 64ms/step - loss: 0.6661 - val_
loss: 0.8046
Epoch 304/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6613 - val_
```

```
loss: 0.8274
Epoch 305/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6602 - val_
loss: 0.8074
Epoch 306/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6663 - val_
loss: 0.8377
Epoch 307/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6623 - val_
loss: 0.8036
Epoch 308/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6575 - val_
loss: 0.8542
Epoch 309/400
102/102 [==============================] - 7s 65ms/step - loss: 0.6650 - val_
loss: 0.7816
Epoch 310/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6685 - val_
loss: 0.8189
Epoch 311/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6619 - val_
loss: 0.7907
Epoch 312/400
102/102 [==============================] - 6s 60ms/step - loss: 0.6619 - val_
loss: 0.8730
Epoch 313/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6605 - val_
loss: 0.7947
Epoch 314/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6634 - val_
loss: 0.8390
Epoch 315/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6620 - val_
loss: 0.8278
Epoch 316/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6617 - val_
loss: 0.8351
Epoch 317/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6613 - val_
loss: 0.8151
Epoch 318/400
102/102 [==============================] - 6s 60ms/step - loss: 0.6583 - val_
loss: 0.7900
Epoch 319/400
102/102 [==============================] - 6s 60ms/step - loss: 0.6584 - val_
loss: 0.8212
Epoch 320/400
102/102 [==============================] - 6s 60ms/step - loss: 0.6575 - val_
loss: 0.7968
Epoch 321/400
102/102 [==============================] - 6s 60ms/step - loss: 0.6578 - val_
loss: 0.7933
Epoch 322/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6623 - val_
loss: 0.8034
Epoch 323/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6602 - val_
```

```
loss: 0.8049
Epoch 324/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6655 - val_
loss: 0.7796
Epoch 325/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6656 - val_
loss: 0.7938
Epoch 326/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6643 - val_
loss: 0.7946
Epoch 327/400
102/102 [==============================] - 6s 64ms/step - loss: 0.6578 - val_
loss: 0.8171
Epoch 328/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6691 - val_
loss: 0.8394
Epoch 329/400
102/102 [==============================] - 7s 65ms/step - loss: 0.6678 - val_
loss: 0.8302
Epoch 330/400
102/102 [==============================] - 7s 65ms/step - loss: 0.6555 - val_
loss: 0.8108
Epoch 331/400
102/102 [==============================] - 7s 65ms/step - loss: 0.6555 - val_
loss: 0.8338
Epoch 332/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6563 - val_
loss: 0.7945
Epoch 333/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6563 - val_
loss: 0.7766
Epoch 334/400
102/102 [==============================] - 7s 64ms/step - loss: 0.6568 - val_
loss: 0.8258
Epoch 335/400
102/102 [==============================] - 7s 65ms/step - loss: 0.6536 - val_
loss: 0.8156
Epoch 336/400
102/102 [==============================] - 7s 64ms/step - loss: 0.6528 - val_
loss: 0.8246
Epoch 337/400
102/102 [==============================] - 7s 64ms/step - loss: 0.6536 - val_
loss: 0.8149
Epoch 338/400
102/102 [==============================] - 7s 64ms/step - loss: 0.6512 - val_
loss: 0.8314
Epoch 339/400
102/102 [==============================] - 7s 65ms/step - loss: 0.6499 - val_
loss: 0.8008
Epoch 340/400
102/102 [==============================] - 7s 65ms/step - loss: 0.6508 - val_
loss: 0.7835
Epoch 341/400
102/102 [==============================] - 6s 64ms/step - loss: 0.6525 - val_
loss: 0.8064
Epoch 342/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6493 - val_
```

```
loss: 0.8072
Epoch 343/400
102/102 [==============================] - 7s 64ms/step - loss: 0.6509 - val_
loss: 0.8170
Epoch 344/400
102/102 [==============================] - 6s 64ms/step - loss: 0.6513 - val_
loss: 0.8020
Epoch 345/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6481 - val_
loss: 0.8314
Epoch 346/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6504 - val_
loss: 0.8710
Epoch 347/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6507 - val_
loss: 0.8198
Epoch 348/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6461 - val_
loss: 0.8223
Epoch 349/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6487 - val_
loss: 0.7753
Epoch 350/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6553 - val_
loss: 0.7920
Epoch 351/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6489 - val_
loss: 0.8270
Epoch 352/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6433 - val_
loss: 0.8089
Epoch 353/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6452 - val_
loss: 0.8427
Epoch 354/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6515 - val_
loss: 0.7816
Epoch 355/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6474 - val_
loss: 0.8077
Epoch 356/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6432 - val_
loss: 0.8054
Epoch 357/400
102/102 [==============================] - 7s 64ms/step - loss: 0.6461 - val_
loss: 0.8169
Epoch 358/400
102/102 [==============================] - 7s 67ms/step - loss: 0.6411 - val_
loss: 0.8317
Epoch 359/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6394 - val_
loss: 0.7906
Epoch 360/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6390 - val_
loss: 0.8088
Epoch 361/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6385 - val_
```

```
loss: 0.8181
Epoch 362/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6356 - val_
loss: 0.7632
Epoch 363/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6351 - val_
loss: 0.8117
Epoch 364/400
102/102 [==============================] - 7s 66ms/step - loss: 0.6351 - val_
loss: 0.7829
Epoch 365/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6333 - val_
loss: 0.8015
Epoch 366/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6300 - val_
loss: 0.7838
Epoch 367/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6310 - val_
loss: 0.7927
Epoch 368/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6297 - val_
loss: 0.7869
Epoch 369/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6280 - val_
loss: 0.7991
Epoch 370/400
102/102 [==============================] - 6s 63ms/step - loss: 0.6276 - val_
loss: 0.7613
Epoch 371/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6280 - val_
loss: 0.7885
Epoch 372/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6211 - val_
loss: 0.7772
Epoch 373/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6254 - val_
loss: 0.7857
Epoch 374/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6238 - val_
loss: 0.7596
Epoch 375/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6255 - val_
loss: 0.7357
Epoch 376/400
102/102 [==============================] - 6s 62ms/step - loss: 0.6193 - val_
loss: 0.7791
Epoch 377/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6149 - val_
loss: 0.7572
Epoch 378/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6117 - val_
loss: 0.7568
Epoch 379/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6084 - val_
loss: 0.7737
Epoch 380/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6072 - val_
```

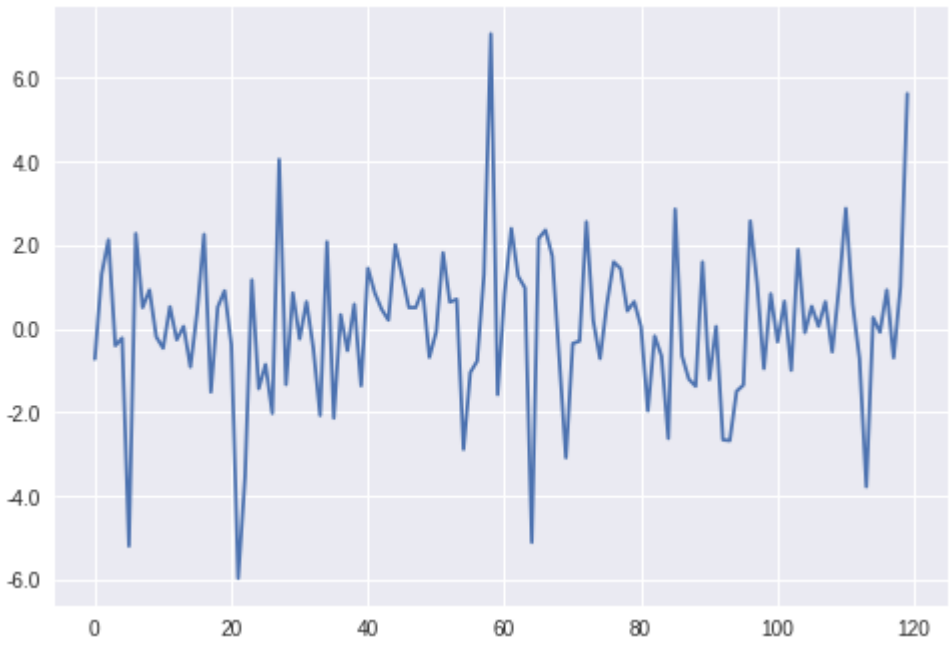
```
loss: 0.7554
Epoch 381/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6100 - val_
loss: 0.7498
Epoch 382/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6117 - val_
loss: 0.7438
Epoch 383/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6089 - val_
loss: 0.7620
Epoch 384/400
102/102 [==============================] - 6s 61ms/step - loss: 0.5985 - val_
loss: 0.7607
Epoch 385/400
102/102 [==============================] - 6s 62ms/step - loss: 0.5971 - val_
loss: 0.7337
Epoch 386/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6010 - val_
loss: 0.7368
Epoch 387/400
102/102 [==============================] - 6s 61ms/step - loss: 0.6006 - val_
loss: 0.7258
Epoch 388/400
102/102 [==============================] - 6s 61ms/step - loss: 0.5942 - val_
loss: 0.7410
Epoch 389/400
102/102 [==============================] - 6s 61ms/step - loss: 0.5892 - val_
loss: 0.7169
Epoch 390/400
102/102 [==============================] - 6s 61ms/step - loss: 0.5904 - val_
loss: 0.7303
Epoch 391/400
102/102 [==============================] - 6s 61ms/step - loss: 0.5912 - val_
loss: 0.7682
Epoch 392/400
102/102 [==============================] - 6s 61ms/step - loss: 0.5941 - val_
loss: 0.7085
Epoch 393/400
102/102 [==============================] - 6s 61ms/step - loss: 0.5915 - val_
loss: 0.7011
Epoch 394/400
102/102 [==============================] - 6s 61ms/step - loss: 0.5842 - val_
loss: 0.7222
Epoch 395/400
102/102 [==============================] - 6s 61ms/step - loss: 0.5719 - val_
loss: 0.7164
Epoch 396/400
102/102 [==============================] - 6s 61ms/step - loss: 0.5654 - val_
loss: 0.6997
Epoch 397/400
102/102 [==============================] - 6s 61ms/step - loss: 0.5606 - val_
loss: 0.7248
Epoch 398/400
102/102 [==============================] - 6s 61ms/step - loss: 0.5596 - val_
loss: 0.6984
Epoch 399/400
102/102 [==============================] - 6s 61ms/step - loss: 0.5529 - val_
```

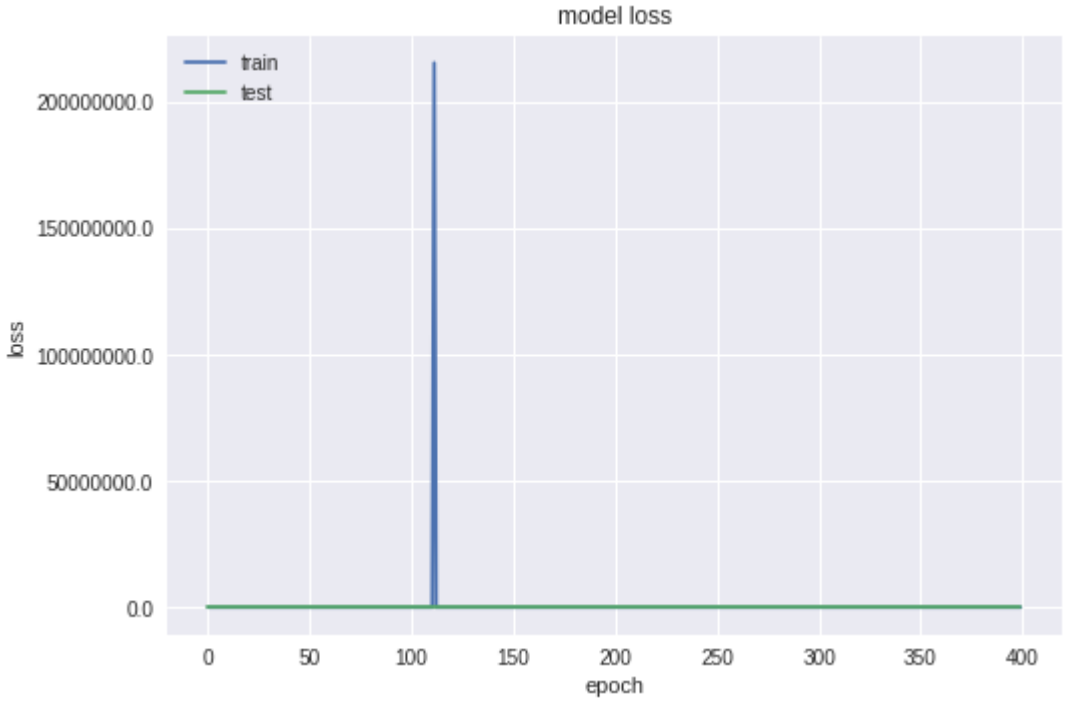
```
loss: 0.7190
Epoch 400/400
102/102 [==============================] - 6s 61ms/step - loss: 0.5495 - val_
loss: 0.6950
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_2 (LSTM)                (None, 400)               643200
_________________________________________________________________
dropout_2 (Dropout)          (None, 400)               0
_________________________________________________________________
dense_2 (Dense)              (None, 1)                 401
=================================================================
Total params: 643,601
Trainable params: 643,601
Non-trainable params: 0
_________________________________________________________________
None
dict_keys(['val_loss', 'loss'])
 21/120 [====>.........................] - ETA: 0s
/usr/local/lib/python3.6/dist-packages/matplotlib/cbook/deprecation.py:106: M
atplotlibDeprecationWarning: Adding an axes using the same arguments as a pre
vious axes currently reuses the earlier instance.  In a future version, a new
instance will always be created and returned.  Meanwhile, this warning can be
suppressed, and the future behavior ensured, by passing a unique label to eac
h axes instance.
  warnings.warn(message, mplDeprecation, stacklevel=1)
```

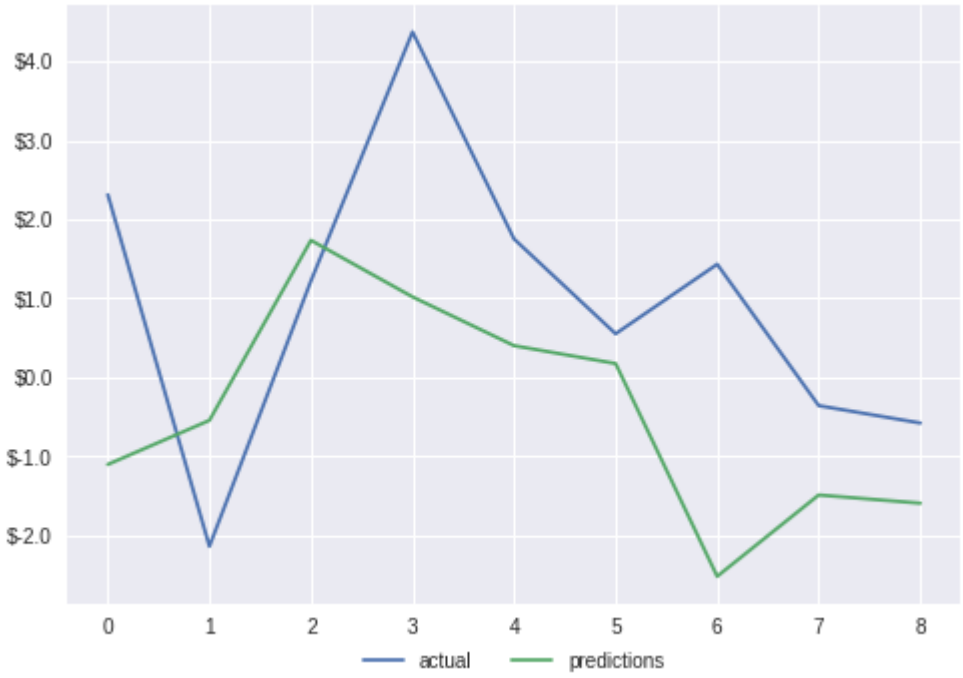
```
120/120 [==============================] - 1s 5ms/step
9/9 [==============================] - 0s 6ms/step
 in train MSE =  0.5685
 in test MSE =  0.664124329884847
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_2 (LSTM)                (None, 400)               643200
_________________________________________________________________
dropout_2 (Dropout)          (None, 400)               0
_________________________________________________________________
dense_2 (Dense)              (None, 1)                 401
=================================================================
Total params: 643,601
Trainable params: 643,601
Non-trainable params: 0
_________________________________________________________________
Inputs: (None, 19, 1)
Outputs: (None, 1)
Actual input: (9, 19, 1)
Actual output: (9, 1)
prediction data:
[-1.5948521]
y_test:
[[ 2.31]
 [-2.14]
 [ 1.22]
 [ 4.37]
 [ 1.75]
 [ 0.55]
 [ 1.43]
 [-0.36]
 [-0.58]]
act_data:
[ 2.31 -2.14  1.22  4.37  1.75  0.55  1.43 -0.36 -0.58]
pred1:
[[-1.1043627 ]
 [-0.5464101 ]
 [ 1.7330536 ]
 [ 1.0172749 ]
 [ 0.39932415]
 [ 0.1731242 ]
 [-2.520542  ]
 [-1.490585  ]
 [-1.5948521 ]]
do moving test predictions for next 22 days:
pred moving before scaling:
[-0.2535531, -0.024653893, 0.0232387, -0.28601393, 0.25468084, 0.07299067, 0.
06284113, 0.14290114, -0.01948798, 0.014185671, -0.035663683, 0.30670565, -0.
0038653314, -0.23048119, -0.59511244, -0.31839535, -0.4179925, -0.57594, -0.2
8579098, -0.7414947, -0.5286669, -0.33591974]
pred moving after scaling:
[[-1.1043628 ]
 [ 0.38462645]
 [ 0.69616777]
 [-1.3155206 ]
 [ 2.201699  ]
```

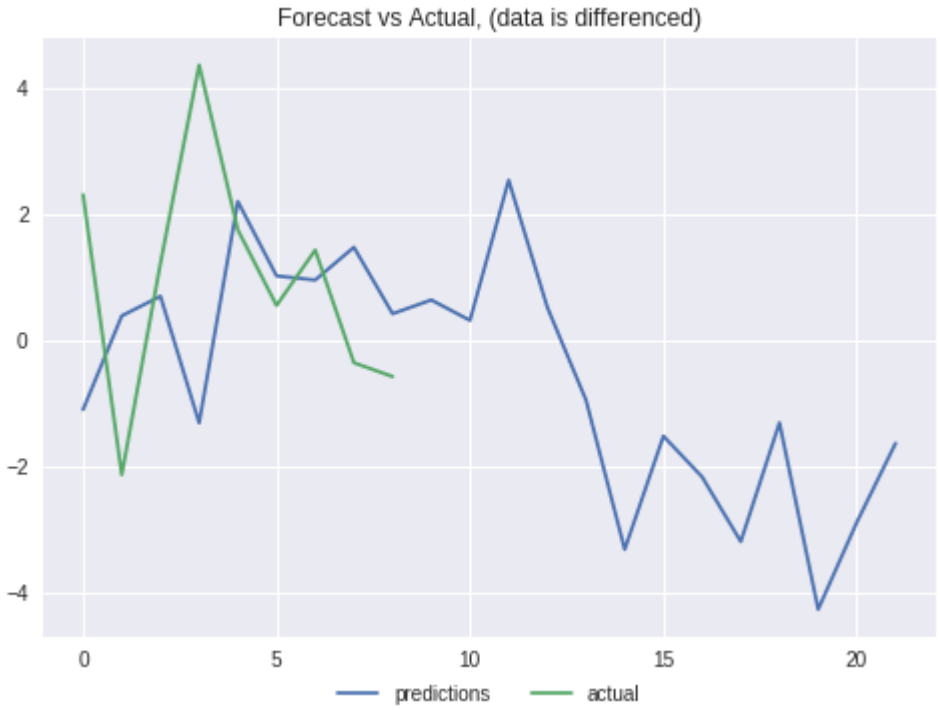
```
 [ 1.0198044 ]
 [ 0.95378155]
 [ 1.474572  ]
 [ 0.41823068]
 [ 0.6372778 ]
 [ 0.31300774]
 [ 2.5401204 ]
 [ 0.519856  ]
 [-0.9542802 ]
 [-3.3262064 ]
 [-1.5261618 ]
 [-2.174041  ]
 [-3.2014897 ]
 [-1.3140703 ]
 [-4.278423  ]
 [-2.893978  ]
 [-1.6401578 ]]
accuracy_in_change:
0.4444444444444444
```

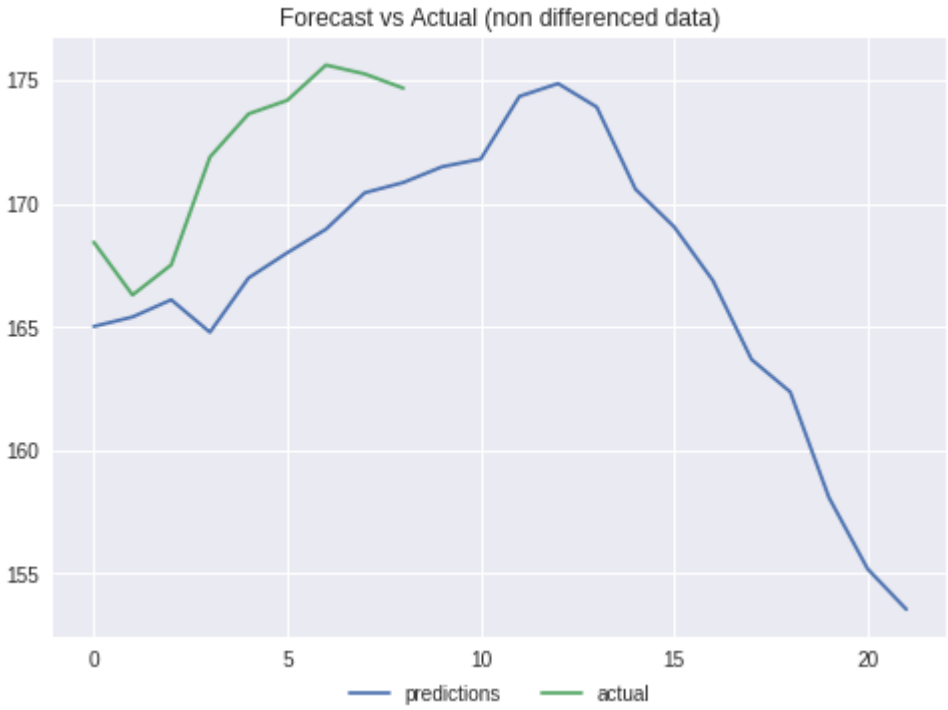
```
/usr/local/lib/python3.6/dist-packages/matplotlib/cbook/deprecation.py:106: M
atplotlibDeprecationWarning: Adding an axes using the same arguments as a pre
vious axes currently reuses the earlier instance.  In a future version, a new
instance will always be created and returned.  Meanwhile, this warning can be
suppressed, and the future behavior ensured, by passing a unique label to eac
h axes instance.
  warnings.warn(message, mplDeprecation, stacklevel=1)
```




model loss
train
test
200000000.0
150000000.0
100000000.0
50000000.0
0.0
loss
0
50
100
150
200
250
300
350
400
epoch


$4.0
$3.0
$2.0
$1.0
$0.0
$-1.0
$-2.0
0
1
2
3
4
5
6
7
8
actual
predictions





Looking at the non differenced data we are able to see that the model was able to predict a "peak-esk" formation that matches the actual data in magnitude, but it is a few days later than what actually happened. In the differenced data graph the severe up and down formation of the actual data seems to be hard to predict. The reasoning behind this is that in the real life just one bit of news can be enough to completely swing a stock price and this model does not take into account violent swings that can be caused from those types of events.

The next sections include what happens if we train over 600 epochs and lastly 1000 epochs. Spoilers: the 600 epoch performs pretty close to the 1000 epoch run.

NEW SECTION EPOCH 600

Since the model has to recomputed everytime I figured it would be easier to use sections to separate them.

In [0]:
```
import numpy as np
import pandas as pd
from sklearn import preprocessing

import matplotlib.pyplot as plt
import matplotlib.ticker as mtick

from keras.regularizers import L1L2

data_csv = pd.read_csv (fname)

#---------------------------------------------------------- ADJUSTABLE PARA
METERS ----------------------------------------------------

#how many data we will use
# (should not be more than dataset length )
data_to_use= 150

# number of training data
# should be less than data_to_use
train_end =120
```

In [0]:
```
#---------------------------------------------------------- THIS IS FROM ONLIN
E SOURCES ----------------------------------------------------------


total_data=len(data_csv)

#most recent data is in the end
#so need offset
start=total_data - data_to_use


yt = data_csv.iloc [start:total_data ,4]    #Close price
yt_ = yt.shift (-1)

print (yt_)

data = pd.concat ([yt, yt_], axis =1)
data. columns = ['yt', 'yt_']


N=18
cols =['yt']
for i in range (N):

    data['yt'+str(i)] = list(yt.shift(i+1))
    cols.append ('yt'+str(i))

data = data.dropna()
data_original = data
data=data.diff()
data = data.dropna()


