Stock_Price_Prediction_LSTM

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0.1 # Stock Price Prediction - LSTM

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0.2 1. Retrieve Data

Use `pandas_datareader` to retrieve historical and present stock price by ticker and time range. Here, I choose "GOOGL" as an example, but in the real data product, customer can choose whatever valid stock ticker they want to do prediction.

(Reference pandas_datareader link)

1.1 Import required libraries

```python
[39]: import pandas_datareader.data as web
import pandas as pd
import datetime
import os
from sklearn.preprocessing import StandardScaler
from sklearn.model_selection import train_test_split
from collections import deque
import numpy as np
import tensorflow as tf
from tensorflow.keras.models import Sequential, load_model
from tensorflow.keras.layers import LSTM, Dense, Dropout
from tensorflow.keras.callbacks import ModelCheckpoint
import matplotlib.pyplot as plt
```

1.2 Set start time and end time as parameters to retrieve data.

```python
[2]: start = datetime.date(2000, 1, 1)
end = datetime.date.today()
print(start, end)
```

```
2000-01-01 2023-04-28
```

1.3 Get origianl real-time data from `DataReader`.

```
[3]: ticker = 'GOOGL'
     df = web.DataReader(ticker, 'stooq', start, end)
     df
```

```
[3]:               Open      High       Low      Close      Volume
     Date
     2023-04-27  104.45000  108.3700  103.54000  107.59000   50089187.0
     2023-04-26  104.92000  106.3500  102.63000  103.71000   53347560.0
     2023-04-25  105.82500  106.6900  103.84000  103.85000   46664104.0
     2023-04-24  105.49000  106.6300  104.70000  105.97000   23542829.0
     2023-04-21  105.47000  106.0000  104.78000  105.41000   25800082.0
     ...              ...       ...       ...       ...         ...
     2004-08-25    2.62400    2.7000    2.59700    2.65000  183956000.0
     2004-08-24    2.78100    2.7900    2.58925    2.62175  305252000.0
     2004-08-23    2.76875    2.8370    2.72625    2.73500  365488000.0
     2004-08-20    2.52525    2.7270    2.51250    2.70775  457144000.0
     2004-08-19    2.50000    2.6015    2.39900    2.50850  894076000.0

     [4705 rows x 5 columns]
```

1.4 sort the date by ascending

```
[4]: df.dropna(inplace=True)
     df.sort_index(inplace=True)
     df
```

```
[4]:               Open      High       Low      Close      Volume
     Date
     2004-08-19    2.50000    2.6015    2.39900    2.50850  894076000.0
     2004-08-20    2.52525    2.7270    2.51250    2.70775  457144000.0
     2004-08-23    2.76875    2.8370    2.72625    2.73500  365488000.0
     2004-08-24    2.78100    2.7900    2.58925    2.62175  305252000.0
     2004-08-25    2.62400    2.7000    2.59700    2.65000  183956000.0
     ...              ...       ...       ...       ...         ...
     2023-04-21  105.47000  106.0000  104.78000  105.41000   25800082.0
     2023-04-24  105.49000  106.6300  104.70000  105.97000   23542829.0
     2023-04-25  105.82500  106.6900  103.84000  103.85000   46664104.0
     2023-04-26  104.92000  106.3500  102.63000  103.71000   53347560.0
     2023-04-27  104.45000  108.3700  103.54000  107.59000   50089187.0

     [4704 rows x 5 columns]
```

1.5 Create `label` column as prediction value. We want to know the price/trend of the stock 10 days later.

- `pre_days`: prediction days

```
[5]: pre_days = 10
     df['label'] = df['Close'].shift(-pre_days)
     df
```

```
[5]:                   Open      High       Low      Close      Volume    label
     Date
     2004-08-19     2.50000    2.6015    2.39900    2.50850  894076000.0  2.53775
     2004-08-20     2.52525    2.7270    2.51250    2.70775  457144000.0  2.50025
     2004-08-23     2.76875    2.8370    2.72625    2.73500  365488000.0  2.53950
     2004-08-24     2.78100    2.7900    2.58925    2.62175  305252000.0  2.55750
     2004-08-25     2.62400    2.7000    2.59700    2.65000  183956000.0  2.55775
     ...                ...       ...        ...        ...          ...      ...
     2023-04-21   105.47000  106.0000  104.78000  105.41000   25800082.0      NaN
     2023-04-24   105.49000  106.6300  104.70000  105.97000   23542829.0      NaN
     2023-04-25   105.82500  106.6900  103.84000  103.85000   46664104.0      NaN
     2023-04-26   104.92000  106.3500  102.63000  103.71000   53347560.0      NaN
     2023-04-27   104.45000  108.3700  103.54000  107.59000   50089187.0      NaN

     [4704 rows x 6 columns]
```

0.3 2. Data Preprocessing

2.1 Standardize the data

Use `StandardScaler` to complete data standardization.

```
[6]: scaler = StandardScaler()
     scale_X = scaler.fit_transform(df.iloc[:, :-1])
     print(scale_X)
```

```
[[-1.02020079 -1.01728517 -1.0229223  -1.0198426   5.09758988]
 [-1.01949078 -1.01379531 -1.01969465 -1.01424127  2.20909426]
 [-1.01264371 -1.01073647 -1.01361617 -1.01347522  1.60316942]
 ...
 [ 1.88523364  1.87717209  1.86179288  1.82907598 -0.50453024]
 [ 1.85978561  1.86771749  1.82738366  1.82514029 -0.46034686]
 [ 1.8465695   1.92388895  1.85326166  1.9342151  -0.48188751]]
```

2.2 Set train & test data

- `mem_his_days`: memory of history days
- `deq`: a first in first out data structure, which make sure only remember and store the length of `mem_his_days` stock price data.
- X: train set, which means `mem_his_days` days of stock price data in each element and excludes last ten records. (refer to see `pre_days`)
- `X_lately`: last ten records.
- y: test data, which names 'label' in dataframe.

```
[7]: mem_his_days = 5
     deq = deque(maxlen=mem_his_days)

     X = []
     for i in scale_X:
         deq.append(list(i))
         if len(deq) == mem_his_days:
             X.append(list(deq))

     X_lately = X[-pre_days :]
     X = np.array(X[: -pre_days])

     y = np.array(df['label'].values[mem_his_days - 1: -pre_days])
```

```
[8]: print(X.shape)
     print(y.shape)
```

```
(4690, 5, 5)
(4690,)
```