# target variable - closed price
# after shifting
y = data ['yt_']
x = data [cols]


scaler_x = preprocessing.MinMaxScaler ( feature_range =( -1, 1))
x = np. array (x).reshape ((len( x) ,len(cols)))
x = scaler_x.fit_transform (x)

scaler_y = preprocessing. MinMaxScaler ( feature_range =( -1, 1))
y = np.array (y).reshape ((len( y), 1))
y = scaler_y.fit_transform (y)


x_train = x [0: train_end,]
x_test = x[ train_end +1:len(x),]
y_train = y [0: train_end]
y_test = y[ train_end +1:len(y)]

x_train = x_train.reshape (x_train. shape + (1,))
x_test = x_test.reshape (x_test. shape + (1,))
```

```
8214    140.17
8215    139.42
8216    140.20
8217    139.57
8218    139.05
8219    140.79
8220    140.63
8221    141.98
8222    142.87
8223    142.02
8224    142.13
8225    141.99
8226    144.89
8227    145.81
8228    145.37
8229    144.84
8230    147.24
8231    151.24
8232    152.21
8233    151.49
8234    152.80
8235    154.93
8236    154.53
8237    154.31
8238    149.12
8239    151.40
8240    151.91
8241    152.84
8242    152.65
8243    152.19
         ...
8334    153.92
8335    152.93
8336    154.83
8337    154.74
8338    155.28
8339    155.34
8340    155.99
8341    155.44
8342    156.43
8343    159.31
8344    159.90
8345    159.19
8346    155.42
8347    155.69
8348    155.61
8349    156.54
8350    155.85
8351    156.85
8352    162.47
8353    166.12
8354    168.43
8355    166.29
8356    167.51
8357    171.88
8358    173.63
8359    174.18
```

```
8360    175.61
8361    175.25
8362    174.67
8363       NaN
Name: Close, Length: 150, dtype: float64
```

In [0]:
```
#-----------------------------------------MODEL BUILDING 600-------------
-----------------------------------------------
from keras.models import Sequential
from keras.layers.core import Dense
from keras.layers.recurrent import LSTM
from keras.layers import  Dropout
from keras import optimizers

from numpy.random import seed
seed(1)
from tensorflow import set_random_seed
set_random_seed(2)

from keras import regularizers


model = Sequential ()
model.add (LSTM ( 400,  activation = 'relu', inner_activation = 'hard_sigmoid'
 , bias_regularizer=L1L2(l1=0.01, l2=0.01),  input_shape =(len(cols), 1), retu
rn_sequences = False ))
model.add(Dropout(0.3))
model.add (Dense (output_dim =1, activation = 'linear', activity_regularizer=r
egularizers.l1(0.01)))
adam=optimizers.Adam(lr=0.01, beta_1=0.89, beta_2=0.999, epsilon=None, decay=
0.0, amsgrad=True)
model.compile (loss ="mean_squared_error" , optimizer = "adam")
history=model.fit (x_train, y_train, batch_size =1, nb_epoch =600, shuffle = F
alse, validation_split=0.15)


y_train_back=scaler_y.inverse_transform (np. array (y_train). reshape ((len( y
_train), 1)))
plt.figure(1)
plt.plot (y_train_back)
```

```
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:16: UserWarning:
Update your `LSTM` call to the Keras 2 API: `LSTM(400, activation="relu", bia
s_regularizer=<keras.reg..., input_shape=(19, 1), return_sequences=False, rec
urrent_activation="hard_sigmoid")`
  app.launch_new_instance()
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:18: UserWarning:
Update your `Dense` call to the Keras 2 API: `Dense(activation="linear", acti
vity_regularizer=<keras.reg..., units=1)`
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:21: UserWarning:
The `nb_epoch` argument in `fit` has been renamed `epochs`.
```

```
Train on 102 samples, validate on 18 samples
Epoch 1/600
102/102 [==============================] - 8s 74ms/step - loss: 7.4998 - val_
loss: 6.9157
Epoch 2/600
102/102 [==============================] - 6s 60ms/step - loss: 6.3868 - val_
loss: 5.8631
Epoch 3/600
102/102 [==============================] - 6s 60ms/step - loss: 5.3893 - val_
loss: 4.9211
Epoch 4/600
102/102 [==============================] - 6s 60ms/step - loss: 4.4972 - val_
loss: 4.0807
Epoch 5/600
102/102 [==============================] - 6s 62ms/step - loss: 3.7036 - val_
loss: 3.3348
Epoch 6/600
102/102 [==============================] - 6s 61ms/step - loss: 3.0006 - val_
loss: 2.6763
Epoch 7/600
102/102 [==============================] - 6s 59ms/step - loss: 2.3822 - val_
loss: 2.0976
Epoch 8/600
102/102 [==============================] - 6s 60ms/step - loss: 1.8403 - val_
loss: 1.5947
Epoch 9/600
102/102 [==============================] - 6s 60ms/step - loss: 1.3687 - val_
loss: 1.1575
Epoch 10/600
102/102 [==============================] - 6s 60ms/step - loss: 938559.1613 -
val_loss: 1.2109
Epoch 11/600
102/102 [==============================] - 6s 61ms/step - loss: 1.1855 - val_
loss: 1.1590
Epoch 12/600
102/102 [==============================] - 6s 59ms/step - loss: 1.1417 - val_
loss: 1.1264
Epoch 13/600
102/102 [==============================] - 6s 58ms/step - loss: 1.1154 - val_
loss: 1.1109
Epoch 14/600
102/102 [==============================] - 6s 60ms/step - loss: 1.1072 - val_
loss: 1.1074
Epoch 15/600
102/102 [==============================] - 6s 60ms/step - loss: 1.1041 - val_
loss: 1.1056
Epoch 16/600
102/102 [==============================] - 6s 60ms/step - loss: 1.1019 - val_
loss: 1.1049
Epoch 17/600
102/102 [==============================] - 6s 60ms/step - loss: 1.1003 - val_
loss: 1.1046
Epoch 18/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0983 - val_
loss: 1.1037
Epoch 19/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0963 - val_
```

```
loss: 1.1039
Epoch 20/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0968 - val_
loss: 1.1030
Epoch 21/600
102/102 [==============================] - 6s 61ms/step - loss: 1.0939 - val_
loss: 1.1025
Epoch 22/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0937 - val_
loss: 1.1023
Epoch 23/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0915 - val_
loss: 1.1019
Epoch 24/600
102/102 [==============================] - 6s 59ms/step - loss: 1.0906 - val_
loss: 1.1008
Epoch 25/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0922 - val_
loss: 1.1017
Epoch 26/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0905 - val_
loss: 1.1012
Epoch 27/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0912 - val_
loss: 1.1013
Epoch 28/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0878 - val_
loss: 1.1016
Epoch 29/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0893 - val_
loss: 1.1011
Epoch 30/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0893 - val_
loss: 1.0999
Epoch 31/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0871 - val_
loss: 1.0997
Epoch 32/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0888 - val_
loss: 1.0986
Epoch 33/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0872 - val_
loss: 1.1004
Epoch 34/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0843 - val_
loss: 1.0982
Epoch 35/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0837 - val_
loss: 1.0995
Epoch 36/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0834 - val_
loss: 1.0984
Epoch 37/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0850 - val_
loss: 1.1026
Epoch 38/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0878 - val_
```

```
loss: 1.0991
Epoch 39/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0843 - val_
loss: 1.0973
Epoch 40/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0848 - val_
loss: 1.0967
Epoch 41/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0809 - val_
loss: 1.0958
Epoch 42/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0813 - val_
loss: 1.0952
Epoch 43/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0821 - val_
loss: 1.0927
Epoch 44/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0883 - val_
loss: 1.0963
Epoch 45/600
102/102 [==============================] - 6s 59ms/step - loss: 1.0769 - val_
loss: 1.0956
Epoch 46/600
102/102 [==============================] - 6s 59ms/step - loss: 1.0777 - val_
loss: 1.1041
Epoch 47/600
102/102 [==============================] - 6s 58ms/step - loss: 1.0764 - val_
loss: 1.0933
Epoch 48/600
102/102 [==============================] - 6s 59ms/step - loss: 1.0801 - val_
loss: 1.0937
Epoch 49/600
102/102 [==============================] - 6s 58ms/step - loss: 1.0819 - val_
loss: 1.0938
Epoch 50/600
102/102 [==============================] - 6s 59ms/step - loss: 1.0732 - val_
loss: 1.0983
Epoch 51/600
102/102 [==============================] - 6s 58ms/step - loss: 1.0739 - val_
loss: 1.1037
Epoch 52/600
102/102 [==============================] - 6s 58ms/step - loss: 1.0728 - val_
loss: 1.1051
Epoch 53/600
102/102 [==============================] - 6s 58ms/step - loss: 1.0759 - val_
loss: 1.1002
Epoch 54/600
102/102 [==============================] - 6s 58ms/step - loss: 1.0748 - val_
loss: 1.0956
Epoch 55/600
102/102 [==============================] - 6s 59ms/step - loss: 1.0998 - val_
loss: 1.0998
Epoch 56/600
102/102 [==============================] - 6s 62ms/step - loss: 1.0855 - val_
loss: 1.0912
Epoch 57/600
102/102 [==============================] - 6s 62ms/step - loss: 1.0830 - val_
```

```
loss: 1.0898
Epoch 58/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0778 - val_
loss: 1.0905
Epoch 59/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0765 - val_
loss: 1.0882
Epoch 60/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0746 - val_
loss: 1.0877
Epoch 61/600
102/102 [==============================] - 6s 59ms/step - loss: 1.0730 - val_
loss: 1.0868
Epoch 62/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0719 - val_
loss: 1.0868
Epoch 63/600
102/102 [==============================] - 6s 59ms/step - loss: 1.0696 - val_
loss: 1.0860
Epoch 64/600
102/102 [==============================] - 6s 59ms/step - loss: 1.0724 - val_
loss: 1.0856
Epoch 65/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0675 - val_
loss: 1.0884
Epoch 66/600
102/102 [==============================] - 6s 58ms/step - loss: 1.0694 - val_
loss: 1.0877
Epoch 67/600
102/102 [==============================] - 6s 58ms/step - loss: 1.0674 - val_
loss: 1.0857
Epoch 68/600
102/102 [==============================] - 6s 58ms/step - loss: 1.0673 - val_
loss: 1.0819
Epoch 69/600
102/102 [==============================] - 6s 57ms/step - loss: 1.0719 - val_
loss: 1.0846
Epoch 70/600
102/102 [==============================] - 6s 58ms/step - loss: 1.0664 - val_
loss: 1.0890
Epoch 71/600
102/102 [==============================] - 6s 58ms/step - loss: 1.0650 - val_
loss: 1.0857
Epoch 72/600
102/102 [==============================] - 6s 58ms/step - loss: 1.0642 - val_
loss: 1.0886
Epoch 73/600
102/102 [==============================] - 6s 59ms/step - loss: 1.0618 - val_
loss: 1.0853
Epoch 74/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0632 - val_
loss: 1.0889
Epoch 75/600
102/102 [==============================] - 6s 59ms/step - loss: 1.0632 - val_
loss: 1.0843
Epoch 76/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0597 - val_
```

```
loss: 1.0845
Epoch 77/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0604 - val_
loss: 1.0897
Epoch 78/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0683 - val_
loss: 1.0799
Epoch 79/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0667 - val_
loss: 1.0816
Epoch 80/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0578 - val_
loss: 1.0795
Epoch 81/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0482 - val_
loss: 1.0824
Epoch 82/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0577 - val_
loss: 1.0822
Epoch 83/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0499 - val_
loss: 1.0791
Epoch 84/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0466 - val_
loss: 1.0798
Epoch 85/600
102/102 [==============================] - 6s 61ms/step - loss: 1.0649 - val_
loss: 1.0935
Epoch 86/600
102/102 [==============================] - 6s 61ms/step - loss: 1.0843 - val_
loss: 1.0866
Epoch 87/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0738 - val_
loss: 1.0845
Epoch 88/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0678 - val_
loss: 1.0832
Epoch 89/600
102/102 [==============================] - 6s 61ms/step - loss: 1.0646 - val_
loss: 1.0815
Epoch 90/600
102/102 [==============================] - 6s 61ms/step - loss: 1.0599 - val_
loss: 1.0795
Epoch 91/600
102/102 [==============================] - 6s 61ms/step - loss: 1.0578 - val_
loss: 1.0784
Epoch 92/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0563 - val_
loss: 1.0763
Epoch 93/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0523 - val_
loss: 1.0749
Epoch 94/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0546 - val_
loss: 1.0739
Epoch 95/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0512 - val_
```

```
loss: 1.0738
Epoch 96/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0483 - val_
loss: 1.0717
Epoch 97/600
102/102 [==============================] - 6s 61ms/step - loss: 1.0467 - val_
loss: 1.0712
Epoch 98/600
102/102 [==============================] - 6s 61ms/step - loss: 1.0446 - val_
loss: 1.0699
Epoch 99/600
102/102 [==============================] - 6s 59ms/step - loss: 1.0431 - val_
loss: 1.0696
Epoch 100/600
102/102 [==============================] - 6s 59ms/step - loss: 1.0442 - val_
loss: 1.0691
Epoch 101/600
102/102 [==============================] - 6s 60ms/step - loss: 1.0387 - val_
loss: 1.0738
Epoch 102/600
102/102 [==============================] - 6s 61ms/step - loss: 1.0344 - val_
loss: 1.0684
Epoch 103/600
102/102 [==============================] - 6s 61ms/step - loss: 1.0339 - val_
loss: 1.0677
Epoch 104/600
102/102 [==============================] - 6s 61ms/step - loss: 1.0298 - val_
loss: 1.0683
Epoch 105/600
102/102 [==============================] - 6s 61ms/step - loss: 1.0353 - val_
loss: 1.0634
Epoch 106/600
102/102 [==============================] - 6s 61ms/step - loss: 1.0261 - val_
loss: 1.0668
Epoch 107/600
102/102 [==============================] - 7s 65ms/step - loss: 1.0240 - val_
loss: 1.0680
Epoch 108/600
102/102 [==============================] - 6s 63ms/step - loss: 1.0225 - val_
loss: 1.0652
Epoch 109/600
102/102 [==============================] - 6s 62ms/step - loss: 1.0233 - val_
loss: 1.0688
Epoch 110/600
102/102 [==============================] - 6s 61ms/step - loss: 1.0181 - val_
loss: 1.0644
Epoch 111/600
102/102 [==============================] - 6s 61ms/step - loss: 1.0128 - val_
loss: 1.0644
Epoch 112/600
102/102 [==============================] - 6s 61ms/step - loss: 1.0113 - val_
loss: 1.0652
Epoch 113/600
102/102 [==============================] - 6s 61ms/step - loss: 1.0149 - val_
loss: 1.0642
Epoch 114/600
102/102 [==============================] - 6s 62ms/step - loss: 1.0084 - val_
```

```
loss: 1.0642
Epoch 115/600
102/102 [==============================] - 6s 62ms/step - loss: 1.0038 - val_
loss: 1.0661
Epoch 116/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9995 - val_
loss: 1.0583
Epoch 117/600
102/102 [==============================] - 6s 62ms/step - loss: 1.0027 - val_
loss: 1.0595
Epoch 118/600
102/102 [==============================] - 6s 62ms/step - loss: 0.9961 - val_
loss: 1.0587
Epoch 119/600
102/102 [==============================] - 6s 61ms/step - loss: 1.0053 - val_
loss: 1.0535
Epoch 120/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9993 - val_
loss: 1.0572
Epoch 121/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9888 - val_
loss: 1.0556
Epoch 122/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9897 - val_
loss: 1.0669
Epoch 123/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9852 - val_
loss: 1.0484
Epoch 124/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9951 - val_
loss: 1.0535
Epoch 125/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9985 - val_
loss: 1.0409
Epoch 126/600
102/102 [==============================] - 6s 62ms/step - loss: 0.9773 - val_
loss: 1.0544
Epoch 127/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9770 - val_
loss: 1.0438
Epoch 128/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9707 - val_
loss: 1.0454
Epoch 129/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9681 - val_
loss: 1.0469
Epoch 130/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9659 - val_
loss: 1.0376
Epoch 131/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9614 - val_
loss: 1.0536
Epoch 132/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9630 - val_
loss: 1.0504
Epoch 133/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9563 - val_
```

```
loss: 1.0461
Epoch 134/600
102/102 [==============================] - 6s 60ms/step - loss: 0.9552 - val_
loss: 1.0379
Epoch 135/600
102/102 [==============================] - 6s 60ms/step - loss: 0.9740 - val_
loss: 1.0334
Epoch 136/600
102/102 [==============================] - 6s 60ms/step - loss: 0.9752 - val_
loss: 1.0119
Epoch 137/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9558 - val_
loss: 1.0235
Epoch 138/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9538 - val_
loss: 1.0147
Epoch 139/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9422 - val_
loss: 1.0181
Epoch 140/600
102/102 [==============================] - 6s 60ms/step - loss: 0.9438 - val_
loss: 1.0114
Epoch 141/600
102/102 [==============================] - 6s 60ms/step - loss: 0.9393 - val_
loss: 1.0191
Epoch 142/600
102/102 [==============================] - 6s 60ms/step - loss: 0.9589 - val_
loss: 1.0059
Epoch 143/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9434 - val_
loss: 1.0066
Epoch 144/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9392 - val_
loss: 1.0025
Epoch 145/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9457 - val_
loss: 1.0060
Epoch 146/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9348 - val_
loss: 1.0050
Epoch 147/600
102/102 [==============================] - 6s 60ms/step - loss: 0.9256 - val_
loss: 0.9986
Epoch 148/600
102/102 [==============================] - 6s 60ms/step - loss: 0.9242 - val_
loss: 1.0000
Epoch 149/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9269 - val_
loss: 1.0117
Epoch 150/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9282 - val_
loss: 1.0119
Epoch 151/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9163 - val_
loss: 1.0016
Epoch 152/600
102/102 [==============================] - 6s 60ms/step - loss: 0.9081 - val_
```

```
loss: 0.9954
Epoch 153/600
102/102 [==============================] - 6s 59ms/step - loss: 0.9075 - val_
loss: 0.9912
Epoch 154/600
102/102 [==============================] - 6s 60ms/step - loss: 0.9075 - val_
loss: 0.9926
Epoch 155/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9042 - val_
loss: 0.9901
Epoch 156/600
102/102 [==============================] - 6s 61ms/step - loss: 0.9177 - val_
loss: 0.9753
Epoch 157/600
102/102 [==============================] - 6s 63ms/step - loss: 0.9063 - val_
loss: 0.9825
Epoch 158/600
102/102 [==============================] - 6s 62ms/step - loss: 0.8974 - val_
loss: 0.9803
Epoch 159/600
102/102 [==============================] - 6s 61ms/step - loss: 0.8925 - val_
loss: 0.9855
Epoch 160/600
102/102 [==============================] - 6s 60ms/step - loss: 0.9031 - val_
loss: 0.9841
Epoch 161/600
102/102 [==============================] - 6s 61ms/step - loss: 0.8936 - val_
loss: 0.9641
Epoch 162/600
102/102 [==============================] - 6s 61ms/step - loss: 0.8810 - val_
loss: 0.9736
Epoch 163/600
102/102 [==============================] - 6s 61ms/step - loss: 0.8874 - val_
loss: 0.9714
Epoch 164/600
102/102 [==============================] - 6s 63ms/step - loss: 0.8792 - val_
loss: 0.9813
Epoch 165/600
102/102 [==============================] - 6s 61ms/step - loss: 0.8760 - val_
loss: 0.9782
Epoch 166/600
102/102 [==============================] - 6s 61ms/step - loss: 0.8693 - val_
loss: 0.9621
Epoch 167/600
102/102 [==============================] - 6s 60ms/step - loss: 0.8760 - val_
loss: 0.9530
Epoch 168/600
102/102 [==============================] - 6s 61ms/step - loss: 0.8859 - val_
loss: 0.9443
Epoch 169/600
102/102 [==============================] - 6s 60ms/step - loss: 0.8662 - val_
loss: 0.9485
Epoch 170/600
102/102 [==============================] - 6s 61ms/step - loss: 0.8576 - val_
loss: 0.9515
Epoch 171/600
102/102 [==============================] - 6s 62ms/step - loss: 0.8499 - val_
```

```
loss: 0.9430
Epoch 172/600
102/102 [==============================] - 6s 60ms/step - loss: 0.8565 - val_
loss: 0.9304
Epoch 173/600
102/102 [==============================] - 6s 58ms/step - loss: 0.8608 - val_
loss: 0.9284
Epoch 174/600
102/102 [==============================] - 6s 58ms/step - loss: 0.8516 - val_
loss: 0.9357
Epoch 175/600
102/102 [==============================] - 6s 59ms/step - loss: 0.8385 - val_
loss: 0.9309
Epoch 176/600
102/102 [==============================] - 6s 59ms/step - loss: 0.8352 - val_
loss: 0.9285
Epoch 177/600
102/102 [==============================] - 6s 60ms/step - loss: 0.8263 - val_
loss: 0.9413
Epoch 178/600
102/102 [==============================] - 6s 59ms/step - loss: 0.8225 - val_
loss: 0.9225
Epoch 179/600
102/102 [==============================] - 6s 59ms/step - loss: 0.8148 - val_
loss: 0.9323
Epoch 180/600
102/102 [==============================] - 6s 59ms/step - loss: 0.8224 - val_
loss: 0.9203
Epoch 181/600
102/102 [==============================] - 6s 59ms/step - loss: 0.8115 - val_
loss: 0.9747
Epoch 182/600
102/102 [==============================] - 6s 60ms/step - loss: 0.8058 - val_
loss: 0.9174
Epoch 183/600
102/102 [==============================] - 6s 59ms/step - loss: 0.8164 - val_
loss: 0.9284
Epoch 184/600
102/102 [==============================] - 6s 60ms/step - loss: 0.8069 - val_
loss: 0.9079
Epoch 185/600
102/102 [==============================] - 6s 60ms/step - loss: 0.7877 - val_
loss: 0.8796
Epoch 186/600
102/102 [==============================] - 6s 59ms/step - loss: 0.7883 - val_
loss: 0.8918
Epoch 187/600
102/102 [==============================] - 6s 60ms/step - loss: 0.7776 - val_
loss: 0.8833
Epoch 188/600
102/102 [==============================] - 6s 60ms/step - loss: 0.7677 - val_
loss: 0.9107
Epoch 189/600
102/102 [==============================] - 6s 60ms/step - loss: 0.7590 - val_
loss: 0.8726
Epoch 190/600
102/102 [==============================] - 6s 60ms/step - loss: 0.7680 - val_
```

```
loss: 0.9143
Epoch 191/600
102/102 [==============================] - 6s 60ms/step - loss: 0.8034 - val_
loss: 0.8395
Epoch 192/600
102/102 [==============================] - 6s 60ms/step - loss: 0.7832 - val_
loss: 0.8388
Epoch 193/600
102/102 [==============================] - 6s 60ms/step - loss: 0.7736 - val_
loss: 0.8370
Epoch 194/600
102/102 [==============================] - 6s 60ms/step - loss: 0.7586 - val_
loss: 0.8399
Epoch 195/600
102/102 [==============================] - 6s 60ms/step - loss: 0.7525 - val_
loss: 0.8375
Epoch 196/600
102/102 [==============================] - 6s 60ms/step - loss: 0.7558 - val_
loss: 0.8353
Epoch 197/600
102/102 [==============================] - 6s 60ms/step - loss: 0.7317 - val_
loss: 0.8399
Epoch 198/600
102/102 [==============================] - 6s 60ms/step - loss: 0.7221 - val_
loss: 0.8144
Epoch 199/600
102/102 [==============================] - 6s 60ms/step - loss: 0.7081 - val_
loss: 0.8440
Epoch 200/600
102/102 [==============================] - 6s 59ms/step - loss: 0.6958 - val_
loss: 0.8175
Epoch 201/600
102/102 [==============================] - 6s 60ms/step - loss: 0.6886 - val_
loss: 0.8263
Epoch 202/600
102/102 [==============================] - 6s 60ms/step - loss: 0.6914 - val_
loss: 0.7715
Epoch 203/600
102/102 [==============================] - 6s 60ms/step - loss: 0.7091 - val_
loss: 0.7785
Epoch 204/600
102/102 [==============================] - 6s 60ms/step - loss: 0.6903 - val_
loss: 0.7583
Epoch 205/600
102/102 [==============================] - 6s 59ms/step - loss: 0.6679 - val_
loss: 0.7514
Epoch 206/600
102/102 [==============================] - 6s 58ms/step - loss: 0.6554 - val_
loss: 0.7736
Epoch 207/600
102/102 [==============================] - 6s 59ms/step - loss: 0.6425 - val_
loss: 0.7771
Epoch 208/600
102/102 [==============================] - 6s 60ms/step - loss: 0.6308 - val_
loss: 0.7759
Epoch 209/600
102/102 [==============================] - 6s 59ms/step - loss: 0.6258 - val_
```