2.3 Train Test set split

```
[9]: X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.1)
```

0.4   3. Generate and Train LSTM Nerual Network

3.1 Add LSTM layers   Reference LSTM link 1. The first layer should have `return_sequences` and define the `input_shape` 2. Repeat add LSTM and Dropout .1 percent data to generate the second and third layers. Remember to remove `input_shape` and `return_sequences` parameters in the last layer since it is defined at the layers before. 3. Add a fully connected layer, and an output layer. 4. Compile the model and use 'adam' as optimizer, use keras MSE as loss function, keras MAPE as metrics.

```
[10]: model = Sequential()

      # The first layer of Recurrent Neural Network shoule have return_sequences and␣
       ↪define input shape
      model.add(LSTM(10, input_shape=X.shape[1: ], activation='relu',␣
       ↪return_sequences=True))

      # To avoid overfitting, use Dropout to remove .1 data
      model.add(Dropout(0.1))

      # Repeat to generate second and third layers
      model.add(LSTM(10, activation='relu', return_sequences=True))
      model.add(Dropout(0.1))
      model.add(LSTM(10, activation='relu'))
      model.add(Dropout(0.1))
```

```python
# Generate Fully Connected layers
model.add(Dense(10, activation='relu'))
model.add(Dropout(0.1))

# Output layer
model.add(Dense(1))

# Compile model
model.compile(optimizer='adam', loss='mse', metrics=['mape'])
```

3.2 Train LSTM model

> Note: The parameters of the model are not modified and polished. And it does not mean the model is perfect and we can find that the model become overfitted during the training process.

```python
[11]: model.fit(X_train, y_train, batch_size=32, epochs=50, validation_data=(X_test,
      ↪y_test))
```

```
Epoch 1/50
132/132 [==============================] - 10s 15ms/step - loss: 2171.0476 -
mape: 87.7493 - val_loss: 275.9417 - val_mape: 46.0735
Epoch 2/50
132/132 [==============================] - 2s 12ms/step - loss: 272.8245 - mape:
32.8086 - val_loss: 41.1079 - val_mape: 17.9358
Epoch 3/50
132/132 [==============================] - 2s 12ms/step - loss: 204.3717 - mape:
28.2007 - val_loss: 55.3681 - val_mape: 17.6427
Epoch 4/50
132/132 [==============================] - 2s 16ms/step - loss: 169.5437 - mape:
26.9752 - val_loss: 49.8854 - val_mape: 16.8374
Epoch 5/50
132/132 [==============================] - 2s 13ms/step - loss: 155.1074 - mape:
25.1210 - val_loss: 64.6596 - val_mape: 16.1746
Epoch 6/50
132/132 [==============================] - 1s 10ms/step - loss: 160.4996 - mape:
25.1097 - val_loss: 39.1356 - val_mape: 14.5679
Epoch 7/50
132/132 [==============================] - 1s 10ms/step - loss: 131.6337 - mape:
23.5786 - val_loss: 84.7723 - val_mape: 17.2291
Epoch 8/50
132/132 [==============================] - 1s 10ms/step - loss: 150.5475 - mape:
23.8861 - val_loss: 32.6174 - val_mape: 13.6174
Epoch 9/50
132/132 [==============================] - 1s 10ms/step - loss: 125.5772 - mape:
23.3208 - val_loss: 38.0183 - val_mape: 13.5202
Epoch 10/50
```

```
132/132 [==============================] - 1s 11ms/step - loss: 133.0133 - mape:
22.5896 - val_loss: 23.5040 - val_mape: 12.8366
Epoch 11/50
132/132 [==============================] - 2s 12ms/step - loss: 123.8028 - mape:
21.7125 - val_loss: 61.2703 - val_mape: 14.9786
Epoch 12/50
132/132 [==============================] - 2s 13ms/step - loss: 114.4971 - mape:
21.4013 - val_loss: 29.3886 - val_mape: 12.5121
Epoch 13/50
132/132 [==============================] - 2s 16ms/step - loss: 116.7740 - mape:
21.6683 - val_loss: 66.1941 - val_mape: 14.3121
Epoch 14/50
132/132 [==============================] - 1s 11ms/step - loss: 121.5533 - mape:
21.3472 - val_loss: 39.7684 - val_mape: 12.5937
Epoch 15/50
132/132 [==============================] - 1s 10ms/step - loss: 105.2289 - mape:
20.4955 - val_loss: 60.0962 - val_mape: 12.9734
Epoch 16/50
132/132 [==============================] - 2s 12ms/step - loss: 105.8940 - mape:
20.4481 - val_loss: 69.8988 - val_mape: 14.0953
Epoch 17/50
132/132 [==============================] - 2s 12ms/step - loss: 97.8817 - mape:
20.0104 - val_loss: 47.2481 - val_mape: 14.2148
Epoch 18/50
132/132 [==============================] - 2s 12ms/step - loss: 104.8436 - mape:
19.9130 - val_loss: 82.8919 - val_mape: 15.2962
Epoch 19/50
132/132 [==============================] - 2s 12ms/step - loss: 96.8328 - mape:
19.8391 - val_loss: 28.1320 - val_mape: 11.8934
Epoch 20/50
132/132 [==============================] - 2s 12ms/step - loss: 107.9472 - mape:
20.1964 - val_loss: 88.0043 - val_mape: 16.1511
Epoch 21/50
132/132 [==============================] - 2s 15ms/step - loss: 96.7992 - mape:
19.6751 - val_loss: 57.4255 - val_mape: 12.0919
Epoch 22/50
132/132 [==============================] - 1s 11ms/step - loss: 100.3206 - mape:
19.6381 - val_loss: 58.9307 - val_mape: 13.7159
Epoch 23/50
132/132 [==============================] - 1s 10ms/step - loss: 95.0765 - mape:
18.7363 - val_loss: 27.5086 - val_mape: 10.9205
Epoch 24/50
132/132 [==============================] - 1s 11ms/step - loss: 89.3202 - mape:
18.8641 - val_loss: 72.7504 - val_mape: 12.4407
Epoch 25/50
132/132 [==============================] - 2s 12ms/step - loss: 98.4689 - mape:
18.8535 - val_loss: 42.3702 - val_mape: 12.3331
Epoch 26/50
```

```
132/132 [==============================] - 1s 10ms/step - loss: 96.4814 - mape:
19.0115 - val_loss: 34.1344 - val_mape: 10.7856
Epoch 27/50
132/132 [==============================] - 1s 10ms/step - loss: 96.3170 - mape:
18.5558 - val_loss: 50.3745 - val_mape: 12.4517
Epoch 28/50
132/132 [==============================] - 1s 10ms/step - loss: 95.5711 - mape:
18.5112 - val_loss: 78.5280 - val_mape: 13.0412
Epoch 29/50
132/132 [==============================] - 2s 12ms/step - loss: 85.3238 - mape:
17.9951 - val_loss: 63.0906 - val_mape: 13.0789
Epoch 30/50
132/132 [==============================] - 2s 14ms/step - loss: 94.6634 - mape:
18.1659 - val_loss: 77.7943 - val_mape: 15.6797
Epoch 31/50
132/132 [==============================] - 1s 11ms/step - loss: 96.4936 - mape:
18.0321 - val_loss: 78.4508 - val_mape: 14.7452
Epoch 32/50
132/132 [==============================] - 1s 10ms/step - loss: 90.2247 - mape:
18.0399 - val_loss: 63.3745 - val_mape: 12.7218
Epoch 33/50
132/132 [==============================] - 1s 11ms/step - loss: 89.0188 - mape:
17.5700 - val_loss: 64.5322 - val_mape: 12.2608
Epoch 34/50
132/132 [==============================] - 2s 12ms/step - loss: 93.9965 - mape:
17.9115 - val_loss: 79.4091 - val_mape: 13.2131
Epoch 35/50
132/132 [==============================] - 1s 10ms/step - loss: 94.8799 - mape:
18.0100 - val_loss: 140.9526 - val_mape: 20.3003
Epoch 36/50
132/132 [==============================] - 1s 10ms/step - loss: 87.5175 - mape:
17.6667 - val_loss: 75.3093 - val_mape: 12.5660
Epoch 37/50
132/132 [==============================] - 1s 11ms/step - loss: 77.9387 - mape:
16.9472 - val_loss: 68.4846 - val_mape: 14.1167
Epoch 38/50
132/132 [==============================] - 2s 15ms/step - loss: 84.5273 - mape:
17.1324 - val_loss: 99.3186 - val_mape: 14.9960
Epoch 39/50
132/132 [==============================] - 2s 14ms/step - loss: 85.3598 - mape:
17.2788 - val_loss: 73.4516 - val_mape: 12.4293
Epoch 40/50
132/132 [==============================] - 1s 11ms/step - loss: 83.4989 - mape:
16.6292 - val_loss: 59.0392 - val_mape: 11.9395
Epoch 41/50
132/132 [==============================] - 1s 10ms/step - loss: 84.1965 - mape:
17.1528 - val_loss: 75.8752 - val_mape: 12.4270
Epoch 42/50
```

```
132/132 [==============================] - 1s 11ms/step - loss: 78.0218 - mape:
16.7661 - val_loss: 69.6372 - val_mape: 12.7928
Epoch 43/50
132/132 [==============================] - 1s 10ms/step - loss: 86.2697 - mape:
17.0344 - val_loss: 77.3056 - val_mape: 13.6585
Epoch 44/50
132/132 [==============================] - 2s 12ms/step - loss: 78.1940 - mape:
16.6101 - val_loss: 52.3611 - val_mape: 11.3904
Epoch 45/50
132/132 [==============================] - 1s 10ms/step - loss: 83.0954 - mape:
16.7141 - val_loss: 69.3477 - val_mape: 11.5202
Epoch 46/50
132/132 [==============================] - 1s 10ms/step - loss: 83.5203 - mape:
16.8032 - val_loss: 62.1622 - val_mape: 12.6912
Epoch 47/50
132/132 [==============================] - 2s 15ms/step - loss: 83.8585 - mape:
16.5977 - val_loss: 93.2935 - val_mape: 13.8595
Epoch 48/50
132/132 [==============================] - 2s 12ms/step - loss: 79.1155 - mape:
16.5310 - val_loss: 76.2520 - val_mape: 12.3237
Epoch 49/50
132/132 [==============================] - 1s 10ms/step - loss: 78.2078 - mape:
16.3317 - val_loss: 141.0660 - val_mape: 17.0713
Epoch 50/50
132/132 [==============================] - 1s 10ms/step - loss: 84.8964 - mape:
16.3650 - val_loss: 82.9616 - val_mape: 13.4758
```

```
[11]: <keras.callbacks.History at 0x7f4338523190>
```

Based on the results above, we notice the model should be optimized to find the best
set of parameters which can provide a better prediction output. But before that, we
should encapsulate data process part into one function.