```
loss: 0.7472
Epoch 210/600
102/102 [==============================] - 6s 58ms/step - loss: 0.6185 - val_
loss: 0.7643
Epoch 211/600
102/102 [==============================] - 6s 58ms/step - loss: 0.6061 - val_
loss: 0.7405
Epoch 212/600
102/102 [==============================] - 6s 58ms/step - loss: 0.5956 - val_
loss: 0.7265
Epoch 213/600
102/102 [==============================] - 6s 59ms/step - loss: 0.5923 - val_
loss: 0.6914
Epoch 214/600
102/102 [==============================] - 6s 60ms/step - loss: 0.5818 - val_
loss: 0.6975
Epoch 215/600
102/102 [==============================] - 6s 59ms/step - loss: 0.5708 - val_
loss: 0.7254
Epoch 216/600
102/102 [==============================] - 6s 58ms/step - loss: 0.5715 - val_
loss: 0.6727
Epoch 217/600
102/102 [==============================] - 6s 58ms/step - loss: 0.5800 - val_
loss: 0.6578
Epoch 218/600
102/102 [==============================] - 6s 59ms/step - loss: 0.5625 - val_
loss: 0.7232
Epoch 219/600
102/102 [==============================] - 6s 58ms/step - loss: 0.5563 - val_
loss: 0.6719
Epoch 220/600
102/102 [==============================] - 6s 59ms/step - loss: 0.5422 - val_
loss: 0.6175
Epoch 221/600
102/102 [==============================] - 6s 58ms/step - loss: 0.5569 - val_
loss: 0.6321
Epoch 222/600
102/102 [==============================] - 6s 58ms/step - loss: 0.5404 - val_
loss: 0.6339
Epoch 223/600
102/102 [==============================] - 6s 58ms/step - loss: 0.5146 - val_
loss: 0.6167
Epoch 224/600
102/102 [==============================] - 6s 58ms/step - loss: 0.5015 - val_
loss: 0.6242
Epoch 225/600
102/102 [==============================] - 6s 59ms/step - loss: 0.4862 - val_
loss: 0.5989
Epoch 226/600
102/102 [==============================] - 6s 58ms/step - loss: 0.4806 - val_
loss: 0.6126
Epoch 227/600
102/102 [==============================] - 6s 58ms/step - loss: 0.4711 - val_
loss: 0.6019
Epoch 228/600
102/102 [==============================] - 6s 59ms/step - loss: 0.4614 - val_
```

```
loss: 0.5816
Epoch 229/600
102/102 [==============================] - 6s 59ms/step - loss: 0.4496 - val_
loss: 0.5810
Epoch 230/600
102/102 [==============================] - 6s 60ms/step - loss: 0.4420 - val_
loss: 0.5438
Epoch 231/600
102/102 [==============================] - 6s 60ms/step - loss: 0.4429 - val_
loss: 0.5536
Epoch 232/600
102/102 [==============================] - 6s 59ms/step - loss: 0.4346 - val_
loss: 0.5523
Epoch 233/600
102/102 [==============================] - 6s 59ms/step - loss: 0.4170 - val_
loss: 0.5712
Epoch 234/600
102/102 [==============================] - 6s 59ms/step - loss: 0.4084 - val_
loss: 0.5247
Epoch 235/600
102/102 [==============================] - 6s 60ms/step - loss: 0.4058 - val_
loss: 0.5142
Epoch 236/600
102/102 [==============================] - 6s 59ms/step - loss: 0.4002 - val_
loss: 0.5159
Epoch 237/600
102/102 [==============================] - 6s 59ms/step - loss: 0.3875 - val_
loss: 0.4817
Epoch 238/600
102/102 [==============================] - 6s 59ms/step - loss: 0.3796 - val_
loss: 0.4808
Epoch 239/600
102/102 [==============================] - 6s 59ms/step - loss: 0.3650 - val_
loss: 0.4891
Epoch 240/600
102/102 [==============================] - 6s 59ms/step - loss: 0.3556 - val_
loss: 0.4767
Epoch 241/600
102/102 [==============================] - 6s 59ms/step - loss: 0.3506 - val_
loss: 0.4633
Epoch 242/600
102/102 [==============================] - 6s 59ms/step - loss: 0.3410 - val_
loss: 0.4790
Epoch 243/600
102/102 [==============================] - 6s 59ms/step - loss: 0.3313 - val_
loss: 0.4696
Epoch 244/600
102/102 [==============================] - 6s 59ms/step - loss: 0.3269 - val_
loss: 0.4709
Epoch 245/600
102/102 [==============================] - 6s 59ms/step - loss: 0.3207 - val_
loss: 0.4646
Epoch 246/600
102/102 [==============================] - 6s 59ms/step - loss: 0.3147 - val_
loss: 0.4213
Epoch 247/600
102/102 [==============================] - 6s 59ms/step - loss: 0.3055 - val_
```

```
loss: 0.4317
Epoch 248/600
102/102 [==============================] - 6s 60ms/step - loss: 0.3012 - val_
loss: 0.4402
Epoch 249/600
102/102 [==============================] - 6s 60ms/step - loss: 0.3492 - val_
loss: 0.3984
Epoch 250/600
102/102 [==============================] - 6s 59ms/step - loss: 0.3551 - val_
loss: 0.4049
Epoch 251/600
102/102 [==============================] - 6s 59ms/step - loss: 0.3339 - val_
loss: 0.4148
Epoch 252/600
102/102 [==============================] - 6s 59ms/step - loss: 0.3021 - val_
loss: 0.3824
Epoch 253/600
102/102 [==============================] - 6s 59ms/step - loss: 0.2796 - val_
loss: 0.3790
Epoch 254/600
102/102 [==============================] - 6s 60ms/step - loss: 0.2723 - val_
loss: 0.4242
Epoch 255/600
102/102 [==============================] - 6s 59ms/step - loss: 0.2639 - val_
loss: 0.3558
Epoch 256/600
102/102 [==============================] - 6s 59ms/step - loss: 0.2580 - val_
loss: 0.3963
Epoch 257/600
102/102 [==============================] - 6s 59ms/step - loss: 0.2537 - val_
loss: 0.4196
Epoch 258/600
102/102 [==============================] - 6s 59ms/step - loss: 0.2692 - val_
loss: 0.3523
Epoch 259/600
102/102 [==============================] - 6s 61ms/step - loss: 0.2731 - val_
loss: 0.3333
Epoch 260/600
102/102 [==============================] - 6s 61ms/step - loss: 0.2621 - val_
loss: 0.3470
Epoch 261/600
102/102 [==============================] - 6s 58ms/step - loss: 0.2415 - val_
loss: 0.3544
Epoch 262/600
102/102 [==============================] - 6s 58ms/step - loss: 0.2297 - val_
loss: 0.3592
Epoch 263/600
102/102 [==============================] - 6s 58ms/step - loss: 0.2213 - val_
loss: 0.3536
Epoch 264/600
102/102 [==============================] - 6s 59ms/step - loss: 0.2203 - val_
loss: 0.3166
Epoch 265/600
102/102 [==============================] - 6s 60ms/step - loss: 0.2163 - val_
loss: 0.3345
Epoch 266/600
102/102 [==============================] - 6s 58ms/step - loss: 0.2055 - val_
```

```
loss: 0.3377
Epoch 267/600
102/102 [==============================] - 6s 59ms/step - loss: 0.2014 - val_
loss: 0.3414
Epoch 268/600
102/102 [==============================] - 6s 58ms/step - loss: 0.1976 - val_
loss: 0.3227
Epoch 269/600
102/102 [==============================] - 6s 58ms/step - loss: 0.1893 - val_
loss: 0.3296
Epoch 270/600
102/102 [==============================] - 6s 58ms/step - loss: 0.1895 - val_
loss: 0.3032
Epoch 271/600
102/102 [==============================] - 6s 58ms/step - loss: 0.1840 - val_
loss: 0.3152
Epoch 272/600
102/102 [==============================] - 6s 58ms/step - loss: 0.1806 - val_
loss: 0.2956
Epoch 273/600
102/102 [==============================] - 6s 58ms/step - loss: 0.1766 - val_
loss: 0.3321
Epoch 274/600
102/102 [==============================] - 6s 59ms/step - loss: 0.1755 - val_
loss: 0.3192
Epoch 275/600
102/102 [==============================] - 6s 59ms/step - loss: 0.1687 - val_
loss: 0.2724
Epoch 276/600
102/102 [==============================] - 6s 58ms/step - loss: 0.1716 - val_
loss: 0.4069
Epoch 277/600
102/102 [==============================] - 6s 59ms/step - loss: 0.1662 - val_
loss: 0.2971
Epoch 278/600
102/102 [==============================] - 6s 59ms/step - loss: 0.1589 - val_
loss: 0.2837
Epoch 279/600
102/102 [==============================] - 6s 59ms/step - loss: 0.1556 - val_
loss: 0.3241
Epoch 280/600
102/102 [==============================] - 6s 59ms/step - loss: 0.1595 - val_
loss: 0.2543
Epoch 281/600
102/102 [==============================] - 6s 60ms/step - loss: 0.2238 - val_
loss: 0.2576
Epoch 282/600
102/102 [==============================] - 6s 60ms/step - loss: 0.2119 - val_
loss: 0.2426
Epoch 283/600
102/102 [==============================] - 6s 60ms/step - loss: 0.1827 - val_
loss: 0.2450
Epoch 284/600
102/102 [==============================] - 6s 60ms/step - loss: 0.1629 - val_
loss: 0.2224
Epoch 285/600
102/102 [==============================] - 6s 60ms/step - loss: 0.1509 - val_
```

```
loss: 0.2397
Epoch 286/600
102/102 [==============================] - 6s 60ms/step - loss: 0.1369 - val_
loss: 0.2986
Epoch 287/600
102/102 [==============================] - 6s 60ms/step - loss: 0.1353 - val_
loss: 0.2709
Epoch 288/600
102/102 [==============================] - 6s 59ms/step - loss: 0.1263 - val_
loss: 0.2597
Epoch 289/600
102/102 [==============================] - 6s 59ms/step - loss: 0.1226 - val_
loss: 0.2283
Epoch 290/600
102/102 [==============================] - 6s 59ms/step - loss: 0.1219 - val_
loss: 0.2259
Epoch 291/600
102/102 [==============================] - 6s 59ms/step - loss: 0.1312 - val_
loss: 0.2239
Epoch 292/600
102/102 [==============================] - 6s 59ms/step - loss: 0.1233 - val_
loss: 0.2701
Epoch 293/600
102/102 [==============================] - 6s 59ms/step - loss: 0.1147 - val_
loss: 0.2139
Epoch 294/600
102/102 [==============================] - 6s 60ms/step - loss: 0.1152 - val_
loss: 0.2485
Epoch 295/600
102/102 [==============================] - 6s 61ms/step - loss: 0.1171 - val_
loss: 0.2456
Epoch 296/600
102/102 [==============================] - 6s 62ms/step - loss: 0.1047 - val_
loss: 0.2468
Epoch 297/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0971 - val_
loss: 0.2339
Epoch 298/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0947 - val_
loss: 0.2697
Epoch 299/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0863 - val_
loss: 0.2377
Epoch 300/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0831 - val_
loss: 0.2737
Epoch 301/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0789 - val_
loss: 0.2698
Epoch 302/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0783 - val_
loss: 0.2067
Epoch 303/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0776 - val_
loss: 0.1840
Epoch 304/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0810 - val_
```

```
loss: 0.1994
Epoch 305/600
102/102 [==============================] - 6s 63ms/step - loss: 0.1085 - val_
loss: 0.1551
Epoch 306/600
102/102 [==============================] - 7s 64ms/step - loss: 0.1381 - val_
loss: 0.1540
Epoch 307/600
102/102 [==============================] - 7s 64ms/step - loss: 0.1179 - val_
loss: 0.1437
Epoch 308/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0998 - val_
loss: 0.1645
Epoch 309/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0914 - val_
loss: 0.1708
Epoch 310/600
102/102 [==============================] - 7s 67ms/step - loss: 0.0959 - val_
loss: 0.1765
Epoch 311/600
102/102 [==============================] - 7s 65ms/step - loss: 0.0805 - val_
loss: 0.1857
Epoch 312/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0696 - val_
loss: 0.1545
Epoch 313/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0673 - val_
loss: 0.1855
Epoch 314/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0579 - val_
loss: 0.1878
Epoch 315/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0589 - val_
loss: 0.1795
Epoch 316/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0561 - val_
loss: 0.1702
Epoch 317/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0667 - val_
loss: 0.2242
Epoch 318/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0811 - val_
loss: 0.1574
Epoch 319/600
102/102 [==============================] - 6s 58ms/step - loss: 0.0917 - val_
loss: 0.1517
Epoch 320/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0674 - val_
loss: 0.1492
Epoch 321/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0523 - val_
loss: 0.1840
Epoch 322/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0448 - val_
loss: 0.1999
Epoch 323/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0431 - val_
```

```
loss: 0.1769
Epoch 324/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0385 - val_
loss: 0.1660
Epoch 325/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0367 - val_
loss: 0.1924
Epoch 326/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0343 - val_
loss: 0.2396
Epoch 327/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0355 - val_
loss: 0.1287
Epoch 328/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0502 - val_
loss: 0.1773
Epoch 329/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0510 - val_
loss: 0.2058
Epoch 330/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0402 - val_
loss: 0.2180
Epoch 331/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0375 - val_
loss: 0.2250
Epoch 332/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0426 - val_
loss: 0.1411
Epoch 333/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0411 - val_
loss: 0.1696
Epoch 334/600
102/102 [==============================] - 6s 61ms/step - loss: 0.1097 - val_
loss: 0.1214
Epoch 335/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0837 - val_
loss: 0.1229
Epoch 336/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0730 - val_
loss: 0.1232
Epoch 337/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0707 - val_
loss: 0.1349
Epoch 338/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0908 - val_
loss: 0.1186
Epoch 339/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0777 - val_
loss: 0.1236
Epoch 340/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0580 - val_
loss: 0.1629
Epoch 341/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0805 - val_
loss: 0.1231
Epoch 342/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0582 - val_
```

```
loss: 0.1793
Epoch 343/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0481 - val_
loss: 0.1472
Epoch 344/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0380 - val_
loss: 0.1557
Epoch 345/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0431 - val_
loss: 0.1512
Epoch 346/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0503 - val_
loss: 0.1793
Epoch 347/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0509 - val_
loss: 0.1314
Epoch 348/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0428 - val_
loss: 0.1909
Epoch 349/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0345 - val_
loss: 0.1853
Epoch 350/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0408 - val_
loss: 0.1774
Epoch 351/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0376 - val_
loss: 0.1482
Epoch 352/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0401 - val_
loss: 0.1595
Epoch 353/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0295 - val_
loss: 0.1308
Epoch 354/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0283 - val_
loss: 0.1115
Epoch 355/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0374 - val_
loss: 0.1589
Epoch 356/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0310 - val_
loss: 0.1723
Epoch 357/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0279 - val_
loss: 0.1404
Epoch 358/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0280 - val_
loss: 0.1693
Epoch 359/600
102/102 [==============================] - 7s 64ms/step - loss: 0.0255 - val_
loss: 0.1320
Epoch 360/600
102/102 [==============================] - 7s 67ms/step - loss: 0.0316 - val_
loss: 0.1778
Epoch 361/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0273 - val_
```

```
loss: 0.1358
Epoch 362/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0201 - val_
loss: 0.1626
Epoch 363/600
102/102 [==============================] - 7s 66ms/step - loss: 0.0207 - val_
loss: 0.1886
Epoch 364/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0344 - val_
loss: 0.2346
Epoch 365/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0361 - val_
loss: 0.1311
Epoch 366/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0396 - val_
loss: 0.1838
Epoch 367/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0628 - val_
loss: 0.1562
Epoch 368/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0706 - val_
loss: 0.1516
Epoch 369/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0460 - val_
loss: 0.1340
Epoch 370/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0437 - val_
loss: 0.1539
Epoch 371/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0309 - val_
loss: 0.1602
Epoch 372/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0291 - val_
loss: 0.1686
Epoch 373/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0397 - val_
loss: 0.1539
Epoch 374/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0898 - val_
loss: 0.1969
Epoch 375/600
102/102 [==============================] - 6s 63ms/step - loss: 0.1231 - val_
loss: 0.1572
Epoch 376/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0893 - val_
loss: 0.1637
Epoch 377/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0723 - val_
loss: 0.1812
Epoch 378/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0580 - val_
loss: 0.1956
Epoch 379/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0483 - val_
loss: 0.1926
Epoch 380/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0417 - val_
```

```
loss: 0.1773
Epoch 381/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0371 - val_
loss: 0.2127
Epoch 382/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0356 - val_
loss: 0.1927
Epoch 383/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0285 - val_
loss: 0.1849
Epoch 384/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0260 - val_
loss: 0.2334
Epoch 385/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0250 - val_
loss: 0.1991
Epoch 386/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0251 - val_
loss: 0.1771
Epoch 387/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0239 - val_
loss: 0.1965
Epoch 388/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0166 - val_
loss: 0.2065
Epoch 389/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0175 - val_
loss: 0.1960
Epoch 390/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0238 - val_
loss: 0.2033
Epoch 391/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0303 - val_
loss: 0.1805
Epoch 392/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0357 - val_
loss: 0.1541
Epoch 393/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0231 - val_
loss: 0.1534
Epoch 394/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0189 - val_
loss: 0.1607
Epoch 395/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0198 - val_
loss: 0.1671
Epoch 396/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0162 - val_
loss: 0.1960
Epoch 397/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0133 - val_
loss: 0.1839
Epoch 398/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0114 - val_
loss: 0.2053
Epoch 399/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0127 - val_
```

```
loss: 0.2109
Epoch 400/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0125 - val_
loss: 0.1704
Epoch 401/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0139 - val_
loss: 0.1661
Epoch 402/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0178 - val_
loss: 0.1532
Epoch 403/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0189 - val_
loss: 0.1647
Epoch 404/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0302 - val_
loss: 0.1848
Epoch 405/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0451 - val_
loss: 0.1476
Epoch 406/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0746 - val_
loss: 0.1054
Epoch 407/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0439 - val_
loss: 0.1166
Epoch 408/600
102/102 [==============================] - 7s 64ms/step - loss: 0.0570 - val_
loss: 0.1150
Epoch 409/600
102/102 [==============================] - 7s 65ms/step - loss: 0.0597 - val_
loss: 0.1418
Epoch 410/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0325 - val_
loss: 0.1438
Epoch 411/600
102/102 [==============================] - 7s 64ms/step - loss: 0.0309 - val_
loss: 0.1455
Epoch 412/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0300 - val_
loss: 0.1361
Epoch 413/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0269 - val_
loss: 0.1447
Epoch 414/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0295 - val_
loss: 0.1279
Epoch 415/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0270 - val_
loss: 0.1795
Epoch 416/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0202 - val_
loss: 0.1540
Epoch 417/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0210 - val_
loss: 0.1636
Epoch 418/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0124 - val_
```

```
loss: 0.1506
Epoch 419/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0132 - val_
loss: 0.1674
Epoch 420/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0121 - val_
loss: 0.1523
Epoch 421/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0141 - val_
loss: 0.1467
Epoch 422/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0180 - val_
loss: 0.1565
Epoch 423/600
102/102 [==============================] - 7s 64ms/step - loss: 0.0170 - val_
loss: 0.1431
Epoch 424/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0124 - val_
loss: 0.1590
Epoch 425/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0121 - val_
loss: 0.1405
Epoch 426/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0137 - val_
loss: 0.1620
Epoch 427/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0167 - val_
loss: 0.1563
Epoch 428/600
102/102 [==============================] - 7s 64ms/step - loss: 0.0193 - val_
loss: 0.1436
Epoch 429/600
102/102 [==============================] - 6s 64ms/step - loss: 0.0201 - val_
loss: 0.1921
Epoch 430/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0162 - val_
loss: 0.1412
Epoch 431/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0128 - val_
loss: 0.1702
Epoch 432/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0114 - val_
loss: 0.1773
Epoch 433/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0106 - val_
loss: 0.1697
Epoch 434/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0108 - val_
loss: 0.1523
Epoch 435/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0125 - val_
loss: 0.1507
Epoch 436/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0137 - val_
loss: 0.1721
Epoch 437/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0095 - val_
```

```
loss: 0.1954
Epoch 438/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0147 - val_
loss: 0.1743
Epoch 439/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0122 - val_
loss: 0.1818
Epoch 440/600
102/102 [==============================] - 7s 64ms/step - loss: 0.0407 - val_
loss: 0.1927
Epoch 441/600
102/102 [==============================] - 7s 64ms/step - loss: 0.1070 - val_
loss: 0.1017
Epoch 442/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0794 - val_
loss: 0.1263
Epoch 443/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0610 - val_
loss: 0.1469
Epoch 444/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0404 - val_
loss: 0.1355
Epoch 445/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0230 - val_
loss: 0.1431
Epoch 446/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0208 - val_
loss: 0.1386
Epoch 447/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0169 - val_
loss: 0.1475
Epoch 448/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0137 - val_
loss: 0.1450
Epoch 449/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0140 - val_
loss: 0.1392
Epoch 450/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0122 - val_
loss: 0.1363
Epoch 451/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0115 - val_
loss: 0.1657
Epoch 452/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0153 - val_
loss: 0.1280
Epoch 453/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0164 - val_
loss: 0.1384
Epoch 454/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0118 - val_
loss: 0.1576
Epoch 455/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0155 - val_
loss: 0.1703
Epoch 456/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0177 - val_
```

```
loss: 0.1357
Epoch 457/600
102/102 [==============================] - 7s 68ms/step - loss: 0.0142 - val_
loss: 0.1310
Epoch 458/600
102/102 [==============================] - 7s 66ms/step - loss: 0.0123 - val_
loss: 0.1504
Epoch 459/600
102/102 [==============================] - 7s 65ms/step - loss: 0.0115 - val_
loss: 0.1518
Epoch 460/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0161 - val_
loss: 0.1378
Epoch 461/600
102/102 [==============================] - 6s 64ms/step - loss: 0.0241 - val_
loss: 0.2026
Epoch 462/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0421 - val_
loss: 0.1467
Epoch 463/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0296 - val_
loss: 0.1209
Epoch 464/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0473 - val_
loss: 0.1854
Epoch 465/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0671 - val_
loss: 0.1860
Epoch 466/600
102/102 [==============================] - 6s 63ms/step - loss: 0.1127 - val_
loss: 0.1524
Epoch 467/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0527 - val_
loss: 0.1521
Epoch 468/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0316 - val_
loss: 0.1339
Epoch 469/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0237 - val_
loss: 0.1316
Epoch 470/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0219 - val_
loss: 0.1506
Epoch 471/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0179 - val_
loss: 0.1592
Epoch 472/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0326 - val_
loss: 0.1472
Epoch 473/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0192 - val_
loss: 0.1203
Epoch 474/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0126 - val_
loss: 0.1359
Epoch 475/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0119 - val_
```

```
loss: 0.1440
Epoch 476/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0305 - val_
loss: 0.1665
Epoch 477/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0290 - val_
loss: 0.1404
Epoch 478/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0251 - val_
loss: 0.1370
Epoch 479/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0185 - val_
loss: 0.1271
Epoch 480/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0133 - val_
loss: 0.1275
Epoch 481/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0130 - val_
loss: 0.1356
Epoch 482/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0094 - val_
loss: 0.1406
Epoch 483/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0101 - val_
loss: 0.1474
Epoch 484/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0097 - val_
loss: 0.1386
Epoch 485/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0088 - val_
loss: 0.1384
Epoch 486/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0086 - val_
loss: 0.1317
Epoch 487/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0096 - val_
loss: 0.1377
Epoch 488/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0091 - val_
loss: 0.1259
Epoch 489/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0081 - val_
loss: 0.1326
Epoch 490/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0079 - val_
loss: 0.1501
Epoch 491/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0108 - val_
loss: 0.1381
Epoch 492/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0113 - val_
loss: 0.1512
Epoch 493/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0095 - val_
loss: 0.1229
Epoch 494/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0124 - val_
```

```
loss: 0.1285
Epoch 495/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0119 - val_
loss: 0.1406
Epoch 496/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0100 - val_
loss: 0.1650
Epoch 497/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0077 - val_
loss: 0.1417
Epoch 498/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0079 - val_
loss: 0.1546
Epoch 499/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0090 - val_
loss: 0.1474
Epoch 500/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0111 - val_
loss: 0.1275
Epoch 501/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0096 - val_
loss: 0.1447
Epoch 502/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0111 - val_
loss: 0.1537
Epoch 503/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0116 - val_
loss: 0.1267
Epoch 504/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0122 - val_
loss: 0.1426
Epoch 505/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0112 - val_
loss: 0.1168
Epoch 506/600
102/102 [==============================] - 6s 64ms/step - loss: 0.0120 - val_
loss: 0.1309
Epoch 507/600
102/102 [==============================] - 7s 69ms/step - loss: 0.0118 - val_
loss: 0.1327
Epoch 508/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0153 - val_
loss: 0.1501
Epoch 509/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0222 - val_
loss: 0.1602
Epoch 510/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0361 - val_
loss: 0.1474
Epoch 511/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0205 - val_
loss: 0.1461
Epoch 512/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0469 - val_
loss: 0.1163
Epoch 513/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0320 - val_
```

```
loss: 0.1475
Epoch 514/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0208 - val_
loss: 0.1480
Epoch 515/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0092 - val_
loss: 0.1411
Epoch 516/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0093 - val_
loss: 0.1352
Epoch 517/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0159 - val_
loss: 0.1341
Epoch 518/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0140 - val_
loss: 0.1545
Epoch 519/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0116 - val_
loss: 0.1434
Epoch 520/600
102/102 [==============================] - 6s 59ms/step - loss: 0.0121 - val_
loss: 0.1413
Epoch 521/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0108 - val_
loss: 0.1372
Epoch 522/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0199 - val_
loss: 0.1335
Epoch 523/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0208 - val_
loss: 0.1563
Epoch 524/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0107 - val_
loss: 0.1592
Epoch 525/600
102/102 [==============================] - 6s 62ms/step - loss: 0.0104 - val_
loss: 0.1512
Epoch 526/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0294 - val_
loss: 0.1925
Epoch 527/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0436 - val_
loss: 0.1373
Epoch 528/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0579 - val_
loss: 0.1080
Epoch 529/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0337 - val_
loss: 0.1590
Epoch 530/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0144 - val_
loss: 0.1678
Epoch 531/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0118 - val_
loss: 0.1770
Epoch 532/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0126 - val_
```

```
loss: 0.1560
Epoch 533/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0105 - val_
loss: 0.1615
Epoch 534/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0105 - val_
loss: 0.1353
Epoch 535/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0136 - val_
loss: 0.1547
Epoch 536/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0101 - val_
loss: 0.1461
Epoch 537/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0096 - val_
loss: 0.1499
Epoch 538/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0074 - val_
loss: 0.1574
Epoch 539/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0072 - val_
loss: 0.1476
Epoch 540/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0069 - val_
loss: 0.1368
Epoch 541/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0079 - val_
loss: 0.1459
Epoch 542/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0084 - val_
loss: 0.1464
Epoch 543/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0069 - val_
loss: 0.1568
Epoch 544/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0084 - val_
loss: 0.1296
Epoch 545/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0083 - val_
loss: 0.1338
Epoch 546/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0089 - val_
loss: 0.1596
Epoch 547/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0083 - val_
loss: 0.1417
Epoch 548/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0070 - val_
loss: 0.1278
Epoch 549/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0085 - val_
loss: 0.1424
Epoch 550/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0064 - val_
loss: 0.1487
Epoch 551/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0079 - val_
```

```
loss: 0.1346
Epoch 552/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0092 - val_
loss: 0.1537
Epoch 553/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0146 - val_
loss: 0.1439
Epoch 554/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0120 - val_
loss: 0.1414
Epoch 555/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0095 - val_
loss: 0.1300
Epoch 556/600
102/102 [==============================] - 6s 63ms/step - loss: 0.0140 - val_
loss: 0.1439
Epoch 557/600
102/102 [==============================] - 7s 72ms/step - loss: 0.0115 - val_
loss: 0.1214
Epoch 558/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0119 - val_
loss: 0.1157
Epoch 559/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0153 - val_
loss: 0.1421
Epoch 560/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0215 - val_
loss: 0.1290
Epoch 561/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0142 - val_
loss: 0.1418
Epoch 562/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0208 - val_
loss: 0.1488
Epoch 563/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0169 - val_
loss: 0.1501
Epoch 564/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0121 - val_
loss: 0.1458
Epoch 565/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0110 - val_
loss: 0.1395
Epoch 566/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0089 - val_
loss: 0.1548
Epoch 567/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0082 - val_
loss: 0.1410
Epoch 568/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0087 - val_
loss: 0.1342
Epoch 569/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0082 - val_
loss: 0.1576
Epoch 570/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0073 - val_
```

```
loss: 0.1287
Epoch 571/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0089 - val_
loss: 0.1478
Epoch 572/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0092 - val_
loss: 0.1395
Epoch 573/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0104 - val_
loss: 0.1590
Epoch 574/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0072 - val_
loss: 0.1387
Epoch 575/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0073 - val_
loss: 0.1254
Epoch 576/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0078 - val_
loss: 0.1469
Epoch 577/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0094 - val_
loss: 0.1243
Epoch 578/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0116 - val_
loss: 0.1523
Epoch 579/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0099 - val_
loss: 0.1489
Epoch 580/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0082 - val_
loss: 0.1446
Epoch 581/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0104 - val_
loss: 0.1171
Epoch 582/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0069 - val_
loss: 0.1470
Epoch 583/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0083 - val_
loss: 0.1506
Epoch 584/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0086 - val_
loss: 0.1710
Epoch 585/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0087 - val_
loss: 0.1182
Epoch 586/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0092 - val_
loss: 0.1732
Epoch 587/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0090 - val_
loss: 0.1717
Epoch 588/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0081 - val_
loss: 0.1336
Epoch 589/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0089 - val_
```

```
loss: 0.1281
Epoch 590/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0098 - val_
loss: 0.1280
Epoch 591/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0080 - val_
loss: 0.1330
Epoch 592/600
102/102 [==============================] - 6s 61ms/step - loss: 0.0102 - val_
loss: 0.1420
Epoch 593/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0098 - val_
loss: 0.1315
Epoch 594/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0102 - val_
loss: 0.1358
Epoch 595/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0339 - val_
loss: 0.2143
Epoch 596/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0435 - val_
loss: 0.1385
Epoch 597/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0183 - val_
loss: 0.1245
Epoch 598/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0212 - val_
loss: 0.1568
Epoch 599/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0105 - val_
loss: 0.1211
Epoch 600/600
102/102 [==============================] - 6s 60ms/step - loss: 0.0088 - val_
loss: 0.1250
```

Out[0]: `[<matplotlib.lines.Line2D at 0x7f071165c940>]`

In [0]:
```
#-----------------------------------------------------PLOT LOSS --------------
-------------------------------------------------
fmt = '%.1f'
tick = mtick.FormatStrFormatter(fmt)
ax = plt.axes()
ax.yaxis.set_major_formatter(tick)
print (model.summary())
print(history.history.keys())

plt.figure(2)
plt.plot(history.history['loss'])
plt.plot(history.history['val_loss'])
plt.title('model loss')
plt.ylabel('loss')
plt.xlabel('epoch')
plt.legend(['train', 'test'], loc='upper left')
fmt = '%.1f'
tick = mtick.FormatStrFormatter(fmt)
ax = plt.axes()
ax.yaxis.set_major_formatter(tick)

score_train = model.evaluate (x_train, y_train, batch_size =1)
score_test = model.evaluate (x_test, y_test, batch_size =1)
print (" in train MSE = ", round( score_train ,4))
print (" in test MSE = ", score_test )

pred1 = model.predict (x_test)
pred1 = scaler_y.inverse_transform (np. array (pred1). reshape ((len( pred1),
1)))

prediction_data = pred1[-1]
model.summary()
print ("Inputs: {}".format(model.input_shape))
print ("Outputs: {}".format(model.output_shape))
print ("Actual input: {}".format(x_test.shape))
print ("Actual output: {}".format(y_test.shape))

print ("prediction data:")
print (prediction_data)

y_test = scaler_y.inverse_transform (np. array (y_test). reshape ((len( y_test
), 1)))
print ("y_test:")
print (y_test)

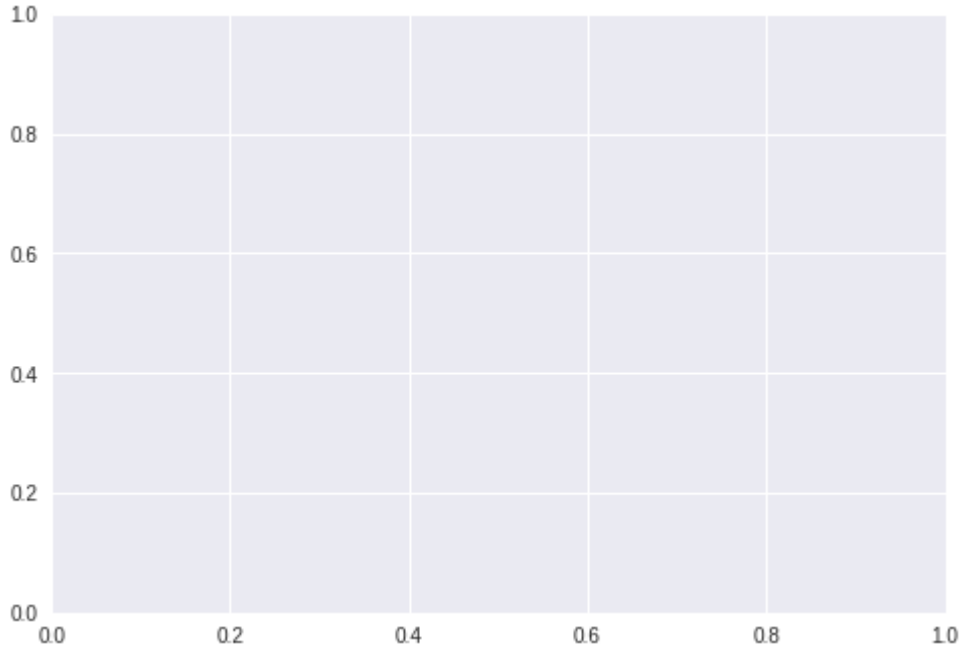
act_data = np.array([row[0] for row in y_test])

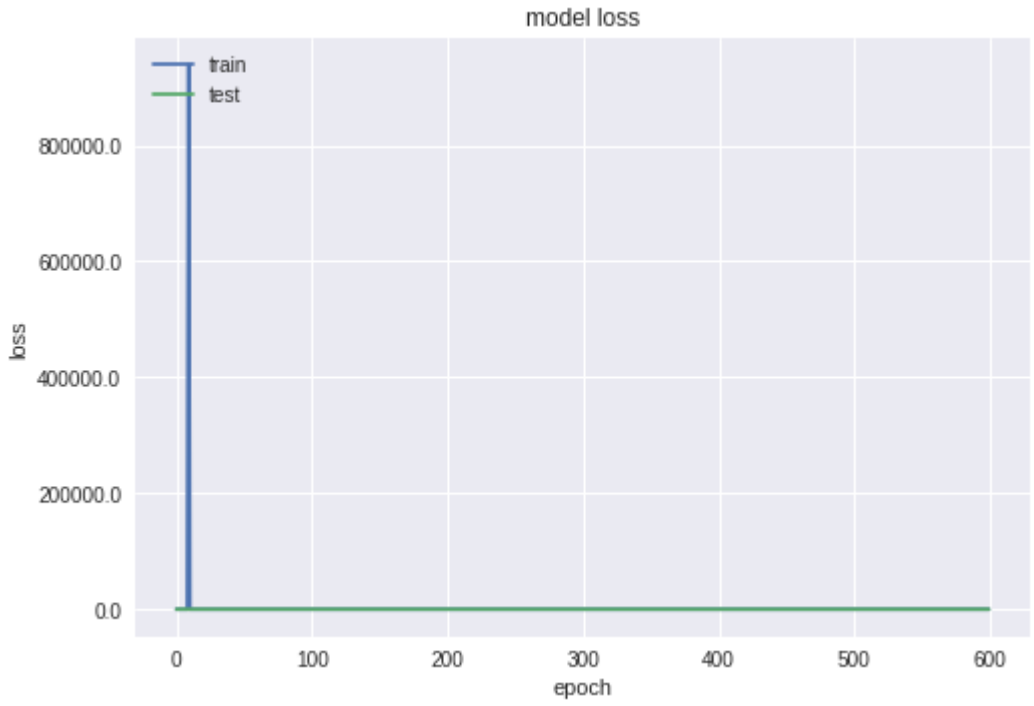
fmt = '%.1f'
tick = mtick.FormatStrFormatter(fmt)
ax = plt.axes()
ax.yaxis.set_major_formatter(tick)
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #   
=================================================================
lstm_5 (LSTM)                (None, 400)               643200    
_________________________________________________________________
dropout_5 (Dropout)          (None, 400)               0         
_________________________________________________________________
dense_5 (Dense)              (None, 1)                 401       
=================================================================
Total params: 643,601
Trainable params: 643,601
Non-trainable params: 0
_________________________________________________________________
None
dict_keys(['val_loss', 'loss'])
 33/120 [=======>......................] - ETA: 0s
/usr/local/lib/python3.6/dist-packages/matplotlib/cbook/deprecation.py:106: M
atplotlibDeprecationWarning: Adding an axes using the same arguments as a pre
vious axes currently reuses the earlier instance.  In a future version, a new
instance will always be created and returned.  Meanwhile, this warning can be
suppressed, and the future behavior ensured, by passing a unique label to eac
h axes instance.
  warnings.warn(message, mplDeprecation, stacklevel=1)
```

```
120/120 [==============================] - 1s 5ms/step
9/9 [==============================] - 0s 5ms/step
 in train MSE =  0.024
 in test MSE =  0.15435632602829072
_________________________________________________________________
Layer (type)                 Output Shape              Param #
=================================================================
lstm_5 (LSTM)                (None, 400)               643200
_________________________________________________________________
dropout_5 (Dropout)          (None, 400)               0
_________________________________________________________________
dense_5 (Dense)              (None, 1)                 401
=================================================================
Total params: 643,601
Trainable params: 643,601
Non-trainable params: 0
_________________________________________________________________
Inputs: (None, 19, 1)
Outputs: (None, 1)
Actual input: (9, 19, 1)
Actual output: (9, 1)
prediction data:
[-3.6984289]
y_test:
[[ 2.31]
 [-2.14]
 [ 1.22]
 [ 4.37]
 [ 1.75]
 [ 0.55]
 [ 1.43]
 [-0.36]
 [-0.58]]

/usr/local/lib/python3.6/dist-packages/matplotlib/cbook/deprecation.py:106: M
atplotlibDeprecationWarning: Adding an axes using the same arguments as a pre
vious axes currently reuses the earlier instance.  In a future version, a new
instance will always be created and returned.  Meanwhile, this warning can be
suppressed, and the future behavior ensured, by passing a unique label to eac
h axes instance.
  warnings.warn(message, mplDeprecation, stacklevel=1)
```





Epoch 600 Dollar Diff

The result of the 600 epoch model is very good at guessing wether or not the stock will either go up or down. What can be worked on is the maginitude of the

In [0]:
```
#------------------------------------------------------------- PLOT DOLLAR
 DIFFERENCE PREDICTIONS ------------------------------------------------------
-
plt.figure(3)
plt.plot( y_test, label="actual")
plt.plot(pred1, label="predictions")

print ("act_data:")
print (act_data)

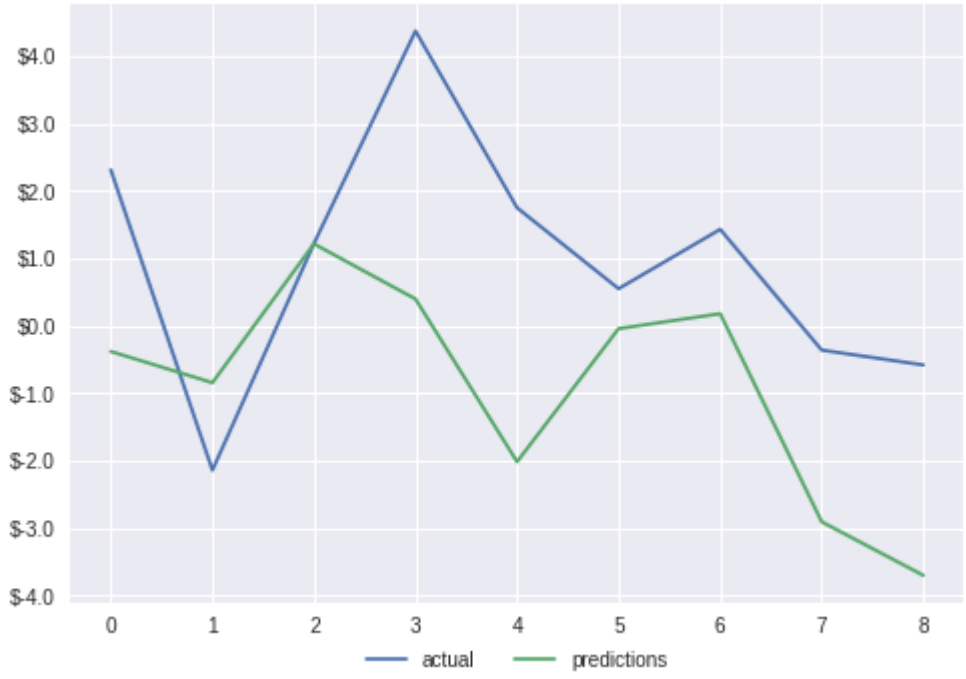
print ("pred1:")
print (pred1)

plt.legend(loc='upper center', bbox_to_anchor=(0.5, -0.05),
          fancybox=True, shadow=True, ncol=2)


fmt = '$%.1f'
tick = mtick.FormatStrFormatter(fmt)
ax = plt.axes()
ax.yaxis.set_major_formatter(tick)
```

```
act_data:
[ 2.31 -2.14  1.22  4.37  1.75  0.55  1.43 -0.36 -0.58]
pred1:
[[-0.38012436]
 [-0.8431242 ]
 [ 1.2144253 ]
 [ 0.39735392]
 [-2.0148365 ]
 [-0.0419422 ]
 [ 0.17976809]
 [-2.905558  ]
 [-3.6984289 ]]
```

```
/usr/local/lib/python3.6/dist-packages/matplotlib/cbook/deprecation.py:106: M
atplotlibDeprecationWarning: Adding an axes using the same arguments as a pre
vious axes currently reuses the earlier instance.  In a future version, a new
instance will always be created and returned.  Meanwhile, this warning can be
suppressed, and the future behavior ensured, by passing a unique label to eac
h axes instance.
  warnings.warn(message, mplDeprecation, stacklevel=1)
```



In [0]:
```
#------------------------------------------------------------ THIS IS FROM AN
 ONLINE SOURCE ------------------------------------------------------------
def moving_test_window_preds(n_future_preds):

    ''' n_future_preds - Represents the number of future predictions we want t
o make
                        This coincides with the number of windows that we wil
l <span id="IL_AD1" class="IL_AD">move</span> forward
                        on the test data
    '''
    preds_moving = []                                       # Store the predictio
n made on each test window
    moving_test_window = [x_test[0,:].tolist()]          # First test window
    moving_test_window = np.array(moving_test_window)

    for i in range(n_future_preds):


        preds_one_step = model.predict(moving_test_window)
        preds_moving.append(preds_one_step[0,0])

        preds_one_step = preds_one_step.reshape(1,1,1)
        moving_test_window = np.concatenate((moving_test_window[:,1:,:], preds
_one_step), axis=1) # new moving test window, where the first element from the
 window has been removed and the prediction  has been appended to the end


    print ("pred moving before scaling:")
    print (preds_moving)

    preds_moving = scaler_y.inverse_transform((np.array(preds_moving)).reshape
(-1, 1))

    print ("pred moving after scaling:")
    print (preds_moving)
    return preds_moving

print ("do moving test predictions for next 22 days:")
preds_moving = moving_test_window_preds(22)


count_correct=0
error =0
for i in range (len(y_test)):
    error=error + ((y_test[i]-preds_moving[i])**2) / y_test[i]


    if y_test[i] >=0 and preds_moving[i] >=0 :
        count_correct=count_correct+1
    if y_test[i] < 0 and preds_moving[i] < 0 :
        count_correct=count_correct+1

accuracy_in_change =  count_correct / (len(y_test) )
```

```
do moving test predictions for next 22 days:
pred moving before scaling:
[-0.14221746, -0.14260966, -0.10333696, -0.08771384, 0.098777495, 0.27547687,
0.044774383, -0.005140528, -0.5165703, -0.31980738, -0.19519708, -0.4927539,
-0.5463826, -0.51234764, -0.4077269, -0.25047028, -0.12200983, -0.033714864,
-0.07609961, -0.11213888, -0.19328405, -0.18431923]
pred moving after scaling:
[[-0.38012454]
 [-0.3826758 ]
 [-0.12720692]
 [-0.02557852]
 [ 1.1875477 ]
 [ 2.3369772 ]
 [ 0.83625734]
 [ 0.51156086]
 [-2.81529   ]
 [-1.535347  ]
 [-0.724757  ]
 [-2.660364  ]
 [-3.0092187 ]
 [-2.7878213 ]
 [-2.1072636 ]
 [-1.0843092 ]
 [-0.24867393]
 [ 0.32568482]
 [ 0.04997202]
 [-0.18446343]
 [-0.71231276]
 [-0.6539966 ]]
```

In [0]:
```
 # ---------------------------------------------------------- PLOT DIFFERENCE
D DATA ----------------------------------------------------------------------
---
plt.figure(4)
plt.title("Forecast vs Actual, (data is differenced)")
plt.plot(preds_moving, label="predictions")
plt.plot(y_test, label="actual")
plt.legend(loc='upper center', bbox_to_anchor=(0.5, -0.05),
          fancybox=True, shadow=True, ncol=2)


print ("accuracy_in_change:")
print (accuracy_in_change)

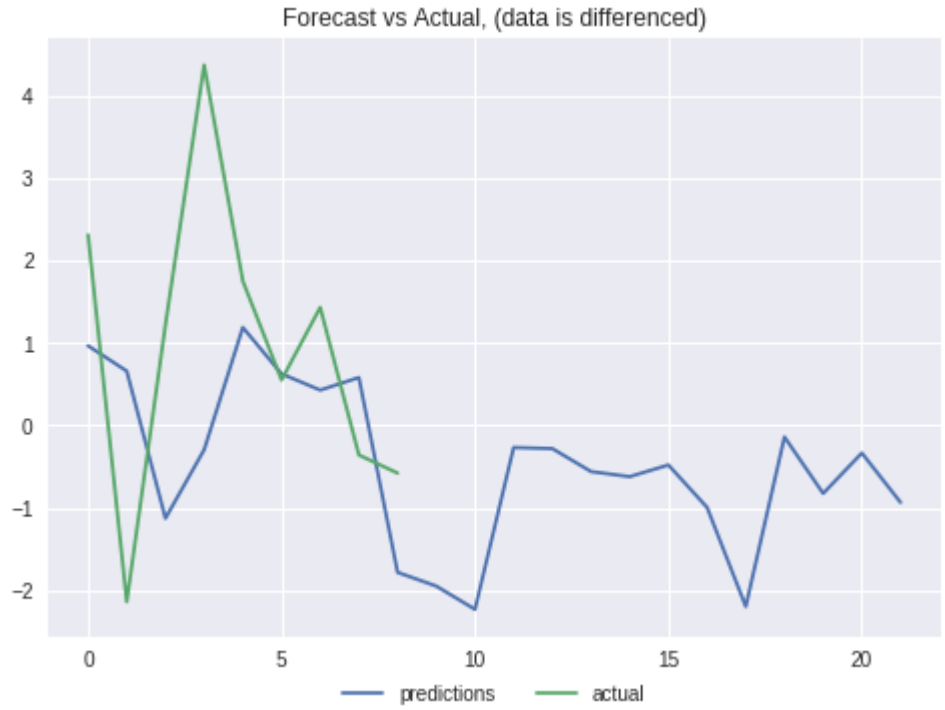
ind=data_original.index.values[0] + data_original.shape[0] -len(y_test)-1
prev_starting_price = data_original.loc[ind,"yt_"]
preds_moving_before_diff =  [0 for x in range(len(preds_moving))]

for i in range (len(preds_moving)):
    if (i==0):
        preds_moving_before_diff[i]=prev_starting_price + preds_moving[i]
    else:
        preds_moving_before_diff[i]=preds_moving_before_diff[i-1]+preds_moving
[i]

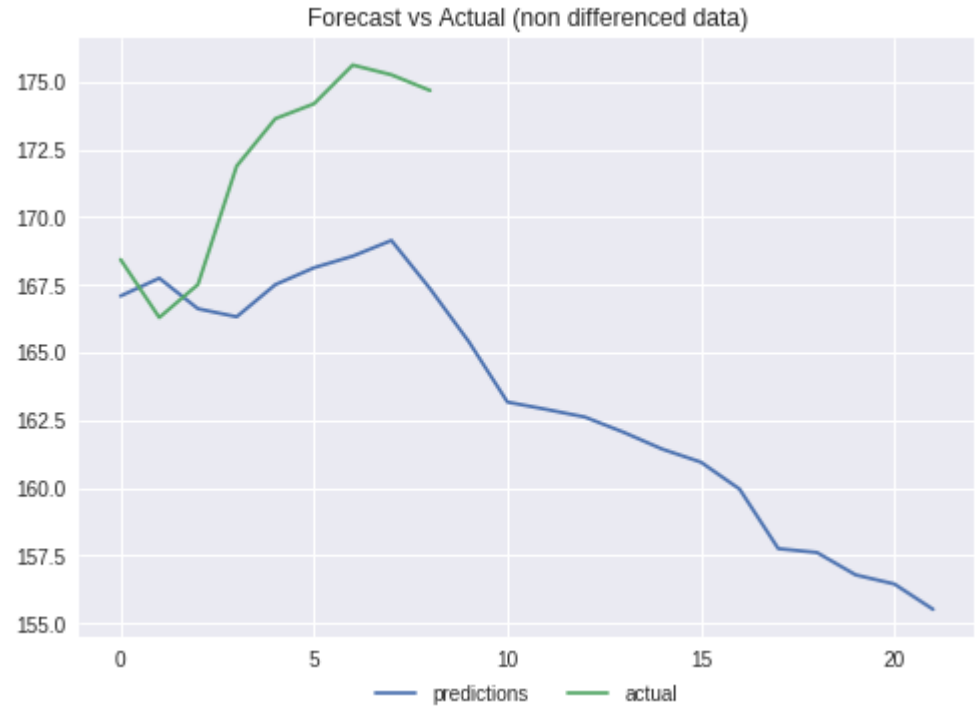

y_test_before_diff = [0 for x in range(len(y_test))]

for i in range (len(y_test)):
    if (i==0):
        y_test_before_diff[i]=prev_starting_price + y_test[i]
    else:
        y_test_before_diff[i]=y_test_before_diff[i-1]+y_test[i]
```