0.5   4. Encapsulate data process function

Different `mem_his_days`, `pre_days` and `df` will influence train result.

```python
[12]: def stock_price_LSTM_data_processing(df: pd.DataFrame, mem_his_days: list,
      ↪pre_days: list):
          df.dropna(inplace=True)
          df.sort_index(inplace=True)

          df['label'] = df['Close'].shift(-pre_days)

          scaler = StandardScaler()
          scale_X = scaler.fit_transform(df.iloc[:, :-1])

          deq = deque(maxlen=mem_his_days)
```

```python
        X = []
        for i in scale_X:
            deq.append(list(i))
            if len(deq) == mem_his_days:
                X.append(list(deq))

        X_lately = X[-pre_days :]
        X = np.array(X[: -pre_days])

        y = np.array(df['label'].values[mem_his_days - 1: -pre_days])

        return X, y, X_lately
```

Try to call the function and pass `df=df`, `mem_his_days=5`, `pre_days=10`.

```python
[13]: X, y, X_lately = stock_price_LSTM_data_processing(df=df, mem_his_days=5,␣
       ↪pre_days=10)
      print(X[0])
      print(len(X) == len(y), len(X_lately))
```

```
[[-1.01893333 -1.01603035 -1.02167181 -1.01859431  5.0928282 ]
 [-1.01822142 -1.01253104 -1.0184355  -1.01297783  2.20632025]
 [-1.0113561  -1.00946391 -1.01234069 -1.0122097   1.60081236]
 [-1.01101072 -1.01077441 -1.01624707 -1.01540201  1.20287471]
 [-1.01543723 -1.01328388 -1.01602609 -1.01460569  0.40155581]]
True 10
```

0.6 5. Optimize Model

5.1 Create list of `mem_days`, `lstm_layers`, `dense_layers`, `units`, and iterate them one by one to figure out the best set of parameters.

- `mem_days`: memory days

- `lstm_layers`: number of different LSTM layers

- `dense_layers`: number of different dense layers

- `units`: number of different neurons in each layer

  NOTE: the algorithm here is brute force. We can optimize it by using grid search in the future if you want.

```python
[14]: # Self-defined
      mem_days = [5, 10, 15]
      lstm_layers = [1, 2, 3]
      dense_layers = [1, 2, 3]
      # units = [8, 16, 32]
      units = [8, 16]
```

5.2 Find best model during the iteration Use `ModelCheckPoint` in Keras `Callbacks API` to find the best model in each training iteration. Reference keras Callbacks API ModelCheckPoint.

How many epochs should I train my model with?
- The right number of epochs depends on the inherent perplexity (or complexity) of your dataset. *A good rule of thumb is to start with a value that is 3 times the number of columns in your data.* If you find that the model is still improving after all epochs complete, try again with a higher value. If you find that the model stopped improving way before the final epoch, try again with a lower value as you may be overtraining. If you have only a small number of records in your dataset or are having a large number of records fail validation, you may need to increase the number of epochs significantly to help the neural network learn the structure of the data. (Reference How many epochs should I train my model with?)

```
[51]:  """
       Run the code below if you want to run the train again

       import shutil
       shutil.rmtree('./models')
       """
```

```
[51]:  "\nRun the code below if you want to run the train again\n\nimport
       shutil\nshutil.rmtree('./models')\n"
```

Note: It takes a really long time to run it more than 2 hours. You can use keyboard to interrupt it and continue to run other cells. It works well even if with an interruption. (Recommand run at least 20 minutes)

```
[17]:  count_1, count_2, count_3, count_4 = 0, 0, 0, 0
       for mem_day in mem_days:
           for lstm_layer in lstm_layers:
               for dense_layer in dense_layers:
                   for unit in units:
                       filepath = f'./models/{ticker}_' + '{val_mape:.2f}_{epoch:
        ↪02d}_' + f'mem_{mem_day}_lstm_{lstm_layer}_dense_{dense_layer}_unit_{unit}'
                       checkpoint = ModelCheckpoint(
                           filepath=filepath,
                           save_weights_only=False,
                           monitor='val_mape',
                           mode='min',
                           save_best_only=True
                       )
                       X, y, X_lately = stock_price_LSTM_data_processing(df=df,
        ↪mem_his_days=mem_day, pre_days=pre_days)
                       X_train, X_test, y_train, y_test = train_test_split(X, y,
        ↪shuffle=False, test_size=0.1)

                       # Train model in each iteration
                       model = Sequential()
```

```python
            for i in range(lstm_layer):
                # The first layer of Recurrent Neural Network shoule have
↪return_sequences and define input shape
                model.add(LSTM(unit, input_shape=X.shape[1: ],
↪activation='relu', return_sequences=True))

                # To avoid overfitting, use Dropout to remove .1 data
                model.add(Dropout(0.1))

            # Repeat to generate second and third layers
            model.add(LSTM(unit, activation='relu', return_sequences=True))
            model.add(Dropout(0.1))
            model.add(LSTM(unit, activation='relu'))
            model.add(Dropout(0.1))

            for i in range(dense_layer):
                # Generate Fully Connected layers
                model.add(Dense(unit, activation='relu'))
                model.add(Dropout(0.1))

            # Output layer
            model.add(Dense(1))

            # Compile model
            model.compile(optimizer='adam', loss='mse', metrics=['mape'])

            # Train model
            model.fit(X_train, y_train, batch_size=32, epochs=15,
↪validation_data=(X_test, y_test), callbacks=[checkpoint])
                count_1 += 1
                print('count_1', count_1)
            count_2 += 1
            print('count_2', count_2)
        count_3 += 1
        print('count_3', count_3)
    count_4 += 1
    print('count_4', count_4)
```

Epoch 1/15
131/132 [============================>.] - ETA: 0s - loss: 1146.8660 - mape:
89.4776