```
accuracy_in_change:
0.5555555555555556
```



In [0]:
```
 # ------------------------------------------------------------ PLOT NON D
IFFERENCED DATA ------------------------------------------------------------
-----
plt.figure(5)
plt.title("Forecast vs Actual (non differenced data)")
plt.plot(preds_moving_before_diff, label="predictions")
plt.plot(y_test_before_diff, label="actual")
plt.legend(loc='upper center', bbox_to_anchor=(0.5, -0.05),
          fancybox=True, shadow=True, ncol=2)
plt.show()
```



EPOCH 1000

The following shows how the model reacts when it is trained over 1000 epochs

In [0]:
```
import numpy as np
import pandas as pd
from sklearn import preprocessing

import matplotlib.pyplot as plt
import matplotlib.ticker as mtick

from keras.regularizers import L1L2

data_csv = pd.read_csv (fname)

#---------------------------------------------------------- ADJUSTABLE PARA
METERS ----------------------------------------------------------

#how many data we will use
# (should not be more than dataset length )
data_to_use= 150

# number of training data
# should be less than data_to_use
train_end =120

#---------------------------------------------------------- THIS IS FROM ONLIN
E SOURCES ----------------------------------------------------------


total_data=len(data_csv)

#most recent data is in the end
#so need offset
start=total_data - data_to_use


yt = data_csv.iloc [start:total_data ,4]    #Close price
yt_ = yt.shift (-1)

print (yt_)

data = pd.concat ([yt, yt_], axis =1)
data. columns = ['yt', 'yt_']


N=18
cols =['yt']
for i in range (N):

    data['yt'+str(i)] = list(yt.shift(i+1))
    cols.append ('yt'+str(i))

data = data.dropna()
data_original = data
data=data.diff()
data = data.dropna()


# target variable - closed price
```

```
# after shifting
y = data ['yt_']
x = data [cols]


scaler_x = preprocessing.MinMaxScaler ( feature_range =( -1, 1))
x = np. array (x).reshape ((len( x) ,len(cols)))
x = scaler_x.fit_transform (x)

scaler_y = preprocessing. MinMaxScaler ( feature_range =( -1, 1))
y = np.array (y).reshape ((len( y), 1))
y = scaler_y.fit_transform (y)


x_train = x [0: train_end,]
x_test = x[ train_end +1:len(x),]
y_train = y [0: train_end]
y_test = y[ train_end +1:len(y)]

x_train = x_train.reshape (x_train. shape + (1,))
x_test = x_test.reshape (x_test. shape + (1,))
```

```
8214    140.17
8215    139.42
8216    140.20
8217    139.57
8218    139.05
8219    140.79
8220    140.63
8221    141.98
8222    142.87
8223    142.02
8224    142.13
8225    141.99
8226    144.89
8227    145.81
8228    145.37
8229    144.84
8230    147.24
8231    151.24
8232    152.21
8233    151.49
8234    152.80
8235    154.93
8236    154.53
8237    154.31
8238    149.12
8239    151.40
8240    151.91
8241    152.84
8242    152.65
8243    152.19
         ...
8334    153.92
8335    152.93
8336    154.83
8337    154.74
8338    155.28
8339    155.34
8340    155.99
8341    155.44
8342    156.43
8343    159.31
8344    159.90
8345    159.19
8346    155.42
8347    155.69
8348    155.61
8349    156.54
8350    155.85
8351    156.85
8352    162.47
8353    166.12
8354    168.43
8355    166.29
8356    167.51
8357    171.88
8358    173.63
8359    174.18
```

```
8360    175.61
8361    175.25
8362    174.67
8363       NaN
Name: Close, Length: 150, dtype: float64
```

In [0]:
```
#-----------------------------------------MODEL BUILDING 1000-------------
-------------------------------------------------
from keras.models import Sequential
from keras.layers.core import Dense
from keras.layers.recurrent import LSTM
from keras.layers import  Dropout
from keras import optimizers

from numpy.random import seed
seed(1)
from tensorflow import set_random_seed
set_random_seed(2)

from keras import regularizers


model = Sequential ()
model.add (LSTM ( 400,  activation = 'relu', inner_activation = 'hard_sigmoid'
 , bias_regularizer=L1L2(l1=0.01, l2=0.01),  input_shape =(len(cols), 1), retu
rn_sequences = False ))
model.add(Dropout(0.3))
model.add (Dense (output_dim =1, activation = 'linear', activity_regularizer=r
egularizers.l1(0.01)))
adam=optimizers.Adam(lr=0.01, beta_1=0.89, beta_2=0.999, epsilon=None, decay=
0.0, amsgrad=True)
model.compile (loss ="mean_squared_error" , optimizer = "adam")
history=model.fit (x_train, y_train, batch_size =1, nb_epoch =1000, shuffle =
False, validation_split=0.15)


y_train_back=scaler_y.inverse_transform (np. array (y_train). reshape ((len( y
_train), 1)))
plt.figure(1)
plt.plot (y_train_back)
```

```
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:16: UserWarning:
Update your `LSTM` call to the Keras 2 API: `LSTM(400, activation="relu", bia
s_regularizer=<keras.reg..., input_shape=(19, 1), return_sequences=False, rec
urrent_activation="hard_sigmoid")`
  app.launch_new_instance()
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:18: UserWarning:
Update your `Dense` call to the Keras 2 API: `Dense(activation="linear", acti
vity_regularizer=<keras.reg..., units=1)`
/usr/local/lib/python3.6/dist-packages/ipykernel_launcher.py:21: UserWarning:
The `nb_epoch` argument in `fit` has been renamed `epochs`.
```

```
Train on 102 samples, validate on 18 samples
Epoch 1/1000
102/102 [==============================] - 8s 74ms/step - loss: 7.4998 - val_
loss: 6.9158
Epoch 2/1000
102/102 [==============================] - 6s 63ms/step - loss: 6.3869 - val_
loss: 5.8631
Epoch 3/1000
102/102 [==============================] - 6s 62ms/step - loss: 5.3893 - val_
loss: 4.9210
Epoch 4/1000
102/102 [==============================] - 6s 62ms/step - loss: 4.4972 - val_
loss: 4.0812
Epoch 5/1000
102/102 [==============================] - 6s 62ms/step - loss: 3.7037 - val_
loss: 3.3347
Epoch 6/1000
102/102 [==============================] - 6s 61ms/step - loss: 3.0006 - val_
loss: 2.6762
Epoch 7/1000
102/102 [==============================] - 6s 61ms/step - loss: 2.3822 - val_
loss: 2.0976
Epoch 8/1000
102/102 [==============================] - 6s 62ms/step - loss: 1.8402 - val_
loss: 1.5942
Epoch 9/1000
102/102 [==============================] - 6s 61ms/step - loss: 393.2056 - va
l_loss: 1.5128
Epoch 10/1000
102/102 [==============================] - 6s 62ms/step - loss: 1.4651 - val_
loss: 1.4510
Epoch 11/1000
102/102 [==============================] - 6s 64ms/step - loss: 1.4469 - val_
loss: 1.4384
Epoch 12/1000
102/102 [==============================] - 7s 64ms/step - loss: 1.4339 - val_
loss: 1.4272
Epoch 13/1000
102/102 [==============================] - 6s 63ms/step - loss: 1.4242 - val_
loss: 1.4184
Epoch 14/1000
102/102 [==============================] - 6s 63ms/step - loss: 1.4155 - val_
loss: 1.4119
Epoch 15/1000
102/102 [==============================] - 6s 63ms/step - loss: 1.4096 - val_
loss: 1.4061
Epoch 16/1000
102/102 [==============================] - 6s 62ms/step - loss: 1.4024 - val_
loss: 1.4009
Epoch 17/1000
102/102 [==============================] - 7s 66ms/step - loss: 1.3964 - val_
loss: 1.3960
Epoch 18/1000
102/102 [==============================] - 7s 67ms/step - loss: 1.3921 - val_
loss: 1.3914
Epoch 19/1000
102/102 [==============================] - 6s 62ms/step - loss: 1.3873 - val_
```

```
loss: 1.3860
Epoch 20/1000
102/102 [==============================] - 6s 64ms/step - loss: 1.3822 - val_
loss: 1.3815
Epoch 21/1000
102/102 [==============================] - 6s 63ms/step - loss: 1.3775 - val_
loss: 1.3771
Epoch 22/1000
102/102 [==============================] - 6s 63ms/step - loss: 1.3725 - val_
loss: 1.3729
Epoch 23/1000
102/102 [==============================] - 6s 63ms/step - loss: 1.3665 - val_
loss: 1.3688
Epoch 24/1000
102/102 [==============================] - 7s 64ms/step - loss: 1.3639 - val_
loss: 1.3639
Epoch 25/1000
102/102 [==============================] - 6s 63ms/step - loss: 1.3586 - val_
loss: 1.3594
Epoch 26/1000
102/102 [==============================] - 6s 63ms/step - loss: 1.3533 - val_
loss: 1.3553
Epoch 27/1000
102/102 [==============================] - 6s 63ms/step - loss: 1.3494 - val_
loss: 1.3510
Epoch 28/1000
102/102 [==============================] - 7s 70ms/step - loss: 1.3458 - val_
loss: 1.3461
Epoch 29/1000
102/102 [==============================] - 6s 64ms/step - loss: 1.3401 - val_
loss: 1.3418
Epoch 30/1000
102/102 [==============================] - 6s 63ms/step - loss: 1.3355 - val_
loss: 1.3376
Epoch 31/1000
102/102 [==============================] - 6s 63ms/step - loss: 1.3296 - val_
loss: 1.3333
Epoch 32/1000
102/102 [==============================] - 7s 64ms/step - loss: 1.3267 - val_
loss: 1.3285
Epoch 33/1000
102/102 [==============================] - 6s 64ms/step - loss: 1.3202 - val_
loss: 1.3237
Epoch 34/1000
102/102 [==============================] - 6s 63ms/step - loss: 1.3176 - val_
loss: 1.3191
Epoch 35/1000
102/102 [==============================] - 7s 64ms/step - loss: 1.3123 - val_
loss: 1.3142
Epoch 36/1000
102/102 [==============================] - 6s 64ms/step - loss: 1.3072 - val_
loss: 1.3092
Epoch 37/1000
102/102 [==============================] - 6s 63ms/step - loss: 1.3030 - val_
loss: 1.3038
Epoch 38/1000
102/102 [==============================] - 6s 64ms/step - loss: 1.2966 - val_
```

```
loss: 1.2985
Epoch 39/1000
102/102 [==============================] - 6s 63ms/step - loss: 1.2899 - val_
loss: 1.2932
Epoch 40/1000
102/102 [==============================] - 7s 64ms/step - loss: 1.2848 - val_
loss: 1.2877
Epoch 41/1000
102/102 [==============================] - 7s 64ms/step - loss: 1.2814 - val_
loss: 1.2815
Epoch 42/1000
102/102 [==============================] - 7s 64ms/step - loss: 1.2726 - val_
loss: 1.2757
Epoch 43/1000
102/102 [==============================] - 7s 64ms/step - loss: 1.2650 - val_
loss: 1.2702
Epoch 44/1000
102/102 [==============================] - 7s 65ms/step - loss: 1.2628 - val_
loss: 1.2632
Epoch 45/1000
102/102 [==============================] - 7s 65ms/step - loss: 1.2540 - val_
loss: 1.2564
Epoch 46/1000
102/102 [==============================] - 7s 64ms/step - loss: 1.2467 - val_
loss: 1.2497
Epoch 47/1000
102/102 [==============================] - 7s 64ms/step - loss: 1.2407 - val_
loss: 1.2421
Epoch 48/1000
102/102 [==============================] - 7s 64ms/step - loss: 1.2326 - val_
loss: 1.2348
Epoch 49/1000
102/102 [==============================] - 7s 65ms/step - loss: 1.2256 - val_
loss: 1.2271
Epoch 50/1000
102/102 [==============================] - 7s 64ms/step - loss: 1.2189 - val_
loss: 1.2192
Epoch 51/1000
102/102 [==============================] - 7s 64ms/step - loss: 1.2109 - val_
loss: 1.2110
Epoch 52/1000
102/102 [==============================] - 6s 63ms/step - loss: 1.2018 - val_
loss: 1.2027
Epoch 53/1000
102/102 [==============================] - 6s 63ms/step - loss: 1.1920 - val_
loss: 1.1942
Epoch 54/1000
102/102 [==============================] - 6s 64ms/step - loss: 1.1831 - val_
loss: 1.1857
Epoch 55/1000
102/102 [==============================] - 7s 64ms/step - loss: 1.1720 - val_
loss: 1.1777
Epoch 56/1000
102/102 [==============================] - 7s 64ms/step - loss: 1.1650 - val_
loss: 1.1692
Epoch 57/1000
102/102 [==============================] - 7s 64ms/step - loss: 1.1557 - val_
```

```
loss: 1.1609
Epoch 58/1000
102/102 [==============================] - 7s 65ms/step - loss: 1.1478 - val_
loss: 1.1520
Epoch 59/1000
102/102 [==============================] - 7s 65ms/step - loss: 1.1409 - val_
loss: 1.1427
Epoch 60/1000
102/102 [==============================] - 7s 64ms/step - loss: 1.1333 - val_
loss: 1.1340
Epoch 61/1000
102/102 [==============================] - 7s 65ms/step - loss: 1.1231 - val_
loss: 1.1254
Epoch 62/1000
102/102 [==============================] - 7s 65ms/step - loss: 1.1115 - val_
loss: 1.1172
Epoch 63/1000
102/102 [==============================] - 7s 64ms/step - loss: 1.1039 - val_
loss: 1.1072
Epoch 64/1000
102/102 [==============================] - 7s 66ms/step - loss: 1.0945 - val_
loss: 1.0972
Epoch 65/1000
102/102 [==============================] - 7s 68ms/step - loss: 1.0846 - val_
loss: 1.0879
Epoch 66/1000
102/102 [==============================] - 7s 64ms/step - loss: 1.0727 - val_
loss: 1.0780
Epoch 67/1000
102/102 [==============================] - 7s 64ms/step - loss: 1.0627 - val_
loss: 1.0663
Epoch 68/1000
102/102 [==============================] - 7s 64ms/step - loss: 1.0517 - val_
loss: 1.0567
Epoch 69/1000
102/102 [==============================] - 6s 64ms/step - loss: 1.0466 - val_
loss: 1.0451
Epoch 70/1000
102/102 [==============================] - 7s 64ms/step - loss: 1.0323 - val_
loss: 1.0338
Epoch 71/1000
102/102 [==============================] - 6s 64ms/step - loss: 1.0189 - val_
loss: 1.0217
Epoch 72/1000
102/102 [==============================] - 6s 63ms/step - loss: 1.0097 - val_
loss: 1.0098
Epoch 73/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.9955 - val_
loss: 0.9971
Epoch 74/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.9816 - val_
loss: 0.9878
Epoch 75/1000
102/102 [==============================] - 7s 69ms/step - loss: 0.9712 - val_
loss: 0.9738
Epoch 76/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.9577 - val_
```

```
loss: 0.9612
Epoch 77/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.9432 - val_
loss: 0.9483
Epoch 78/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.9355 - val_
loss: 0.9344
Epoch 79/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.9151 - val_
loss: 0.9219
Epoch 80/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.9033 - val_
loss: 0.9076
Epoch 81/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.8879 - val_
loss: 0.8949
Epoch 82/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.8784 - val_
loss: 0.8795
Epoch 83/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.8583 - val_
loss: 0.8681
Epoch 84/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.8460 - val_
loss: 0.8544
Epoch 85/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.8292 - val_
loss: 0.8398
Epoch 86/1000
102/102 [==============================] - 6s 63ms/step - loss: 10.1558 - val
_loss: 0.9280
Epoch 87/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.9259 - val_
loss: 0.9160
Epoch 88/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.9106 - val_
loss: 0.9031
Epoch 89/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.8970 - val_
loss: 0.8901
Epoch 90/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.8835 - val_
loss: 0.8769
Epoch 91/1000
102/102 [==============================] - 6s 62ms/step - loss: 0.8680 - val_
loss: 0.8641
Epoch 92/1000
102/102 [==============================] - 6s 62ms/step - loss: 0.8564 - val_
loss: 0.8516
Epoch 93/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.8454 - val_
loss: 0.8387
Epoch 94/1000
102/102 [==============================] - 6s 62ms/step - loss: 0.8314 - val_
loss: 0.8267
Epoch 95/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.8201 - val_
```

```
loss: 0.8154
Epoch 96/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.8082 - val_
loss: 0.8035
Epoch 97/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.7958 - val_
loss: 0.7919
Epoch 98/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.7835 - val_
loss: 0.7802
Epoch 99/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.7718 - val_
loss: 0.7687
Epoch 100/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.7606 - val_
loss: 0.7571
Epoch 101/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.7491 - val_
loss: 0.7454
Epoch 102/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.7385 - val_
loss: 0.7347
Epoch 103/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.7260 - val_
loss: 0.7232
Epoch 104/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.7158 - val_
loss: 0.7119
Epoch 105/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.7035 - val_
loss: 0.7003
Epoch 106/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.6915 - val_
loss: 0.6894
Epoch 107/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.6815 - val_
loss: 0.6783
Epoch 108/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.6717 - val_
loss: 0.6675
Epoch 109/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.6610 - val_
loss: 0.6567
Epoch 110/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.6482 - val_
loss: 0.6462
Epoch 111/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.6387 - val_
loss: 0.6362
Epoch 112/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.6266 - val_
loss: 0.6259
Epoch 113/1000
102/102 [==============================] - 7s 68ms/step - loss: 0.6169 - val_
loss: 0.6160
Epoch 114/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.6077 - val_
```

```
loss: 0.6067
Epoch 115/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.5954 - val_
loss: 0.5966
Epoch 116/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.5863 - val_
loss: 0.5867
Epoch 117/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.5778 - val_
loss: 0.5772
Epoch 118/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.5663 - val_
loss: 0.5676
Epoch 119/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.5573 - val_
loss: 0.5576
Epoch 120/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.5484 - val_
loss: 0.5481
Epoch 121/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.5352 - val_
loss: 0.5394
Epoch 122/1000
102/102 [==============================] - 7s 67ms/step - loss: 0.5278 - val_
loss: 0.5304
Epoch 123/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.5192 - val_
loss: 0.5205
Epoch 124/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.5126 - val_
loss: 0.5108
Epoch 125/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.5002 - val_
loss: 0.5027
Epoch 126/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.4950 - val_
loss: 0.4932
Epoch 127/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.4844 - val_
loss: 0.4849
Epoch 128/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.4756 - val_
loss: 0.4758
Epoch 129/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.4634 - val_
loss: 0.4690
Epoch 130/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.4559 - val_
loss: 0.4586
Epoch 131/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.4488 - val_
loss: 0.4503
Epoch 132/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.4391 - val_
loss: 0.4418
Epoch 133/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.4328 - val_
```

```
loss: 0.4336
Epoch 134/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.4234 - val_
loss: 0.4247
Epoch 135/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.4134 - val_
loss: 0.4160
Epoch 136/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.4082 - val_
loss: 0.4075
Epoch 137/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3974 - val_
loss: 0.4000
Epoch 138/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.3900 - val_
loss: 0.3909
Epoch 139/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3793 - val_
loss: 0.3825
Epoch 140/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3707 - val_
loss: 0.3741
Epoch 141/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.3637 - val_
loss: 0.3660
Epoch 142/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3511 - val_
loss: 0.3576
Epoch 143/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3433 - val_
loss: 0.3492
Epoch 144/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.3366 - val_
loss: 0.3433
Epoch 145/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3273 - val_
loss: 0.3354
Epoch 146/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3208 - val_
loss: 0.3276
Epoch 147/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3116 - val_
loss: 0.3192
Epoch 148/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3012 - val_
loss: 0.3133
Epoch 149/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.2949 - val_
loss: 0.3159
Epoch 150/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.2866 - val_
loss: 0.2962
Epoch 151/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.2785 - val_
loss: 0.2958
Epoch 152/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.2703 - val_
```

```
loss: 0.2799
Epoch 153/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.2666 - val_
loss: 0.2721
Epoch 154/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.2565 - val_
loss: 0.2714
Epoch 155/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.2693 - val_
loss: 0.2696
Epoch 156/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.2659 - val_
loss: 0.2574
Epoch 157/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.2537 - val_
loss: 0.2511
Epoch 158/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.2459 - val_
loss: 0.2445
Epoch 159/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.2382 - val_
loss: 0.2375
Epoch 160/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.2313 - val_
loss: 0.2305
Epoch 161/1000
102/102 [==============================] - 7s 68ms/step - loss: 0.2235 - val_
loss: 0.2241
Epoch 162/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.2146 - val_
loss: 0.2172
Epoch 163/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.2107 - val_
loss: 0.2106
Epoch 164/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.2040 - val_
loss: 0.2043
Epoch 165/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.1973 - val_
loss: 0.1984
Epoch 166/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.1907 - val_
loss: 0.1923
Epoch 167/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1841 - val_
loss: 0.1860
Epoch 168/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1781 - val_
loss: 0.1800
Epoch 169/1000
102/102 [==============================] - 7s 69ms/step - loss: 0.1716 - val_
loss: 0.1751
Epoch 170/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1662 - val_
loss: 0.1701
Epoch 171/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.1603 - val_
```

```
loss: 0.1649
Epoch 172/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1553 - val_
loss: 0.1609
Epoch 173/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1510 - val_
loss: 0.1569
Epoch 174/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.1471 - val_
loss: 0.1521
Epoch 175/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.1434 - val_
loss: 0.1482
Epoch 176/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1399 - val_
loss: 0.1439
Epoch 177/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1351 - val_
loss: 0.1404
Epoch 178/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1307 - val_
loss: 0.1375
Epoch 179/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.1257 - val_
loss: 0.1332
Epoch 180/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.1231 - val_
loss: 0.1292
Epoch 181/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1205 - val_
loss: 0.1276
Epoch 182/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.1181 - val_
loss: 0.1254
Epoch 183/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.1133 - val_
loss: 0.1245
Epoch 184/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.1083 - val_
loss: 0.1223
Epoch 185/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1148 - val_
loss: 0.1203
Epoch 186/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1107 - val_
loss: 0.1161
Epoch 187/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.1060 - val_
loss: 0.1170
Epoch 188/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1030 - val_
loss: 0.1152
Epoch 189/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0998 - val_
loss: 0.1153
Epoch 190/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0992 - val_
```

```
loss: 0.1159
Epoch 191/1000
102/102 [==============================] - 7s 64ms/step - loss: 39.7318 - val
_loss: 0.4710
Epoch 192/1000
102/102 [==============================] - 7s 65ms/step - loss: 12.1337 - val
_loss: 0.4321
Epoch 193/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.4415 - val_
loss: 0.4282
Epoch 194/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.4308 - val_
loss: 0.4278
Epoch 195/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.4241 - val_
loss: 0.4258
Epoch 196/1000
102/102 [==============================] - 7s 66ms/step - loss: 0.4222 - val_
loss: 0.4244
Epoch 197/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.4203 - val_
loss: 0.4215
Epoch 198/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.4196 - val_
loss: 0.4194
Epoch 199/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.4152 - val_
loss: 0.4184
Epoch 200/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.4154 - val_
loss: 0.4157
Epoch 201/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.4092 - val_
loss: 0.4139
Epoch 202/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.4093 - val_
loss: 0.4127
Epoch 203/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.4065 - val_
loss: 0.4105
Epoch 204/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.4074 - val_
loss: 0.4091
Epoch 205/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.4030 - val_
loss: 0.4067
Epoch 206/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.4009 - val_
loss: 0.4057
Epoch 207/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.4002 - val_
loss: 0.4034
Epoch 208/1000
102/102 [==============================] - 7s 69ms/step - loss: 0.3967 - val_
loss: 0.4015
Epoch 209/1000
102/102 [==============================] - 7s 66ms/step - loss: 0.3964 - val_
```

```
loss: 0.3996
Epoch 210/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3942 - val_
loss: 0.3982
Epoch 211/1000
102/102 [==============================] - 6s 62ms/step - loss: 0.3924 - val_
loss: 0.3968
Epoch 212/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3908 - val_
loss: 0.3957
Epoch 213/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3900 - val_
loss: 0.3935
Epoch 214/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.3913 - val_
loss: 0.3919
Epoch 215/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3858 - val_
loss: 0.3896
Epoch 216/1000
102/102 [==============================] - 7s 69ms/step - loss: 0.3851 - val_
loss: 0.3885
Epoch 217/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3809 - val_
loss: 0.3862
Epoch 218/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3836 - val_
loss: 0.3847
Epoch 219/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3774 - val_
loss: 0.3828
Epoch 220/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3733 - val_
loss: 0.3813
Epoch 221/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3775 - val_
loss: 0.3795
Epoch 222/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.3755 - val_
loss: 0.3769
Epoch 223/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3725 - val_
loss: 0.3751
Epoch 224/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.3674 - val_
loss: 0.3736
Epoch 225/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.3677 - val_
loss: 0.3708
Epoch 226/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3658 - val_
loss: 0.3688
Epoch 227/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3634 - val_
loss: 0.3668
Epoch 228/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3596 - val_
```

```
loss: 0.3642
Epoch 229/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3590 - val_
loss: 0.3621
Epoch 230/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3567 - val_
loss: 0.3600
Epoch 231/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3553 - val_
loss: 0.3580
Epoch 232/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3513 - val_
loss: 0.3554
Epoch 233/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.3475 - val_
loss: 0.3536
Epoch 234/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.3476 - val_
loss: 0.3510
Epoch 235/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3445 - val_
loss: 0.3484
Epoch 236/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3421 - val_
loss: 0.3459
Epoch 237/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3361 - val_
loss: 0.3441
Epoch 238/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3376 - val_
loss: 0.3410
Epoch 239/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3335 - val_
loss: 0.3381
Epoch 240/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3321 - val_
loss: 0.3356
Epoch 241/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3286 - val_
loss: 0.3330
Epoch 242/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3266 - val_
loss: 0.3300
Epoch 243/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3226 - val_
loss: 0.3272
Epoch 244/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3204 - val_
loss: 0.3241
Epoch 245/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3190 - val_
loss: 0.3216
Epoch 246/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3140 - val_
loss: 0.3178
Epoch 247/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3114 - val_
```

```
loss: 0.3147
Epoch 248/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3052 - val_
loss: 0.3122
Epoch 249/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3042 - val_
loss: 0.3095
Epoch 250/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3001 - val_
loss: 0.3049
Epoch 251/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.2956 - val_
loss: 0.3024
Epoch 252/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.2947 - val_
loss: 0.2989
Epoch 253/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.2907 - val_
loss: 0.2953
Epoch 254/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.2872 - val_
loss: 0.2914
Epoch 255/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.2828 - val_
loss: 0.2888
Epoch 256/1000
102/102 [==============================] - 7s 67ms/step - loss: 0.2768 - val_
loss: 0.2853
Epoch 257/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.2712 - val_
loss: 0.2822
Epoch 258/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.2712 - val_
loss: 0.2793
Epoch 259/1000
102/102 [==============================] - 6s 63ms/step - loss: 7.2377 - val_
loss: 0.4266
Epoch 260/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.4142 - val_
loss: 0.4160
Epoch 261/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.4077 - val_
loss: 0.4072
Epoch 262/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.4004 - val_
loss: 0.4013
Epoch 263/1000
102/102 [==============================] - 7s 68ms/step - loss: 0.3921 - val_
loss: 0.3950
Epoch 264/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3888 - val_
loss: 0.3889
Epoch 265/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3805 - val_
loss: 0.3833
Epoch 266/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.3773 - val_
```

```
loss: 0.3786
Epoch 267/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3714 - val_
loss: 0.3732
Epoch 268/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3656 - val_
loss: 0.3685
Epoch 269/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3623 - val_
loss: 0.3639
Epoch 270/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.3562 - val_
loss: 0.3593
Epoch 271/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3507 - val_
loss: 0.3554
Epoch 272/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3470 - val_
loss: 0.3499
Epoch 273/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3431 - val_
loss: 0.3457
Epoch 274/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3387 - val_
loss: 0.3415
Epoch 275/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3352 - val_
loss: 0.3372
Epoch 276/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.3298 - val_
loss: 0.3334
Epoch 277/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3251 - val_
loss: 0.3291
Epoch 278/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.3216 - val_
loss: 0.3245
Epoch 279/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3164 - val_
loss: 0.3205
Epoch 280/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3124 - val_
loss: 0.3166
Epoch 281/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.3099 - val_
loss: 0.3125
Epoch 282/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3058 - val_
loss: 0.3089
Epoch 283/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.3022 - val_
loss: 0.3059
Epoch 284/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.2983 - val_
loss: 0.3023
Epoch 285/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.2965 - val_
```