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

132/132 [==============================] - 14s 69ms/step - loss: 1146.5823 -
mape: 89.4539 - val_loss: 5664.6973 - val_mape: 52.0496

```
Epoch 2/15
130/132 [============================>.] - ETA: 0s - loss: 223.9070 - mape:
38.4756

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

132/132 [==============================] - 7s 56ms/step - loss: 223.0863 - mape:
38.4231 - val_loss: 70.9299 - val_mape: 5.8869
Epoch 3/15
132/132 [==============================] - 2s 12ms/step - loss: 120.4313 - mape:
27.4174 - val_loss: 355.8726 - val_mape: 13.8329
Epoch 4/15
132/132 [==============================] - 2s 15ms/step - loss: 121.3325 - mape:
27.0581 - val_loss: 175.0363 - val_mape: 8.8532
Epoch 5/15
132/132 [==============================] - 2s 13ms/step - loss: 100.4437 - mape:
26.0836 - val_loss: 166.2848 - val_mape: 9.0624
Epoch 6/15
132/132 [==============================] - 1s 10ms/step - loss: 93.2708 - mape:
24.8639 - val_loss: 126.4158 - val_mape: 7.6730
Epoch 7/15
132/132 [==============================] - 1s 10ms/step - loss: 84.1198 - mape:
24.0439 - val_loss: 80.6392 - val_mape: 6.2656
Epoch 8/15
132/132 [==============================] - ETA: 0s - loss: 90.2634 - mape:
24.0263

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

132/132 [==============================] - 8s 64ms/step - loss: 90.2634 - mape:
24.0263 - val_loss: 62.1215 - val_mape: 5.5357
Epoch 9/15
132/132 [==============================] - 2s 11ms/step - loss: 86.1684 - mape:
24.1234 - val_loss: 70.2400 - val_mape: 5.8838
Epoch 10/15
129/132 [===========================>.] - ETA: 0s - loss: 78.1379 - mape:
23.4598

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

132/132 [==============================] - 8s 60ms/step - loss: 77.3624 - mape:
23.4481 - val_loss: 61.0162 - val_mape: 5.4835
Epoch 11/15
132/132 [==============================] - ETA: 0s - loss: 75.4869 - mape:
22.4641

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.
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132/132 [==============================] - 9s 71ms/step - loss: 75.4869 - mape:
22.4641 - val_loss: 60.2124 - val_mape: 5.4587
Epoch 12/15
132/132 [==============================] - 1s 11ms/step - loss: 67.3687 - mape:
22.3962 - val_loss: 269.8875 - val_mape: 12.0903
Epoch 13/15
132/132 [==============================] - 1s 10ms/step - loss: 65.8137 - mape:
22.4918 - val_loss: 139.2440 - val_mape: 8.3284
Epoch 14/15
132/132 [==============================] - 1s 10ms/step - loss: 68.8816 - mape:
22.2217 - val_loss: 78.7418 - val_mape: 6.2298
Epoch 15/15
132/132 [==============================] - 2s 18ms/step - loss: 60.9713 - mape:
21.6595 - val_loss: 220.1416 - val_mape: 10.4922
count_1 1
Epoch 1/15
128/131 [===========================>.] - ETA: 0s - loss: 978.3328 - mape:
81.3947

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

131/131 [==============================] - 13s 65ms/step - loss: 961.5664 -
mape: 80.7120 - val_loss: 12074.3447 - val_mape: 78.4673
Epoch 2/15
129/131 [============================>.] - ETA: 0s - loss: 103.3254 - mape:
30.8895

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

131/131 [==============================] - 9s 66ms/step - loss: 102.8440 - mape:
30.7935 - val_loss: 272.9099 - val_mape: 10.2702
Epoch 3/15
128/131 [===========================>.] - ETA: 0s - loss: 75.6773 - mape:
25.6689

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

131/131 [==============================] - 8s 63ms/step - loss: 75.7721 - mape:
25.6317 - val_loss: 183.7032 - val_mape: 8.4507
Epoch 4/15
130/131 [============================>.] - ETA: 0s - loss: 67.3503 - mape:
24.0671

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

131/131 [==============================] - 10s 73ms/step - loss: 67.5584 - mape:
24.0793 - val_loss: 168.3621 - val_mape: 8.0951
Epoch 5/15
```

```
131/131 [==============================] - 2s 12ms/step - loss: 67.3278 - mape:
22.9392 - val_loss: 539.9341 - val_mape: 15.5142
Epoch 6/15
128/131 [============================>.] - ETA: 0s - loss: 59.8359 - mape:
21.6341

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

131/131 [==============================] - 8s 61ms/step - loss: 59.4222 - mape:
21.6974 - val_loss: 119.2245 - val_mape: 7.1241
Epoch 7/15
131/131 [==============================] - 2s 14ms/step - loss: 52.9938 - mape:
20.5045 - val_loss: 269.5659 - val_mape: 10.2941
Epoch 8/15
131/131 [==============================] - 1s 11ms/step - loss: 54.7800 - mape:
20.4380 - val_loss: 283.8654 - val_mape: 11.0988
Epoch 9/15
130/131 [============================>.] - ETA: 0s - loss: 50.0604 - mape:
20.0125

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

131/131 [==============================] - 8s 64ms/step - loss: 50.4541 - mape:
19.9970 - val_loss: 78.9752 - val_mape: 6.2950
Epoch 10/15
131/131 [==============================] - 3s 19ms/step - loss: 50.3579 - mape:
19.1266 - val_loss: 263.0486 - val_mape: 10.8047
Epoch 11/15
131/131 [==============================] - 2s 12ms/step - loss: 52.1208 - mape:
19.5150 - val_loss: 141.8943 - val_mape: 7.4476
Epoch 12/15
131/131 [==============================] - 1s 11ms/step - loss: 50.8160 - mape:
18.8882 - val_loss: 211.3912 - val_mape: 9.1527
Epoch 13/15
131/131 [==============================] - 1s 11ms/step - loss: 45.0844 - mape:
17.8728 - val_loss: 117.6582 - val_mape: 7.7355
Epoch 14/15
129/131 [============================>.] - ETA: 0s - loss: 47.3702 - mape:
18.5736

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

131/131 [==============================] - 9s 70ms/step - loss: 47.4626 - mape:
18.5410 - val_loss: 73.6293 - val_mape: 5.7997
Epoch 15/15
131/131 [==============================] - ETA: 0s - loss: 47.2087 - mape:
18.2659
```

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WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

131/131 [==============================] - 7s 54ms/step - loss: 47.2087 - mape:
18.2659 - val_loss: 69.1179 - val_mape: 5.7111
count_1 2
count_2 1
Epoch 1/15
131/131 [==============================] - ETA: 0s - loss: 1203.2112 - mape:
93.1408

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

131/131 [==============================] - 14s 66ms/step - loss: 1203.2112 -
mape: 93.1408 - val_loss: 35763.4062 - val_mape: 144.6911
Epoch 2/15
130/131 [===========================>.] - ETA: 0s - loss: 268.0453 - mape:
42.9164

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

131/131 [==============================] - 8s 64ms/step - loss: 267.4740 - mape:
42.8794 - val_loss: 87.3494 - val_mape: 6.4126
Epoch 3/15
131/131 [==============================] - 1s 10ms/step - loss: 184.0757 - mape:
36.6440 - val_loss: 87.3857 - val_mape: 6.5168
Epoch 4/15
131/131 [==============================] - 1s 10ms/step - loss: 171.6726 - mape:
33.8885 - val_loss: 89.7103 - val_mape: 6.6650
Epoch 5/15
131/131 [==============================] - 1s 10ms/step - loss: 168.2249 - mape:
34.5292 - val_loss: 271.1856 - val_mape: 12.3057
Epoch 6/15
131/131 [==============================] - 1s 11ms/step - loss: 153.1192 - mape:
32.7059 - val_loss: 116.5527 - val_mape: 7.6907
Epoch 7/15
131/131 [==============================] - 2s 15ms/step - loss: 141.1309 - mape:
32.2373 - val_loss: 89.6822 - val_mape: 6.4374
Epoch 8/15
131/131 [==============================] - 2s 12ms/step - loss: 130.5045 - mape:
30.8775 - val_loss: 878.6073 - val_mape: 23.8171
Epoch 9/15
131/131 [==============================] - 1s 11ms/step - loss: 141.1024 - mape:
31.5993 - val_loss: 447.5525 - val_mape: 16.6632
Epoch 10/15
131/131 [==============================] - 1s 10ms/step - loss: 123.9940 - mape:
30.4194 - val_loss: 415.8728 - val_mape: 15.8545
Epoch 11/15
```

```
131/131 [==============================] - 1s 11ms/step - loss: 125.7739 - mape:
29.4627 - val_loss: 249.3323 - val_mape: 11.8976
Epoch 12/15
131/131 [==============================] - 1s 11ms/step - loss: 113.6849 - mape:
27.9156 - val_loss: 213.3774 - val_mape: 10.8865
Epoch 13/15
131/131 [==============================] - 1s 10ms/step - loss: 110.4471 - mape:
28.0544 - val_loss: 191.1194 - val_mape: 10.1909
Epoch 14/15
131/131 [==============================] - 1s 10ms/step - loss: 114.6443 - mape:
27.3470 - val_loss: 207.6420 - val_mape: 10.7162
Epoch 15/15
131/131 [==============================] - 2s 12ms/step - loss: 104.1877 - mape:
26.3128 - val_loss: 570.5044 - val_mape: 18.9554
count_1 3
Epoch 1/15
130/131 [===========================>.] - ETA: 0s - loss: 837.3411 - mape:
77.7259

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

131/131 [==============================] - 15s 64ms/step - loss: 836.3219 -
mape: 77.6477 - val_loss: 542.7441 - val_mape: 16.0435
Epoch 2/15
127/131 [===========================>.] - ETA: 0s - loss: 87.5632 - mape:
28.1111

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

131/131 [==============================] - 8s 64ms/step - loss: 87.4620 - mape:
28.0199 - val_loss: 80.4957 - val_mape: 6.3156
Epoch 3/15
128/131 [===========================>.] - ETA: 0s - loss: 68.7092 - mape:
23.8909

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

131/131 [==============================] - 7s 57ms/step - loss: 69.0200 - mape:
23.9020 - val_loss: 64.0881 - val_mape: 5.6233
Epoch 4/15
131/131 [==============================] - 2s 16ms/step - loss: 58.1741 - mape:
22.5147 - val_loss: 140.0698 - val_mape: 8.3336
Epoch 5/15
131/131 [==============================] - 2s 13ms/step - loss: 57.1005 - mape:
20.0734 - val_loss: 109.3677 - val_mape: 7.3100
Epoch 6/15
131/131 [==============================] - 1s 11ms/step - loss: 47.4815 - mape:
18.5323 - val_loss: 198.4995 - val_mape: 9.9867
```

```
Epoch 7/15
131/131 [==============================] - 2s 13ms/step - loss: 42.0204 - mape:
18.3891 - val_loss: 164.7555 - val_mape: 9.0627
Epoch 8/15
131/131 [==============================] - 1s 11ms/step - loss: 42.7176 - mape:
17.4806 - val_loss: 151.6603 - val_mape: 8.7306
Epoch 9/15
131/131 [==============================] - 1s 11ms/step - loss: 39.1723 - mape:
16.6949 - val_loss: 387.3049 - val_mape: 14.4527
Epoch 10/15
131/131 [==============================] - 1s 11ms/step - loss: 36.2086 - mape:
15.4126 - val_loss: 284.8251 - val_mape: 12.5089
Epoch 11/15
131/131 [==============================] - 1s 11ms/step - loss: 39.1367 - mape:
16.2065 - val_loss: 287.0265 - val_mape: 12.3044
Epoch 12/15
131/131 [==============================] - 2s 16ms/step - loss: 35.8169 - mape:
15.5959 - val_loss: 383.6100 - val_mape: 14.4489
Epoch 13/15
131/131 [==============================] - 2s 12ms/step - loss: 35.1117 - mape:
15.6927 - val_loss: 1001.6277 - val_mape: 24.5332
Epoch 14/15
131/131 [==============================] - 2s 11ms/step - loss: 34.4419 - mape:
15.6851 - val_loss: 764.1104 - val_mape: 21.1712
Epoch 15/15
131/131 [==============================] - 1s 11ms/step - loss: 33.7581 - mape:
15.2375 - val_loss: 790.8043 - val_mape: 21.9370
count_1 4
count_2 2
Epoch 1/15
127/130 [===========================>.] - ETA: 0s - loss: 977.2615 - mape:
82.4561

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

130/130 [==============================] - 15s 63ms/step - loss: 962.6454 -
mape: 81.6828 - val_loss: 3450.9729 - val_mape: 39.2551
Epoch 2/15
130/130 [==============================] - ETA: 0s - loss: 273.5893 - mape:
43.0064