```
loss: 0.2988
Epoch 286/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.2916 - val_
loss: 0.2945
Epoch 287/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.2898 - val_
loss: 0.2922
Epoch 288/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.2856 - val_
loss: 0.2888
Epoch 289/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.2830 - val_
loss: 0.2845
Epoch 290/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.2804 - val_
loss: 0.2812
Epoch 291/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.2751 - val_
loss: 0.2755
Epoch 292/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.2744 - val_
loss: 0.2721
Epoch 293/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.2662 - val_
loss: 0.2666
Epoch 294/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.2681 - val_
loss: 0.2641
Epoch 295/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.2623 - val_
loss: 0.2607
Epoch 296/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.2571 - val_
loss: 0.2600
Epoch 297/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.2572 - val_
loss: 0.2560
Epoch 298/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.2529 - val_
loss: 0.2539
Epoch 299/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.2503 - val_
loss: 0.2505
Epoch 300/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.2454 - val_
loss: 0.2506
Epoch 301/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.2424 - val_
loss: 0.2562
Epoch 302/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.2447 - val_
loss: 0.2454
Epoch 303/1000
102/102 [==============================] - 7s 67ms/step - loss: 0.2372 - val_
loss: 0.2455
Epoch 304/1000
102/102 [==============================] - 7s 70ms/step - loss: 0.2324 - val_
```

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loss: 0.2407
Epoch 305/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.2294 - val_
loss: 0.2398
Epoch 306/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.2294 - val_
loss: 0.2390
Epoch 307/1000
102/102 [==============================] - 7s 66ms/step - loss: 0.2257 - val_
loss: 0.2422
Epoch 308/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.2326 - val_
loss: 0.2379
Epoch 309/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.2266 - val_
loss: 0.2300
Epoch 310/1000
102/102 [==============================] - 7s 68ms/step - loss: 0.2158 - val_
loss: 0.2285
Epoch 311/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.2105 - val_
loss: 0.2240
Epoch 312/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.2205 - val_
loss: 0.2287
Epoch 313/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.2235 - val_
loss: 0.2245
Epoch 314/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.2136 - val_
loss: 0.2189
Epoch 315/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.2035 - val_
loss: 0.2162
Epoch 316/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.1982 - val_
loss: 0.2151
Epoch 317/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1906 - val_
loss: 0.2186
Epoch 318/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1856 - val_
loss: 0.2150
Epoch 319/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.1865 - val_
loss: 0.2277
Epoch 320/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1944 - val_
loss: 0.2147
Epoch 321/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1950 - val_
loss: 0.2016
Epoch 322/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.1792 - val_
loss: 0.2073
Epoch 323/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1698 - val_
```

```
loss: 0.2075
Epoch 324/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.1775 - val_
loss: 0.2136
Epoch 325/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1998 - val_
loss: 0.2032
Epoch 326/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1844 - val_
loss: 0.1964
Epoch 327/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.1754 - val_
loss: 0.1990
Epoch 328/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1618 - val_
loss: 0.1859
Epoch 329/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1547 - val_
loss: 0.1912
Epoch 330/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.1493 - val_
loss: 0.1868
Epoch 331/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.1483 - val_
loss: 0.1904
Epoch 332/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.1553 - val_
loss: 0.2163
Epoch 333/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1522 - val_
loss: 0.1884
Epoch 334/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1569 - val_
loss: 0.2068
Epoch 335/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.1531 - val_
loss: 0.1752
Epoch 336/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1478 - val_
loss: 0.1832
Epoch 337/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.1353 - val_
loss: 0.1718
Epoch 338/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.1355 - val_
loss: 0.1798
Epoch 339/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.1328 - val_
loss: 0.1706
Epoch 340/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.1365 - val_
loss: 0.1821
Epoch 341/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1252 - val_
loss: 0.1803
Epoch 342/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.1213 - val_
```

```
loss: 0.1767
Epoch 343/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.1199 - val_
loss: 0.1606
Epoch 344/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.1179 - val_
loss: 0.1937
Epoch 345/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.1157 - val_
loss: 0.1553
Epoch 346/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.1191 - val_
loss: 0.1666
Epoch 347/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1107 - val_
loss: 0.1621
Epoch 348/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1059 - val_
loss: 0.1611
Epoch 349/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.1044 - val_
loss: 0.1559
Epoch 350/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.1007 - val_
loss: 0.1701
Epoch 351/1000
102/102 [==============================] - 7s 70ms/step - loss: 0.1140 - val_
loss: 0.1611
Epoch 352/1000
102/102 [==============================] - 7s 66ms/step - loss: 0.1505 - val_
loss: 0.1430
Epoch 353/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1317 - val_
loss: 0.1378
Epoch 354/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.1191 - val_
loss: 0.1321
Epoch 355/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1121 - val_
loss: 0.1308
Epoch 356/1000
102/102 [==============================] - 7s 68ms/step - loss: 0.1072 - val_
loss: 0.1248
Epoch 357/1000
102/102 [==============================] - 7s 66ms/step - loss: 0.1019 - val_
loss: 0.1187
Epoch 358/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0972 - val_
loss: 0.1409
Epoch 359/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1066 - val_
loss: 0.1479
Epoch 360/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1209 - val_
loss: 0.1332
Epoch 361/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.1003 - val_
```

```
loss: 0.1413
Epoch 362/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0807 - val_
loss: 0.1312
Epoch 363/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0831 - val_
loss: 0.1498
Epoch 364/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0905 - val_
loss: 0.1575
Epoch 365/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0838 - val_
loss: 0.1445
Epoch 366/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0916 - val_
loss: 0.1440
Epoch 367/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0921 - val_
loss: 0.1476
Epoch 368/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0879 - val_
loss: 0.1464
Epoch 369/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0691 - val_
loss: 0.1591
Epoch 370/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0727 - val_
loss: 0.1752
Epoch 371/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0654 - val_
loss: 0.1505
Epoch 372/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0640 - val_
loss: 0.1484
Epoch 373/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0637 - val_
loss: 0.1367
Epoch 374/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0676 - val_
loss: 0.2019
Epoch 375/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0812 - val_
loss: 0.1442
Epoch 376/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0831 - val_
loss: 0.1274
Epoch 377/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0838 - val_
loss: 0.1538
Epoch 378/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0870 - val_
loss: 0.1223
Epoch 379/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0644 - val_
loss: 0.1364
Epoch 380/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0602 - val_
```

```
loss: 0.1393
Epoch 381/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0533 - val_
loss: 0.1366
Epoch 382/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0582 - val_
loss: 0.1428
Epoch 383/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0579 - val_
loss: 0.1283
Epoch 384/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0692 - val_
loss: 0.1198
Epoch 385/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0991 - val_
loss: 0.1446
Epoch 386/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.1292 - val_
loss: 0.1226
Epoch 387/1000
102/102 [==============================] - 7s 67ms/step - loss: 0.1036 - val_
loss: 0.1138
Epoch 388/1000
102/102 [==============================] - 7s 66ms/step - loss: 0.0867 - val_
loss: 0.1024
Epoch 389/1000
102/102 [==============================] - 7s 66ms/step - loss: 0.0816 - val_
loss: 0.1092
Epoch 390/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0682 - val_
loss: 0.0975
Epoch 391/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0590 - val_
loss: 0.1042
Epoch 392/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0879 - val_
loss: 0.1289
Epoch 393/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0994 - val_
loss: 0.1012
Epoch 394/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0885 - val_
loss: 0.1011
Epoch 395/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0805 - val_
loss: 0.1007
Epoch 396/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0709 - val_
loss: 0.0997
Epoch 397/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0622 - val_
loss: 0.1097
Epoch 398/1000
102/102 [==============================] - 7s 70ms/step - loss: 0.0669 - val_
loss: 0.1002
Epoch 399/1000
102/102 [==============================] - 7s 67ms/step - loss: 0.0695 - val_
```

```
loss: 0.1034
Epoch 400/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0534 - val_
loss: 0.1071
Epoch 401/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0478 - val_
loss: 0.1151
Epoch 402/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0581 - val_
loss: 0.0986
Epoch 403/1000
102/102 [==============================] - 7s 68ms/step - loss: 0.0643 - val_
loss: 0.0991
Epoch 404/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0613 - val_
loss: 0.1303
Epoch 405/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0450 - val_
loss: 0.1153
Epoch 406/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.4592 - val_
loss: 0.3127
Epoch 407/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.2741 - val_
loss: 0.2537
Epoch 408/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.2414 - val_
loss: 0.2328
Epoch 409/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.2244 - val_
loss: 0.2182
Epoch 410/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.2091 - val_
loss: 0.2070
Epoch 411/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1973 - val_
loss: 0.1981
Epoch 412/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.1883 - val_
loss: 0.1898
Epoch 413/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.1812 - val_
loss: 0.1836
Epoch 414/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.1779 - val_
loss: 0.1787
Epoch 415/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.1687 - val_
loss: 0.1733
Epoch 416/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.1604 - val_
loss: 0.1677
Epoch 417/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1609 - val_
loss: 0.1638
Epoch 418/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.1551 - val_
```

```
loss: 0.1607
Epoch 419/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.1486 - val_
loss: 0.1576
Epoch 420/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1473 - val_
loss: 0.1544
Epoch 421/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1435 - val_
loss: 0.1519
Epoch 422/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1399 - val_
loss: 0.1498
Epoch 423/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1365 - val_
loss: 0.1504
Epoch 424/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.1337 - val_
loss: 0.1478
Epoch 425/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.1281 - val_
loss: 0.1445
Epoch 426/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1245 - val_
loss: 0.1421
Epoch 427/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1235 - val_
loss: 0.1497
Epoch 428/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1207 - val_
loss: 0.1469
Epoch 429/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.1167 - val_
loss: 0.1419
Epoch 430/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.1109 - val_
loss: 0.1438
Epoch 431/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.1086 - val_
loss: 0.1421
Epoch 432/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.1055 - val_
loss: 0.1560
Epoch 433/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1044 - val_
loss: 0.1437
Epoch 434/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0953 - val_
loss: 0.1579
Epoch 435/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0996 - val_
loss: 0.1673
Epoch 436/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0937 - val_
loss: 0.1688
Epoch 437/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1052 - val_
```

```
loss: 0.1270
Epoch 438/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0893 - val_
loss: 0.1429
Epoch 439/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.1002 - val_
loss: 0.1310
Epoch 440/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0803 - val_
loss: 0.1433
Epoch 441/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0763 - val_
loss: 0.1318
Epoch 442/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0716 - val_
loss: 0.1367
Epoch 443/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0709 - val_
loss: 0.1341
Epoch 444/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0733 - val_
loss: 0.1433
Epoch 445/1000
102/102 [==============================] - 7s 67ms/step - loss: 0.0752 - val_
loss: 0.1247
Epoch 446/1000
102/102 [==============================] - 7s 69ms/step - loss: 0.0714 - val_
loss: 0.1455
Epoch 447/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0714 - val_
loss: 0.1410
Epoch 448/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0672 - val_
loss: 0.1449
Epoch 449/1000
102/102 [==============================] - 7s 67ms/step - loss: 0.0609 - val_
loss: 0.1366
Epoch 450/1000
102/102 [==============================] - 7s 66ms/step - loss: 0.0607 - val_
loss: 0.1413
Epoch 451/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0530 - val_
loss: 0.1435
Epoch 452/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0576 - val_
loss: 0.1335
Epoch 453/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0594 - val_
loss: 0.1513
Epoch 454/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0509 - val_
loss: 0.1195
Epoch 455/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0621 - val_
loss: 0.1447
Epoch 456/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0513 - val_
```

```
loss: 0.1370
Epoch 457/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0483 - val_
loss: 0.1129
Epoch 458/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0455 - val_
loss: 0.1183
Epoch 459/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0542 - val_
loss: 0.1438
Epoch 460/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0554 - val_
loss: 0.1486
Epoch 461/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0545 - val_
loss: 0.1462
Epoch 462/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0517 - val_
loss: 0.1121
Epoch 463/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0400 - val_
loss: 0.1295
Epoch 464/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0350 - val_
loss: 0.1161
Epoch 465/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0338 - val_
loss: 0.1428
Epoch 466/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0373 - val_
loss: 0.1276
Epoch 467/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0412 - val_
loss: 0.1354
Epoch 468/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0430 - val_
loss: 0.1368
Epoch 469/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0339 - val_
loss: 0.1289
Epoch 470/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0316 - val_
loss: 0.1087
Epoch 471/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0341 - val_
loss: 0.1291
Epoch 472/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0326 - val_
loss: 0.1346
Epoch 473/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0266 - val_
loss: 0.1231
Epoch 474/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0352 - val_
loss: 0.1605
Epoch 475/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0575 - val_
```

```
loss: 0.1298
Epoch 476/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0554 - val_
loss: 0.1464
Epoch 477/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0436 - val_
loss: 0.1291
Epoch 478/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0308 - val_
loss: 0.1589
Epoch 479/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0279 - val_
loss: 0.1462
Epoch 480/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0245 - val_
loss: 0.1364
Epoch 481/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0223 - val_
loss: 0.1362
Epoch 482/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0292 - val_
loss: 0.1563
Epoch 483/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0272 - val_
loss: 0.1419
Epoch 484/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0234 - val_
loss: 0.1416
Epoch 485/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0301 - val_
loss: 0.1313
Epoch 486/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0263 - val_
loss: 0.1450
Epoch 487/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0315 - val_
loss: 0.1300
Epoch 488/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0317 - val_
loss: 0.1158
Epoch 489/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0271 - val_
loss: 0.1409
Epoch 490/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0357 - val_
loss: 0.1196
Epoch 491/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0202 - val_
loss: 0.1613
Epoch 492/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0174 - val_
loss: 0.1398
Epoch 493/1000
102/102 [==============================] - 7s 70ms/step - loss: 0.0236 - val_
loss: 0.1437
Epoch 494/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0327 - val_
```

```
loss: 0.1813
Epoch 495/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0386 - val_
loss: 0.1294
Epoch 496/1000
102/102 [==============================] - 7s 69ms/step - loss: 0.0247 - val_
loss: 0.1425
Epoch 497/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0230 - val_
loss: 0.1295
Epoch 498/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0256 - val_
loss: 0.1230
Epoch 499/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0273 - val_
loss: 0.1257
Epoch 500/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0337 - val_
loss: 0.1409
Epoch 501/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0328 - val_
loss: 0.1332
Epoch 502/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0526 - val_
loss: 0.1238
Epoch 503/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0369 - val_
loss: 0.1490
Epoch 504/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0304 - val_
loss: 0.1079
Epoch 505/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0206 - val_
loss: 0.1190
Epoch 506/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0414 - val_
loss: 0.1305
Epoch 507/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0282 - val_
loss: 0.1385
Epoch 508/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0204 - val_
loss: 0.1272
Epoch 509/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0265 - val_
loss: 0.1302
Epoch 510/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0232 - val_
loss: 0.1086
Epoch 511/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0161 - val_
loss: 0.1352
Epoch 512/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0136 - val_
loss: 0.1274
Epoch 513/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0137 - val_
```

```
loss: 0.1226
Epoch 514/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0154 - val_
loss: 0.1187
Epoch 515/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0488 - val_
loss: 0.1375
Epoch 516/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0317 - val_
loss: 0.1620
Epoch 517/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0247 - val_
loss: 0.1275
Epoch 518/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0216 - val_
loss: 0.1561
Epoch 519/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0188 - val_
loss: 0.1173
Epoch 520/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0229 - val_
loss: 0.1519
Epoch 521/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0218 - val_
loss: 0.1294
Epoch 522/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0183 - val_
loss: 0.1251
Epoch 523/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0155 - val_
loss: 0.1166
Epoch 524/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0163 - val_
loss: 0.1393
Epoch 525/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0134 - val_
loss: 0.1300
Epoch 526/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0122 - val_
loss: 0.1231
Epoch 527/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0140 - val_
loss: 0.1290
Epoch 528/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0156 - val_
loss: 0.1254
Epoch 529/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0140 - val_
loss: 0.1632
Epoch 530/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0227 - val_
loss: 0.1196
Epoch 531/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0197 - val_
loss: 0.1275
Epoch 532/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0176 - val_
```

```
loss: 0.1171
Epoch 533/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0140 - val_
loss: 0.1316
Epoch 534/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0147 - val_
loss: 0.1268
Epoch 535/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0235 - val_
loss: 0.1142
Epoch 536/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0217 - val_
loss: 0.1279
Epoch 537/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0380 - val_
loss: 0.1195
Epoch 538/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0619 - val_
loss: 0.1430
Epoch 539/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0433 - val_
loss: 0.1313
Epoch 540/1000
102/102 [==============================] - 7s 68ms/step - loss: 0.0383 - val_
loss: 0.1453
Epoch 541/1000
102/102 [==============================] - 7s 68ms/step - loss: 0.0230 - val_
loss: 0.1433
Epoch 542/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0194 - val_
loss: 0.1205
Epoch 543/1000
102/102 [==============================] - 7s 69ms/step - loss: 0.0161 - val_
loss: 0.1255
Epoch 544/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0165 - val_
loss: 0.1081
Epoch 545/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0157 - val_
loss: 0.1204
Epoch 546/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0122 - val_
loss: 0.1251
Epoch 547/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0143 - val_
loss: 0.1480
Epoch 548/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0111 - val_
loss: 0.1079
Epoch 549/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0155 - val_
loss: 0.1216
Epoch 550/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0133 - val_
loss: 0.1286
Epoch 551/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0216 - val_
```

```
loss: 0.1103
Epoch 552/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0135 - val_
loss: 0.1139
Epoch 553/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0156 - val_
loss: 0.1200
Epoch 554/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0184 - val_
loss: 0.1103
Epoch 555/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0212 - val_
loss: 0.1133
Epoch 556/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0165 - val_
loss: 0.1114
Epoch 557/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0138 - val_
loss: 0.1140
Epoch 558/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0220 - val_
loss: 0.1140
Epoch 559/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0153 - val_
loss: 0.1127
Epoch 560/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0173 - val_
loss: 0.1061
Epoch 561/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0159 - val_
loss: 0.1238
Epoch 562/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0128 - val_
loss: 0.1088
Epoch 563/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0141 - val_
loss: 0.1224
Epoch 564/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0150 - val_
loss: 0.1054
Epoch 565/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0114 - val_
loss: 0.1223
Epoch 566/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0172 - val_
loss: 0.1162
Epoch 567/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0142 - val_
loss: 0.1120
Epoch 568/1000
102/102 [==============================] - 6s 62ms/step - loss: 0.0139 - val_
loss: 0.1174
Epoch 569/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0219 - val_
loss: 0.1308
Epoch 570/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0146 - val_
```

```
loss: 0.1152
Epoch 571/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0215 - val_
loss: 0.1431
Epoch 572/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0203 - val_
loss: 0.1160
Epoch 573/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0204 - val_
loss: 0.1006
Epoch 574/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0286 - val_
loss: 0.1193
Epoch 575/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0449 - val_
loss: 0.1633
Epoch 576/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0550 - val_
loss: 0.1291
Epoch 577/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0371 - val_
loss: 0.1421
Epoch 578/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0183 - val_
loss: 0.1199
Epoch 579/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0133 - val_
loss: 0.1246
Epoch 580/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0123 - val_
loss: 0.1080
Epoch 581/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0144 - val_
loss: 0.1140
Epoch 582/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0123 - val_
loss: 0.1199
Epoch 583/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0128 - val_
loss: 0.1181
Epoch 584/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0099 - val_
loss: 0.1228
Epoch 585/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0080 - val_
loss: 0.1248
Epoch 586/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0107 - val_
loss: 0.1213
Epoch 587/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0097 - val_
loss: 0.1246
Epoch 588/1000
102/102 [==============================] - 7s 68ms/step - loss: 0.0119 - val_
loss: 0.1329
Epoch 589/1000
102/102 [==============================] - 7s 66ms/step - loss: 0.0108 - val_
```

```
loss: 0.1271
Epoch 590/1000
102/102 [==============================] - 7s 68ms/step - loss: 0.0107 - val_
loss: 0.1159
Epoch 591/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0084 - val_
loss: 0.1110
Epoch 592/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0098 - val_
loss: 0.1487
Epoch 593/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0121 - val_
loss: 0.1124
Epoch 594/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0136 - val_
loss: 0.1182
Epoch 595/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0126 - val_
loss: 0.1204
Epoch 596/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0097 - val_
loss: 0.1146
Epoch 597/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0094 - val_
loss: 0.1201
Epoch 598/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0135 - val_
loss: 0.1178
Epoch 599/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0130 - val_
loss: 0.1125
Epoch 600/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0123 - val_
loss: 0.1016
Epoch 601/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0151 - val_
loss: 0.1135
Epoch 602/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0153 - val_
loss: 0.1286
Epoch 603/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0151 - val_
loss: 0.1125
Epoch 604/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0139 - val_
loss: 0.1161
Epoch 605/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0140 - val_
loss: 0.1091
Epoch 606/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0128 - val_
loss: 0.1223
Epoch 607/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0124 - val_
loss: 0.1127
Epoch 608/1000
102/102 [==============================] - 6s 62ms/step - loss: 0.0099 - val_
```

```
loss: 0.1254
Epoch 609/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0127 - val_
loss: 0.0954
Epoch 610/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0110 - val_
loss: 0.1126
Epoch 611/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0104 - val_
loss: 0.1059
Epoch 612/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0224 - val_
loss: 0.1189
Epoch 613/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0213 - val_
loss: 0.1230
Epoch 614/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0149 - val_
loss: 0.1097
Epoch 615/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0149 - val_
loss: 0.0982
Epoch 616/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0183 - val_
loss: 0.1194
Epoch 617/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0128 - val_
loss: 0.1093
Epoch 618/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0109 - val_
loss: 0.1154
Epoch 619/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0264 - val_
loss: 0.1113
Epoch 620/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0230 - val_
loss: 0.1122
Epoch 621/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0148 - val_
loss: 0.1078
Epoch 622/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0668 - val_
loss: 0.1129
Epoch 623/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0347 - val_
loss: 0.1112
Epoch 624/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0227 - val_
loss: 0.1050
Epoch 625/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0145 - val_
loss: 0.1070
Epoch 626/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0106 - val_
loss: 0.1211
Epoch 627/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0095 - val_
```

```
loss: 0.1093
Epoch 628/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0082 - val_
loss: 0.1124
Epoch 629/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0099 - val_
loss: 0.1052
Epoch 630/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0074 - val_
loss: 0.1005
Epoch 631/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0085 - val_
loss: 0.1009
Epoch 632/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0085 - val_
loss: 0.1010
Epoch 633/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0088 - val_
loss: 0.1004
Epoch 634/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0093 - val_
loss: 0.0997
Epoch 635/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0088 - val_
loss: 0.1052
Epoch 636/1000
102/102 [==============================] - 7s 70ms/step - loss: 0.0079 - val_
loss: 0.1042
Epoch 637/1000
102/102 [==============================] - 7s 72ms/step - loss: 0.0097 - val_
loss: 0.0984
Epoch 638/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0086 - val_
loss: 0.0972
Epoch 639/1000
102/102 [==============================] - 6s 62ms/step - loss: 0.0085 - val_
loss: 0.0972
Epoch 640/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0088 - val_
loss: 0.0981
Epoch 641/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0088 - val_
loss: 0.0939
Epoch 642/1000
102/102 [==============================] - 6s 62ms/step - loss: 0.0089 - val_
loss: 0.1055
Epoch 643/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0097 - val_
loss: 0.0997
Epoch 644/1000
102/102 [==============================] - 6s 62ms/step - loss: 0.0096 - val_
loss: 0.1011
Epoch 645/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0083 - val_
loss: 0.1055
Epoch 646/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0095 - val_
```

```
loss: 0.0981
Epoch 647/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0097 - val_
loss: 0.0990
Epoch 648/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0101 - val_
loss: 0.1050
Epoch 649/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0112 - val_
loss: 0.0975
Epoch 650/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0099 - val_
loss: 0.1093
Epoch 651/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0097 - val_
loss: 0.0946
Epoch 652/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0089 - val_
loss: 0.1028
Epoch 653/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0151 - val_
loss: 0.1109
Epoch 654/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0126 - val_
loss: 0.1055
Epoch 655/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0101 - val_
loss: 0.1046
Epoch 656/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0112 - val_
loss: 0.0999
Epoch 657/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0113 - val_
loss: 0.1002
Epoch 658/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0110 - val_
loss: 0.1074
Epoch 659/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0126 - val_
loss: 0.1060
Epoch 660/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0230 - val_
loss: 0.1462
Epoch 661/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0261 - val_
loss: 0.1151
Epoch 662/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0165 - val_
loss: 0.1131
Epoch 663/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0177 - val_
loss: 0.1096
Epoch 664/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0151 - val_
loss: 0.1160
Epoch 665/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0113 - val_
```

```
loss: 0.1020
Epoch 666/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0091 - val_
loss: 0.1005
Epoch 667/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0102 - val_
loss: 0.0924
Epoch 668/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0122 - val_
loss: 0.1074
Epoch 669/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0078 - val_
loss: 0.0991
Epoch 670/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0086 - val_
loss: 0.1161
Epoch 671/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0085 - val_
loss: 0.1019
Epoch 672/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0088 - val_
loss: 0.1056
Epoch 673/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0103 - val_
loss: 0.1052
Epoch 674/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0108 - val_
loss: 0.1070
Epoch 675/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0078 - val_
loss: 0.1088
Epoch 676/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0101 - val_
loss: 0.1082
Epoch 677/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0081 - val_
loss: 0.0988
Epoch 678/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0082 - val_
loss: 0.1027
Epoch 679/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0086 - val_
loss: 0.1061
Epoch 680/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0091 - val_
loss: 0.1005
Epoch 681/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0088 - val_
loss: 0.1110
Epoch 682/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0109 - val_
loss: 0.1155
Epoch 683/1000
102/102 [==============================] - 7s 71ms/step - loss: 0.0102 - val_
loss: 0.1155
Epoch 684/1000
102/102 [==============================] - 8s 77ms/step - loss: 0.0104 - val_
```

```
loss: 0.1177
Epoch 685/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0157 - val_
loss: 0.1052
Epoch 686/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0121 - val_
loss: 0.0934
Epoch 687/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0085 - val_
loss: 0.1010
Epoch 688/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0103 - val_
loss: 0.0863
Epoch 689/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0159 - val_
loss: 0.1148
Epoch 690/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0289 - val_
loss: 0.1251
Epoch 691/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0165 - val_
loss: 0.1022
Epoch 692/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0101 - val_
loss: 0.0990
Epoch 693/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0147 - val_
loss: 0.0952
Epoch 694/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0110 - val_
loss: 0.0888
Epoch 695/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0190 - val_
loss: 0.1142
Epoch 696/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0133 - val_
loss: 0.1180
Epoch 697/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0079 - val_
loss: 0.1025
Epoch 698/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0090 - val_
loss: 0.1041
Epoch 699/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0075 - val_
loss: 0.1097
Epoch 700/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0071 - val_
loss: 0.1136
Epoch 701/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0076 - val_
loss: 0.1026
Epoch 702/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0073 - val_
loss: 0.1053
Epoch 703/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0077 - val_
```

```
loss: 0.1063
Epoch 704/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0075 - val_
loss: 0.1061
Epoch 705/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0089 - val_
loss: 0.1051
Epoch 706/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0077 - val_
loss: 0.1089
Epoch 707/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0087 - val_
loss: 0.1061
Epoch 708/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0087 - val_
loss: 0.1035
Epoch 709/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0124 - val_
loss: 0.1239
Epoch 710/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0233 - val_
loss: 0.1391
Epoch 711/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0516 - val_
loss: 0.1159
Epoch 712/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0221 - val_
loss: 0.1208
Epoch 713/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0129 - val_
loss: 0.1157
Epoch 714/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0074 - val_
loss: 0.1211
Epoch 715/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0192 - val_
loss: 0.1098
Epoch 716/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0095 - val_
loss: 0.1093
Epoch 717/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0089 - val_
loss: 0.1066
Epoch 718/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0077 - val_
loss: 0.1038
Epoch 719/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0099 - val_
loss: 0.1002
Epoch 720/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0095 - val_
loss: 0.1061
Epoch 721/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0088 - val_
loss: 0.1141
Epoch 722/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0071 - val_
```

```
loss: 0.1075
Epoch 723/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0127 - val_
loss: 0.1016
Epoch 724/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0095 - val_
loss: 0.1102
Epoch 725/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0075 - val_
loss: 0.1065
Epoch 726/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0064 - val_
loss: 0.1000
Epoch 727/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0079 - val_
loss: 0.1033
Epoch 728/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0075 - val_
loss: 0.1010
Epoch 729/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0076 - val_
loss: 0.1055
Epoch 730/1000
102/102 [==============================] - 7s 66ms/step - loss: 0.0074 - val_
loss: 0.1042
Epoch 731/1000
102/102 [==============================] - 8s 78ms/step - loss: 0.0084 - val_
loss: 0.1042
Epoch 732/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0089 - val_
loss: 0.1018
Epoch 733/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0078 - val_
loss: 0.1010
Epoch 734/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0081 - val_
loss: 0.1104
Epoch 735/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0078 - val_
loss: 0.1058
Epoch 736/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0080 - val_
loss: 0.1039
Epoch 737/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0096 - val_
loss: 0.1121
Epoch 738/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0075 - val_
loss: 0.1090
Epoch 739/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0071 - val_
loss: 0.1062
Epoch 740/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0063 - val_
loss: 0.1073
Epoch 741/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0088 - val_
```

```
loss: 0.1183
Epoch 742/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0082 - val_
loss: 0.1017
Epoch 743/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0104 - val_
loss: 0.1185
Epoch 744/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0086 - val_
loss: 0.1030
Epoch 745/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0098 - val_
loss: 0.1012
Epoch 746/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0083 - val_
loss: 0.1134
Epoch 747/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0090 - val_
loss: 0.1060
Epoch 748/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0081 - val_
loss: 0.1099
Epoch 749/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0078 - val_
loss: 0.1177
Epoch 750/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0073 - val_
loss: 0.1086
Epoch 751/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0076 - val_
loss: 0.1146
Epoch 752/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0084 - val_
loss: 0.1064
Epoch 753/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0087 - val_
loss: 0.1074
Epoch 754/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0084 - val_
loss: 0.1148
Epoch 755/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0080 - val_
loss: 0.1087
Epoch 756/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0088 - val_
loss: 0.1066
Epoch 757/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0075 - val_
loss: 0.1193
Epoch 758/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0071 - val_
loss: 0.1092
Epoch 759/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0096 - val_
loss: 0.1083
Epoch 760/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0098 - val_
```

```
loss: 0.1162
Epoch 761/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0217 - val_
loss: 0.1241
Epoch 762/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0220 - val_
loss: 0.1735
Epoch 763/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0180 - val_
loss: 0.1179
Epoch 764/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0129 - val_
loss: 0.1265
Epoch 765/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0091 - val_
loss: 0.1259
Epoch 766/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0103 - val_
loss: 0.1150
Epoch 767/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0104 - val_
loss: 0.1040
Epoch 768/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0102 - val_
loss: 0.1084
Epoch 769/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0094 - val_
loss: 0.1043
Epoch 770/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0066 - val_
loss: 0.1128
Epoch 771/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0070 - val_
loss: 0.1066
Epoch 772/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0077 - val_
loss: 0.1056
Epoch 773/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0103 - val_
loss: 0.1026
Epoch 774/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0079 - val_
loss: 0.1089
Epoch 775/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0059 - val_
loss: 0.1057
Epoch 776/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0077 - val_
loss: 0.1006
Epoch 777/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0068 - val_
loss: 0.0998
Epoch 778/1000
102/102 [==============================] - 7s 73ms/step - loss: 0.0073 - val_
loss: 0.0960
Epoch 779/1000
102/102 [==============================] - 7s 69ms/step - loss: 0.0078 - val_
```

```
loss: 0.1002
Epoch 780/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0092 - val_
loss: 0.0961
Epoch 781/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0088 - val_
loss: 0.0947
Epoch 782/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0078 - val_
loss: 0.1010
Epoch 783/1000
102/102 [==============================] - 7s 66ms/step - loss: 0.0061 - val_
loss: 0.0970
Epoch 784/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0068 - val_
loss: 0.0973
Epoch 785/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0078 - val_
loss: 0.1105
Epoch 786/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0091 - val_
loss: 0.1063
Epoch 787/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0092 - val_
loss: 0.1072
Epoch 788/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0088 - val_
loss: 0.1057
Epoch 789/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0076 - val_
loss: 0.1030
Epoch 790/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0071 - val_
loss: 0.1061
Epoch 791/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0071 - val_
loss: 0.1165
Epoch 792/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0063 - val_
loss: 0.1080
Epoch 793/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0082 - val_
loss: 0.1103
Epoch 794/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0108 - val_
loss: 0.1120
Epoch 795/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0069 - val_
loss: 0.1151
Epoch 796/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0068 - val_
loss: 0.1108
Epoch 797/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0072 - val_
loss: 0.1064
Epoch 798/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0071 - val_
```

```
loss: 0.1071
Epoch 799/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0081 - val_
loss: 0.1086
Epoch 800/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0086 - val_
loss: 0.1084
Epoch 801/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0085 - val_
loss: 0.1079
Epoch 802/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0092 - val_
loss: 0.1077
Epoch 803/1000
102/102 [==============================] - 7s 66ms/step - loss: 0.0096 - val_
loss: 0.1026
Epoch 804/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0083 - val_
loss: 0.0961
Epoch 805/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0088 - val_
loss: 0.1043
Epoch 806/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0071 - val_
loss: 0.1043
Epoch 807/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0093 - val_
loss: 0.1067
Epoch 808/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0082 - val_
loss: 0.0977
Epoch 809/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0085 - val_
loss: 0.1032
Epoch 810/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0076 - val_
loss: 0.0998
Epoch 811/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0100 - val_
loss: 0.0988
Epoch 812/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0083 - val_
loss: 0.0961
Epoch 813/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0074 - val_
loss: 0.0949
Epoch 814/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0069 - val_
loss: 0.1003
Epoch 815/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0103 - val_
loss: 0.1122
Epoch 816/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0094 - val_
loss: 0.1024
Epoch 817/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0084 - val_
```

```
loss: 0.1053
Epoch 818/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0068 - val_
loss: 0.1056
Epoch 819/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0064 - val_
loss: 0.0999
Epoch 820/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0068 - val_
loss: 0.1079
Epoch 821/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0061 - val_
loss: 0.1033
Epoch 822/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0063 - val_
loss: 0.1019
Epoch 823/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0077 - val_
loss: 0.0983
Epoch 824/1000
102/102 [==============================] - 7s 68ms/step - loss: 0.0077 - val_
loss: 0.0996
Epoch 825/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0087 - val_
loss: 0.1015
Epoch 826/1000
102/102 [==============================] - 7s 69ms/step - loss: 0.0082 - val_
loss: 0.1090
Epoch 827/1000
102/102 [==============================] - 7s 66ms/step - loss: 0.0117 - val_
loss: 0.1523
Epoch 828/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0101 - val_
loss: 0.1064
Epoch 829/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0075 - val_
loss: 0.1109
Epoch 830/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0075 - val_
loss: 0.1046
Epoch 831/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0096 - val_
loss: 0.1160
Epoch 832/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0116 - val_
loss: 0.1103
Epoch 833/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0151 - val_
loss: 0.1270
Epoch 834/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0102 - val_
loss: 0.1343
Epoch 835/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0086 - val_
loss: 0.1290
Epoch 836/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0076 - val_
```

```
loss: 0.1128
Epoch 837/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0076 - val_
loss: 0.1165
Epoch 838/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0074 - val_
loss: 0.1092
Epoch 839/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0076 - val_
loss: 0.1149
Epoch 840/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0074 - val_
loss: 0.1070
Epoch 841/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0082 - val_
loss: 0.1061
Epoch 842/1000
102/102 [==============================] - 6s 62ms/step - loss: 0.0077 - val_
loss: 0.1098
Epoch 843/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0082 - val_
loss: 0.1035
Epoch 844/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0071 - val_
loss: 0.1011
Epoch 845/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0055 - val_
loss: 0.1032
Epoch 846/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0081 - val_
loss: 0.1068
Epoch 847/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0062 - val_
loss: 0.1007
Epoch 848/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0062 - val_
loss: 0.0966
Epoch 849/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0088 - val_
loss: 0.1035
Epoch 850/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0068 - val_
loss: 0.1052
Epoch 851/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0068 - val_
loss: 0.1058
Epoch 852/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0073 - val_
loss: 0.1077
Epoch 853/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0081 - val_
loss: 0.1028
Epoch 854/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0067 - val_
loss: 0.1012
Epoch 855/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0065 - val_
```

```
loss: 0.1029
Epoch 856/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0067 - val_
loss: 0.1030
Epoch 857/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0075 - val_
loss: 0.1035
Epoch 858/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0065 - val_
loss: 0.1003
Epoch 859/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0080 - val_
loss: 0.0982
Epoch 860/1000
102/102 [==============================] - 6s 62ms/step - loss: 0.0076 - val_
loss: 0.1057
Epoch 861/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0061 - val_
loss: 0.0903
Epoch 862/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0064 - val_
loss: 0.0971
Epoch 863/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0063 - val_
loss: 0.0990
Epoch 864/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0065 - val_
loss: 0.0925
Epoch 865/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0075 - val_
loss: 0.0943
Epoch 866/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0090 - val_
loss: 0.1061
Epoch 867/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0094 - val_
loss: 0.1095
Epoch 868/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0079 - val_
loss: 0.1087
Epoch 869/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0084 - val_
loss: 0.1002
Epoch 870/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0254 - val_
loss: 0.1021
Epoch 871/1000
102/102 [==============================] - 7s 67ms/step - loss: 0.0087 - val_
loss: 0.1015
Epoch 872/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0066 - val_
loss: 0.1017
Epoch 873/1000
102/102 [==============================] - 7s 67ms/step - loss: 0.0077 - val_
loss: 0.0995
Epoch 874/1000
102/102 [==============================] - 7s 68ms/step - loss: 0.0056 - val_
```

```
loss: 0.0975
Epoch 875/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0070 - val_
loss: 0.1052
Epoch 876/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0059 - val_
loss: 0.1057
Epoch 877/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0074 - val_
loss: 0.1230
Epoch 878/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0081 - val_
loss: 0.1045
Epoch 879/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0065 - val_
loss: 0.1072
Epoch 880/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0069 - val_
loss: 0.1115
Epoch 881/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0067 - val_
loss: 0.1079
Epoch 882/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0083 - val_
loss: 0.1001
Epoch 883/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0067 - val_
loss: 0.1014
Epoch 884/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0078 - val_
loss: 0.1057
Epoch 885/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0066 - val_
loss: 0.0979
Epoch 886/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0059 - val_
loss: 0.1096
Epoch 887/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0066 - val_
loss: 0.1044
Epoch 888/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0073 - val_
loss: 0.1078
Epoch 889/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0080 - val_
loss: 0.1071
Epoch 890/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0078 - val_
loss: 0.1108
Epoch 891/1000
102/102 [==============================] - 6s 62ms/step - loss: 0.0061 - val_
loss: 0.1070
Epoch 892/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0089 - val_
loss: 0.1008
Epoch 893/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0062 - val_
```

```
loss: 0.1016
Epoch 894/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0060 - val_
loss: 0.1168
Epoch 895/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0072 - val_
loss: 0.1127
Epoch 896/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0079 - val_
loss: 0.1080
Epoch 897/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0069 - val_
loss: 0.1101
Epoch 898/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0063 - val_
loss: 0.1062
Epoch 899/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0059 - val_
loss: 0.1087
Epoch 900/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0065 - val_
loss: 0.1028
Epoch 901/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0068 - val_
loss: 0.1038
Epoch 902/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0064 - val_
loss: 0.1068
Epoch 903/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0059 - val_
loss: 0.1034
Epoch 904/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0069 - val_
loss: 0.1210
Epoch 905/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0061 - val_
loss: 0.1030
Epoch 906/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0066 - val_
loss: 0.0989
Epoch 907/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0069 - val_
loss: 0.1160
Epoch 908/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0079 - val_
loss: 0.1061
Epoch 909/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0072 - val_
loss: 0.1057
Epoch 910/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0059 - val_
loss: 0.1022
Epoch 911/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0087 - val_
loss: 0.1162
Epoch 912/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0067 - val_
```

```
loss: 0.1083
Epoch 913/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0068 - val_
loss: 0.1148
Epoch 914/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0066 - val_
loss: 0.1040
Epoch 915/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0073 - val_
loss: 0.0912
Epoch 916/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0063 - val_
loss: 0.1014
Epoch 917/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0065 - val_
loss: 0.1041
Epoch 918/1000
102/102 [==============================] - 7s 66ms/step - loss: 0.0066 - val_
loss: 0.1178
Epoch 919/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0062 - val_
loss: 0.1195
Epoch 920/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0072 - val_
loss: 0.1048
Epoch 921/1000
102/102 [==============================] - 7s 66ms/step - loss: 0.0061 - val_
loss: 0.1053
Epoch 922/1000
102/102 [==============================] - 7s 67ms/step - loss: 0.0081 - val_
loss: 0.1144
Epoch 923/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0079 - val_
loss: 0.1091
Epoch 924/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0058 - val_
loss: 0.1093
Epoch 925/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0074 - val_
loss: 0.1177
Epoch 926/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0073 - val_
loss: 0.1158
Epoch 927/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0090 - val_
loss: 0.1165
Epoch 928/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0102 - val_
loss: 0.1063
Epoch 929/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0072 - val_
loss: 0.1012
Epoch 930/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0066 - val_
loss: 0.0997
Epoch 931/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0069 - val_
```

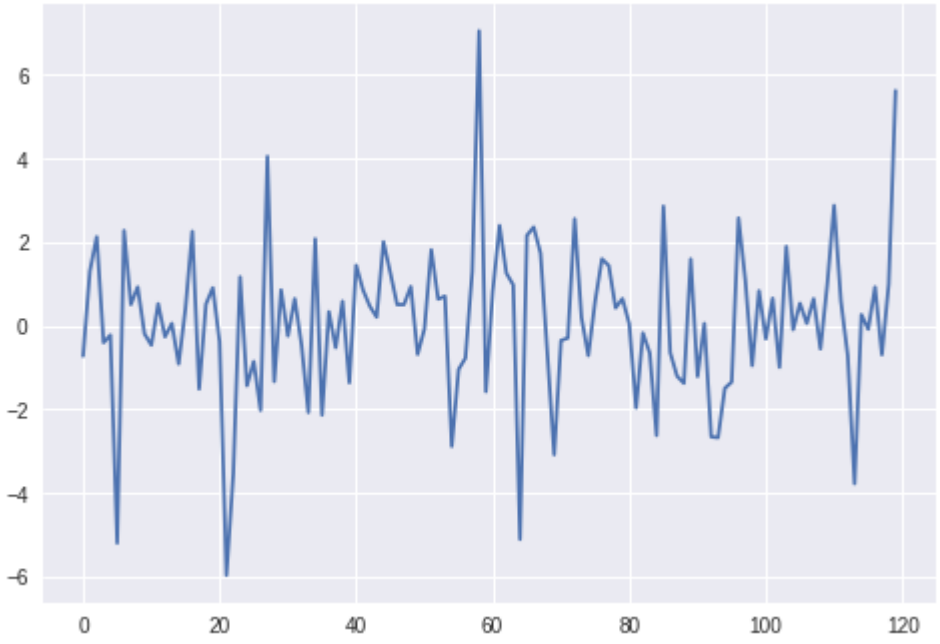
```
loss: 0.0998
Epoch 932/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0058 - val_
loss: 0.1017
Epoch 933/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0066 - val_
loss: 0.1014
Epoch 934/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0059 - val_
loss: 0.1073
Epoch 935/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0064 - val_
loss: 0.1158
Epoch 936/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0076 - val_
loss: 0.1160
Epoch 937/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0073 - val_
loss: 0.1032
Epoch 938/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0071 - val_
loss: 0.1056
Epoch 939/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0067 - val_
loss: 0.1039
Epoch 940/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0084 - val_
loss: 0.1008
Epoch 941/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0063 - val_
loss: 0.0961
Epoch 942/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0073 - val_
loss: 0.0980
Epoch 943/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0057 - val_
loss: 0.0981
Epoch 944/1000
102/102 [==============================] - 6s 62ms/step - loss: 0.0058 - val_
loss: 0.1021
Epoch 945/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0065 - val_
loss: 0.1099
Epoch 946/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0070 - val_
loss: 0.0918
Epoch 947/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0067 - val_
loss: 0.0971
Epoch 948/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0078 - val_
loss: 0.1028
Epoch 949/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0068 - val_
loss: 0.1045
Epoch 950/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0121 - val_
```

```
loss: 0.1365
Epoch 951/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0202 - val_
loss: 0.1267
Epoch 952/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0131 - val_
loss: 0.1186
Epoch 953/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0139 - val_
loss: 0.1076
Epoch 954/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0065 - val_
loss: 0.1004
Epoch 955/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0080 - val_
loss: 0.1056
Epoch 956/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0061 - val_
loss: 0.1049
Epoch 957/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0065 - val_
loss: 0.1012
Epoch 958/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0054 - val_
loss: 0.1030
Epoch 959/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0057 - val_
loss: 0.1050
Epoch 960/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0060 - val_
loss: 0.1006
Epoch 961/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0063 - val_
loss: 0.1001
Epoch 962/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0065 - val_
loss: 0.0996
Epoch 963/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0058 - val_
loss: 0.0981
Epoch 964/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0055 - val_
loss: 0.1107
Epoch 965/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0062 - val_
loss: 0.1042
Epoch 966/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0054 - val_
loss: 0.1078
Epoch 967/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0072 - val_
loss: 0.1053
Epoch 968/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0053 - val_
loss: 0.1014
Epoch 969/1000
102/102 [==============================] - 7s 66ms/step - loss: 0.0064 - val_
```

```
loss: 0.1021
Epoch 970/1000
102/102 [==============================] - 7s 68ms/step - loss: 0.0061 - val_
loss: 0.1058
Epoch 971/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0065 - val_
loss: 0.1033
Epoch 972/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0059 - val_
loss: 0.0958
Epoch 973/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0056 - val_
loss: 0.1000
Epoch 974/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0054 - val_
loss: 0.0966
Epoch 975/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0052 - val_
loss: 0.1020
Epoch 976/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0057 - val_
loss: 0.1030
Epoch 977/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0072 - val_
loss: 0.0999
Epoch 978/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0066 - val_
loss: 0.1095
Epoch 979/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0056 - val_
loss: 0.0944
Epoch 980/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0066 - val_
loss: 0.1029
Epoch 981/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0065 - val_
loss: 0.1042
Epoch 982/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0065 - val_
loss: 0.0946
Epoch 983/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0064 - val_
loss: 0.1066
Epoch 984/1000
102/102 [==============================] - 6s 63ms/step - loss: 0.0065 - val_
loss: 0.0998
Epoch 985/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0061 - val_
loss: 0.0943
Epoch 986/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0064 - val_
loss: 0.0997
Epoch 987/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0079 - val_
loss: 0.1002
Epoch 988/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0061 - val_
```

```
loss: 0.0996
Epoch 989/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0054 - val_
loss: 0.1016
Epoch 990/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0079 - val_
loss: 0.1021
Epoch 991/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0066 - val_
loss: 0.1004
Epoch 992/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0066 - val_
loss: 0.1049
Epoch 993/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0057 - val_
loss: 0.1072
Epoch 994/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0063 - val_
loss: 0.1037
Epoch 995/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0066 - val_
loss: 0.1058
Epoch 996/1000
102/102 [==============================] - 6s 64ms/step - loss: 0.0067 - val_
loss: 0.1007
Epoch 997/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0070 - val_
loss: 0.1103
Epoch 998/1000
102/102 [==============================] - 7s 65ms/step - loss: 0.0069 - val_
loss: 0.1054
Epoch 999/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0085 - val_
loss: 0.1018
Epoch 1000/1000
102/102 [==============================] - 7s 64ms/step - loss: 0.0073 - val_
loss: 0.1002
```