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

130/130 [==============================] - 9s 69ms/step - loss: 273.5893 - mape:
43.0064 - val_loss: 817.9623 - val_mape: 18.2259
Epoch 3/15
128/130 [============================>.] - ETA: 0s - loss: 205.4633 - mape:
37.7848
```

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WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

130/130 [==============================] - 8s 65ms/step - loss: 204.6305 - mape:
37.6631 - val_loss: 220.1983 - val_mape: 9.3395
Epoch 4/15
130/130 [==============================] - 1s 11ms/step - loss: 182.8852 - mape:
34.9834 - val_loss: 312.2413 - val_mape: 13.2635
Epoch 5/15
130/130 [==============================] - 2s 13ms/step - loss: 155.8042 - mape:
33.5136 - val_loss: 194.6272 - val_mape: 10.1224
Epoch 6/15
130/130 [==============================] - 1s 11ms/step - loss: 136.2875 - mape:
31.3610 - val_loss: 335.9604 - val_mape: 13.8263
Epoch 7/15
130/130 [==============================] - 2s 13ms/step - loss: 115.6831 - mape:
28.4576 - val_loss: 333.4860 - val_mape: 13.8095
Epoch 8/15
130/130 [==============================] - 2s 12ms/step - loss: 105.0609 - mape:
27.7591 - val_loss: 810.9379 - val_mape: 22.6065
Epoch 9/15
130/130 [==============================] - 2s 16ms/step - loss: 98.0993 - mape:
26.9610 - val_loss: 746.0375 - val_mape: 21.6272
Epoch 10/15
130/130 [==============================] - 2s 15ms/step - loss: 87.9409 - mape:
25.3844 - val_loss: 767.2962 - val_mape: 21.9031
Epoch 11/15
130/130 [==============================] - 1s 11ms/step - loss: 77.8709 - mape:
24.3429 - val_loss: 1243.8989 - val_mape: 28.1808
Epoch 12/15
130/130 [==============================] - 1s 11ms/step - loss: 81.1038 - mape:
23.6810 - val_loss: 484.2990 - val_mape: 16.8688
Epoch 13/15
130/130 [==============================] - 1s 11ms/step - loss: 77.4918 - mape:
22.9074 - val_loss: 1034.5048 - val_mape: 25.4664
Epoch 14/15
130/130 [==============================] - 1s 11ms/step - loss: 75.1577 - mape:
22.0306 - val_loss: 1328.4750 - val_mape: 28.9666
Epoch 15/15
130/130 [==============================] - 1s 11ms/step - loss: 67.2782 - mape:
21.8043 - val_loss: 1405.5477 - val_mape: 29.6581
count_1 5
Epoch 1/15
127/130 [===========================>.] - ETA: 0s - loss: 767.0884 - mape:
73.3926

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.
```

130/130 [==============================] - 14s 63ms/step - loss: 753.6151 -
mape: 72.4850 - val_loss: 634.9725 - val_mape: 16.3542
Epoch 2/15
127/130 [============================>.] - ETA: 0s - loss: 107.6124 - mape:
30.3719

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

130/130 [==============================] - 9s 72ms/step - loss: 107.2230 - mape:
30.3082 - val_loss: 135.3255 - val_mape: 7.7685
Epoch 3/15
130/130 [==============================] - ETA: 0s - loss: 86.6030 - mape:
25.2898

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

130/130 [==============================] - 10s 76ms/step - loss: 86.6030 - mape:
25.2898 - val_loss: 80.6072 - val_mape: 5.8638
Epoch 4/15
128/130 [============================>.] - ETA: 0s - loss: 69.7718 - mape:
21.2592