Out[0]: [<matplotlib.lines.Line2D at 0x7efbd131b9b0>]


6
4
2
0
−2
−4
−6
0
20
40
60
80
100
120

In [0]:
```
#-----------------------------------------------------PLOT LOSS --------------
-------------------------------------------------
fmt = '%.1f'
tick = mtick.FormatStrFormatter(fmt)
ax = plt.axes()
ax.yaxis.set_major_formatter(tick)
print (model.summary())
print(history.history.keys())

plt.figure(2)
plt.plot(history.history['loss'])
plt.plot(history.history['val_loss'])
plt.title('model loss')
plt.ylabel('loss')
plt.xlabel('epoch')
plt.legend(['train', 'test'], loc='upper left')
fmt = '%.1f'
tick = mtick.FormatStrFormatter(fmt)
ax = plt.axes()
ax.yaxis.set_major_formatter(tick)

score_train = model.evaluate (x_train, y_train, batch_size =1)
score_test = model.evaluate (x_test, y_test, batch_size =1)
print (" in train MSE = ", round( score_train ,4))
print (" in test MSE = ", score_test )

pred1 = model.predict (x_test)
pred1 = scaler_y.inverse_transform (np. array (pred1). reshape ((len( pred1),
1)))

prediction_data = pred1[-1]
model.summary()
print ("Inputs: {}".format(model.input_shape))
print ("Outputs: {}".format(model.output_shape))
print ("Actual input: {}".format(x_test.shape))
print ("Actual output: {}".format(y_test.shape))

print ("prediction data:")
print (prediction_data)

y_test = scaler_y.inverse_transform (np. array (y_test). reshape ((len( y_test
), 1)))
print ("y_test:")
print (y_test)

act_data = np.array([row[0] for row in y_test])

fmt = '%.1f'
tick = mtick.FormatStrFormatter(fmt)
ax = plt.axes()
ax.yaxis.set_major_formatter(tick)
```

```
_________________________________________________________________
Layer (type)                 Output Shape              Param #   
=================================================================
lstm_1 (LSTM)                (None, 400)               643200    
_________________________________________________________________
dropout_1 (Dropout)          (None, 400)               0         
_________________________________________________________________
dense_1 (Dense)              (None, 1)                 401       
=================================================================
Total params: 643,601
Trainable params: 643,601
Non-trainable params: 0
_________________________________________________________________
None
dict_keys(['val_loss', 'loss'])
 28/120 [======>.......................] - ETA: 0s
/usr/local/lib/python3.6/dist-packages/matplotlib/cbook/deprecation.py:106: M
atplotlibDeprecationWarning: Adding an axes using the same arguments as a pre
vious axes currently reuses the earlier instance.  In a future version, a new
instance will always be created and returned.  Meanwhile, this warning can be
suppressed, and the future behavior ensured, by passing a unique label to eac
h axes instance.
  warnings.warn(message, mplDeprecation, stacklevel=1)
```

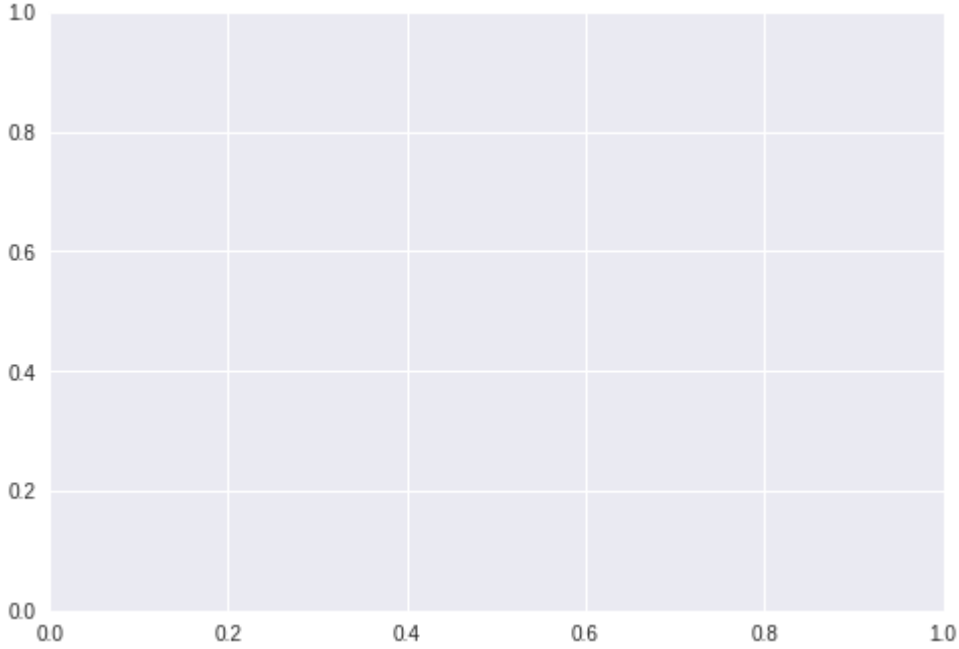
```
120/120 [==============================] - 1s 6ms/step
9/9 [==============================] - 0s 7ms/step
 in train MSE =  0.0193
 in test MSE =  0.08369573578238487
```

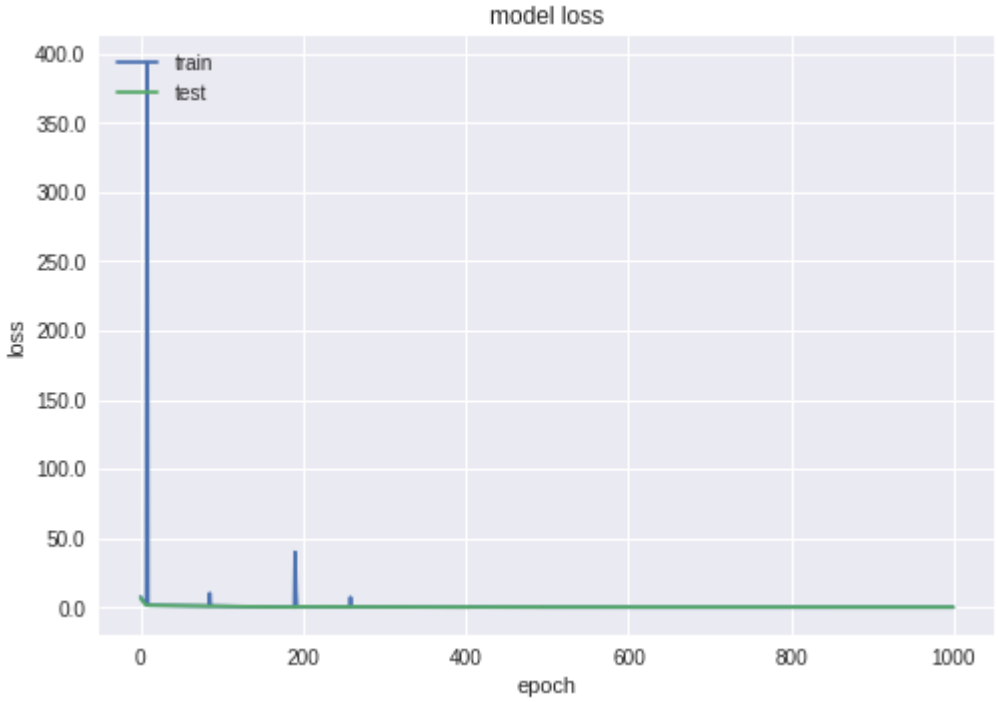
Layer (type)	Output Shape	Param #
lstm_1 (LSTM)	(None, 400)	643200
dropout_1 (Dropout)	(None, 400)	0
dense_1 (Dense)	(None, 1)	401

```
Total params: 643,601
Trainable params: 643,601
Non-trainable params: 0
```

```
Inputs: (None, 19, 1)
Outputs: (None, 1)
Actual input: (9, 19, 1)
Actual output: (9, 1)
prediction data:
[-0.7242483]
y_test:
[[ 2.31]
 [-2.14]
 [ 1.22]
 [ 4.37]
 [ 1.75]
 [ 0.55]
 [ 1.43]
 [-0.36]
 [-0.58]]
```

```
/usr/local/lib/python3.6/dist-packages/matplotlib/cbook/deprecation.py:106: M
atplotlibDeprecationWarning: Adding an axes using the same arguments as a pre
vious axes currently reuses the earlier instance.  In a future version, a new
instance will always be created and returned.  Meanwhile, this warning can be
suppressed, and the future behavior ensured, by passing a unique label to eac
h axes instance.
  warnings.warn(message, mplDeprecation, stacklevel=1)
```


1.0
0.8
0.6
0.4
0.2
0.0
0.0
0.2
0.4
0.6
0.8
1.0


model loss
train
test
400.0
350.0
300.0
250.0
200.0
150.0
100.0
50.0
0.0
loss
0
200
400
600
800
1000
epoch

In [0]:
```
#------------------------------------------------------------- PLOT DOLLAR
 DIFFERENCE PREDICTIONS ------------------------------------------------------
-
plt.figure(3)
plt.plot( y_test, label="actual")
plt.plot(pred1, label="predictions")

print ("act_data:")
print (act_data)

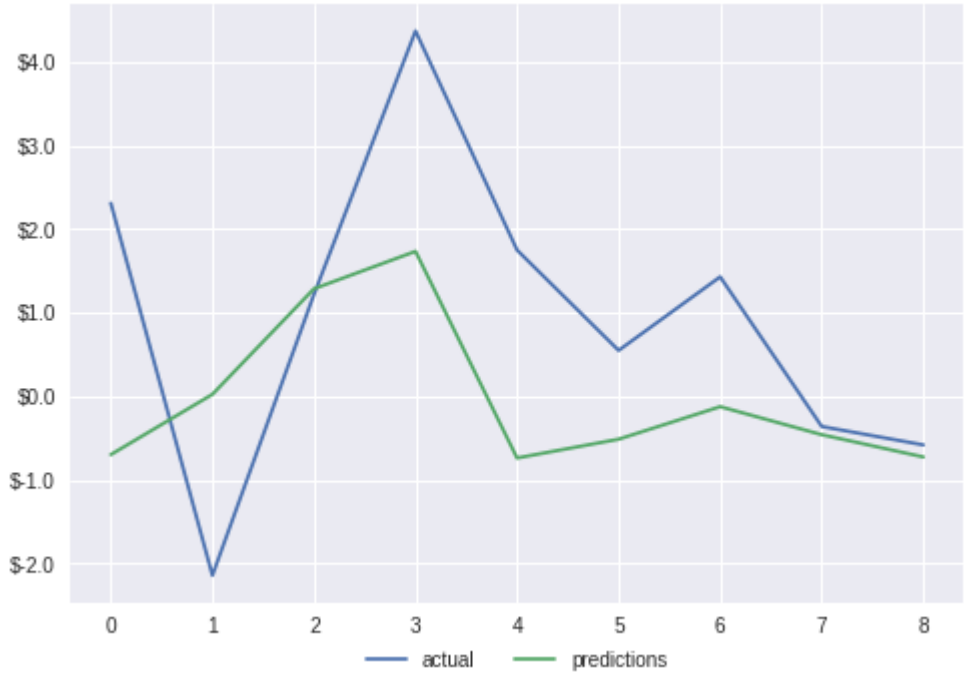
print ("pred1:")
print (pred1)

plt.legend(loc='upper center', bbox_to_anchor=(0.5, -0.05),
          fancybox=True, shadow=True, ncol=2)


fmt = '$%.1f'
tick = mtick.FormatStrFormatter(fmt)
ax = plt.axes()
ax.yaxis.set_major_formatter(tick)
```

```
act_data:
[ 2.31 -2.14  1.22  4.37  1.75  0.55  1.43 -0.36 -0.58]
pred1:
[[-0.69635785]
 [ 0.02460127]
 [ 1.2870923 ]
 [ 1.7346636 ]
 [-0.7369436 ]
 [-0.51209843]
 [-0.12286408]
 [-0.4580882 ]
 [-0.7242483 ]]
```

```
/usr/local/lib/python3.6/dist-packages/matplotlib/cbook/deprecation.py:106: M
atplotlibDeprecationWarning: Adding an axes using the same arguments as a pre
vious axes currently reuses the earlier instance.  In a future version, a new
instance will always be created and returned.  Meanwhile, this warning can be
suppressed, and the future behavior ensured, by passing a unique label to eac
h axes instance.
  warnings.warn(message, mplDeprecation, stacklevel=1)
```



In [0]:
```
#---------------------------------------------------------- THIS IS FROM AN
 ONLINE SOURCE ----------------------------------------------------
def moving_test_window_preds(n_future_preds):

    ''' n_future_preds - Represents the number of future predictions we want t
o make
                        This coincides with the number of windows that we wil
l <span id="IL_AD1" class="IL_AD">move</span> forward
                        on the test data
    '''
    preds_moving = []                                       # Store the predictio
n made on each test window
    moving_test_window = [x_test[0,:].tolist()]          # First test window
    moving_test_window = np.array(moving_test_window)

    for i in range(n_future_preds):


        preds_one_step = model.predict(moving_test_window)
        preds_moving.append(preds_one_step[0,0])

        preds_one_step = preds_one_step.reshape(1,1,1)
        moving_test_window = np.concatenate((moving_test_window[:,1:,:], preds
_one_step), axis=1) # new moving test window, where the first element from the
 window has been removed and the prediction  has been appended to the end


    print ("pred moving before scaling:")
    print (preds_moving)

    preds_moving = scaler_y.inverse_transform((np.array(preds_moving)).reshape
(-1, 1))

    print ("pred moving after scaling:")
    print (preds_moving)
    return preds_moving

print ("do moving test predictions for next 22 days:")
preds_moving = moving_test_window_preds(22)


count_correct=0
error =0
for i in range (len(y_test)):
    error=error + ((y_test[i]-preds_moving[i])**2) / y_test[i]


    if y_test[i] >=0 and preds_moving[i] >=0 :
        count_correct=count_correct+1
    if y_test[i] < 0 and preds_moving[i] < 0 :
        count_correct=count_correct+1

accuracy_in_change =  count_correct / (len(y_test) )
```

```
do moving test predictions for next 22 days:
pred moving before scaling:
[-0.19083132, -0.23171595, 0.06256686, -0.098098956, 0.028642073, -0.1097735
7, -0.16906123, -0.1766864, -0.22003943, -0.20722544, -0.23434256, -0.1551406
8, -0.15711203, -0.18768673, -0.21017373, -0.21093537, -0.22050217, -0.228187
44, -0.246604, -0.24633326, -0.26695108, -0.24862185]
pred moving after scaling:
[[-0.6963577 ]
 [-0.9623122 ]
 [ 0.9519974 ]
 [-0.09313371]
 [ 0.7313167 ]
 [-0.16907707]
 [-0.5547433 ]
 [-0.6043451 ]
 [-0.8863565 ]
 [-0.8030015 ]
 [-0.97939837]
 [-0.46419016]
 [-0.4770138 ]
 [-0.6759022 ]
 [-0.8221801 ]
 [-0.8271346 ]
 [-0.8893666 ]
 [-0.9393593 ]
 [-1.059159  ]
 [-1.0573978 ]
 [-1.1915168 ]
 [-1.0722852 ]]
```

In [0]:
```
 # ------------------------------------------------------- PLOT DIFFERENCE
D DATA ------------------------------------------------------------------------
---
plt.figure(4)
plt.title("Forecast vs Actual, (data is differenced)")
plt.plot(preds_moving, label="predictions")
plt.plot(y_test, label="actual")
plt.legend(loc='upper center', bbox_to_anchor=(0.5, -0.05),
          fancybox=True, shadow=True, ncol=2)


print ("accuracy_in_change:")
print (accuracy_in_change)

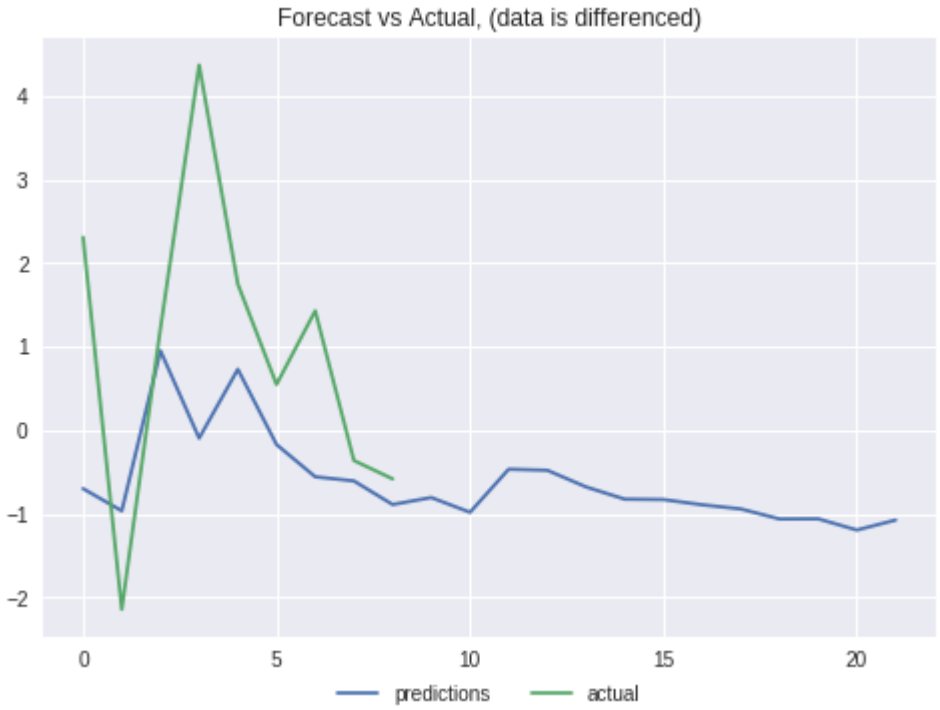
ind=data_original.index.values[0] + data_original.shape[0] -len(y_test)-1
prev_starting_price = data_original.loc[ind,"yt_"]
preds_moving_before_diff =  [0 for x in range(len(preds_moving))]

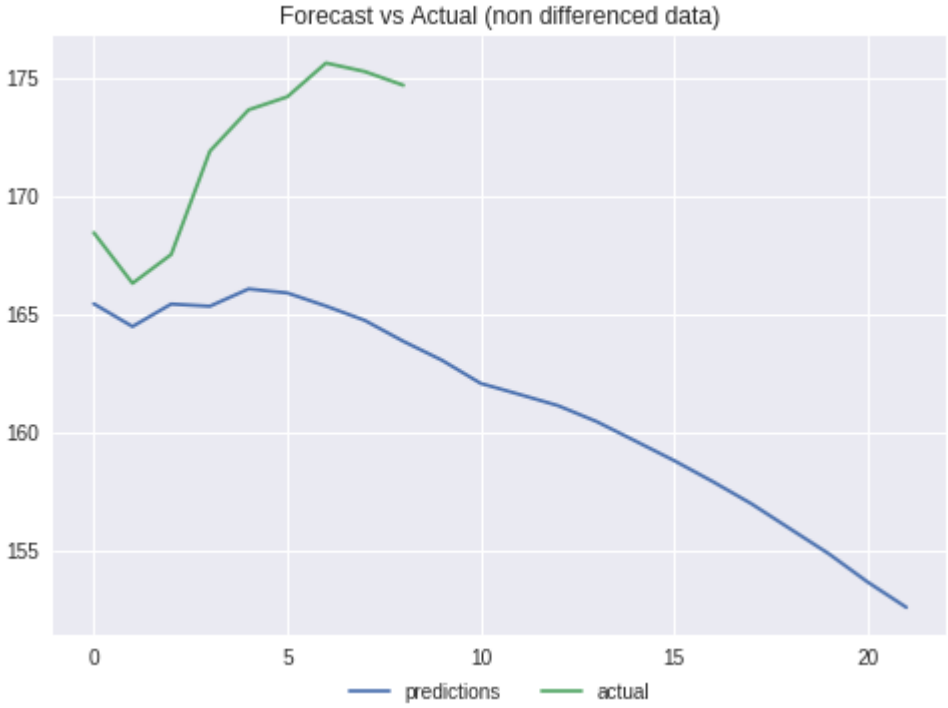
for i in range (len(preds_moving)):
    if (i==0):
        preds_moving_before_diff[i]=prev_starting_price + preds_moving[i]
    else:
        preds_moving_before_diff[i]=preds_moving_before_diff[i-1]+preds_moving
[i]


y_test_before_diff = [0 for x in range(len(y_test))]

for i in range (len(y_test)):
    if (i==0):
        y_test_before_diff[i]=prev_starting_price + y_test[i]
    else:
        y_test_before_diff[i]=y_test_before_diff[i-1]+y_test[i]
 # ------------------------------------------------------------- PLOT NON D
IFFERENCED DATA ---------------------------------------------------------------
-----
plt.figure(5)
plt.title("Forecast vs Actual (non differenced data)")
plt.plot(preds_moving_before_diff, label="predictions")
plt.plot(y_test_before_diff, label="actual")
plt.legend(loc='upper center', bbox_to_anchor=(0.5, -0.05),
          fancybox=True, shadow=True, ncol=2)
plt.show()
```

```
accuracy_in_change:
0.5555555555555556
```





Well after reviewing the three sets of runs we can see that the 400 epoch run was actually more acurate than the 600 and 1000 epoch run. The number of epochs seems to add a smooth-ness to the end result which is not very helpful as the stock market, especially in these times, is not very smooth.

Conclusion

First and foremost we can see that the model can generate with a fair amount of accuracy guess on the direction where the stock was going. This is very important as it is the first step in solving the problem of predicting the market. Once the direction is chosen we can more easily manage the gap between the maginitude. However, it should be noted that doing so will be nearly impossible as this model does not take into account various outside sources that can dramtically affect a stock's price. This model trains on being given 120 days of the given stock's closing price. It then validates how accurate it is by trying to guess the next 30 and is given an accuracy score by then being given what those thirty days are. For the most part this accuracy is around 40-60% which is pretty good, again considering what the current market conditions are. The predictions are made after the model is fully trained and it outputs a graph that shows the dollar differenced graph. The prediction graph shows 7 days of I am considering on heavily expanding on this project in the future to constantly pull in fresh market data and also look at certain news feeds and see how that affects the prices. Also a way to automate the process to train different stocks under one model. This current program does not work across stocks as the differencing functions would be severely affected by the vast differences in price even among the top ten stocks.