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

130/130 [==============================] - 9s 70ms/step - loss: 69.3481 - mape:
21.2162 - val_loss: 68.9830 - val_mape: 5.7204
Epoch 5/15
130/130 [==============================] - 2s 13ms/step - loss: 60.3903 - mape:
19.3670 - val_loss: 216.9355 - val_mape: 10.5685
Epoch 6/15
130/130 [==============================] - 2s 13ms/step - loss: 54.7238 - mape:
18.2548 - val_loss: 265.9447 - val_mape: 11.8583
Epoch 7/15
130/130 [==============================] - 2s 12ms/step - loss: 48.0090 - mape:
17.6424 - val_loss: 457.9850 - val_mape: 15.9636
Epoch 8/15
130/130 [==============================] - 2s 14ms/step - loss: 48.9257 - mape:
16.8958 - val_loss: 1139.1998 - val_mape: 26.3031
Epoch 9/15
130/130 [==============================] - 2s 13ms/step - loss: 45.0948 - mape:
16.8976 - val_loss: 695.9478 - val_mape: 20.0834
Epoch 10/15
130/130 [==============================] - 1s 11ms/step - loss: 44.1922 - mape:
16.7580 - val_loss: 1167.8495 - val_mape: 26.6274
Epoch 11/15
130/130 [==============================] - 2s 15ms/step - loss: 42.1401 - mape:
16.5586 - val_loss: 805.1124 - val_mape: 21.7673
Epoch 12/15

```
130/130 [==============================] - 2s 16ms/step - loss: 43.6798 - mape:
16.9726 - val_loss: 565.0766 - val_mape: 17.9079
Epoch 13/15
130/130 [==============================] - 1s 11ms/step - loss: 41.2229 - mape:
16.3648 - val_loss: 373.3987 - val_mape: 14.0855
Epoch 14/15
130/130 [==============================] - 1s 11ms/step - loss: 38.5970 - mape:
16.3752 - val_loss: 662.4541 - val_mape: 19.6048
Epoch 15/15
130/130 [==============================] - 1s 11ms/step - loss: 37.9570 - mape:
16.2700 - val_loss: 423.7607 - val_mape: 15.2430
count_1 6
count_2 3
count_3 1
Epoch 1/15
130/130 [==============================] - ETA: 0s - loss: 1019.9604 - mape:
85.9246

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

130/130 [==============================] - 18s 85ms/step - loss: 1019.9604 -
mape: 85.9246 - val_loss: 1175.3735 - val_mape: 27.6729
Epoch 2/15
127/130 [==========================>.] - ETA: 0s - loss: 155.0008 - mape:
37.3261

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

130/130 [==============================] - 11s 82ms/step - loss: 154.2739 -
mape: 37.2313 - val_loss: 128.6938 - val_mape: 7.3060
Epoch 3/15
130/130 [==============================] - 2s 15ms/step - loss: 115.0536 - mape:
32.7372 - val_loss: 578.9918 - val_mape: 15.8104
Epoch 4/15
130/130 [==============================] - 3s 20ms/step - loss: 99.3000 - mape:
31.7264 - val_loss: 229.0897 - val_mape: 9.4124
Epoch 5/15
130/130 [==============================] - 2s 14ms/step - loss: 86.5775 - mape:
30.0818 - val_loss: 209.7687 - val_mape: 8.9767
Epoch 6/15
130/130 [==============================] - 2s 13ms/step - loss: 84.8503 - mape:
29.6010 - val_loss: 126.1805 - val_mape: 7.3658
Epoch 7/15
130/130 [==============================] - 2s 13ms/step - loss: 85.9033 - mape:
28.8623 - val_loss: 159.5277 - val_mape: 7.8387
Epoch 8/15
130/130 [==============================] - 2s 15ms/step - loss: 78.8984 - mape:
28.0053 - val_loss: 148.5043 - val_mape: 7.5375
```

```
Epoch 9/15
130/130 [==============================] - 2s 14ms/step - loss: 75.3291 - mape:
26.8877 - val_loss: 243.4504 - val_mape: 9.8852
Epoch 10/15
130/130 [==============================] - ETA: 0s - loss: 67.4155 - mape:
25.6069

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

130/130 [==============================] - 10s 77ms/step - loss: 67.4155 - mape:
25.6069 - val_loss: 103.8000 - val_mape: 6.9597
Epoch 11/15
130/130 [==============================] - 2s 13ms/step - loss: 67.1174 - mape:
24.8337 - val_loss: 105.7183 - val_mape: 7.3524
Epoch 12/15
129/130 [============================>.] - ETA: 0s - loss: 60.1574 - mape:
23.6061

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

130/130 [==============================] - 10s 81ms/step - loss: 60.1040 - mape:
23.6341 - val_loss: 102.2066 - val_mape: 6.3590
Epoch 13/15
130/130 [==============================] - 2s 14ms/step - loss: 58.8987 - mape:
23.5231 - val_loss: 100.7723 - val_mape: 7.1714
Epoch 14/15
130/130 [==============================] - 2s 14ms/step - loss: 53.5930 - mape:
22.4549 - val_loss: 177.5475 - val_mape: 9.6800
Epoch 15/15
130/130 [==============================] - 2s 19ms/step - loss: 51.7869 - mape:
21.9617 - val_loss: 181.9721 - val_mape: 9.8193
count_1 7
Epoch 1/15
130/130 [==============================] - ETA: 0s - loss: 771.4644 - mape:
75.3644

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

130/130 [==============================] - 18s 93ms/step - loss: 771.4644 -
mape: 75.3644 - val_loss: 14049.0947 - val_mape: 84.6489
Epoch 2/15
128/130 [============================>.] - ETA: 0s - loss: 89.8336 - mape:
28.3518

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

130/130 [==============================] - 10s 75ms/step - loss: 89.6635 - mape:
28.3060 - val_loss: 1342.4717 - val_mape: 23.6482
```

```
Epoch 3/15
129/130 [============================>.] - ETA: 0s - loss: 69.2100 - mape:
25.0754

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

130/130 [==============================] - 10s 79ms/step - loss: 69.1642 - mape:
25.0673 - val_loss: 1041.0670 - val_mape: 20.5911
Epoch 4/15
130/130 [==============================] - ETA: 0s - loss: 64.1705 - mape:
23.6020

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

130/130 [==============================] - 11s 84ms/step - loss: 64.1705 - mape:
23.6020 - val_loss: 306.4174 - val_mape: 10.9421
Epoch 5/15
130/130 [==============================] - 2s 14ms/step - loss: 52.7607 - mape:
22.1634 - val_loss: 439.1442 - val_mape: 12.9748
Epoch 6/15
130/130 [==============================] - 2s 15ms/step - loss: 49.0821 - mape:
21.5490 - val_loss: 531.9484 - val_mape: 14.9893
Epoch 7/15
130/130 [==============================] - 3s 21ms/step - loss: 44.1967 - mape:
20.9410 - val_loss: 426.7145 - val_mape: 13.1244
Epoch 8/15
130/130 [==============================] - ETA: 0s - loss: 46.0347 - mape:
20.7551

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

130/130 [==============================] - 10s 78ms/step - loss: 46.0347 - mape:
20.7551 - val_loss: 258.4045 - val_mape: 9.9702
Epoch 9/15
128/130 [============================>.] - ETA: 0s - loss: 46.7472 - mape:
20.3986

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

130/130 [==============================] - 10s 78ms/step - loss: 46.5884 - mape:
20.3838 - val_loss: 158.7436 - val_mape: 7.7641
Epoch 10/15
130/130 [==============================] - 2s 14ms/step - loss: 41.5288 - mape:
19.8872 - val_loss: 124.4824 - val_mape: 7.9891
Epoch 11/15
127/130 [===========================>.] - ETA: 0s - loss: 40.1423 - mape:
18.9382
```

```
WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

130/130 [==============================] - 11s 82ms/step - loss: 40.3747 - mape:
18.9427 - val_loss: 97.1954 - val_mape: 6.4624
Epoch 12/15
130/130 [==============================] - 2s 14ms/step - loss: 39.7390 - mape:
19.3388 - val_loss: 93.0049 - val_mape: 6.8356
Epoch 13/15
130/130 [==============================] - 2s 15ms/step - loss: 39.4825 - mape:
18.9799 - val_loss: 150.6840 - val_mape: 7.8183
Epoch 14/15
130/130 [==============================] - 3s 22ms/step - loss: 38.3065 - mape:
18.4282 - val_loss: 206.7547 - val_mape: 10.4488
Epoch 15/15
130/130 [==============================] - 2s 15ms/step - loss: 37.3074 - mape:
18.4133 - val_loss: 100.1898 - val_mape: 7.0502
count_1 8
count_2 4
Epoch 1/15
127/129 [============================>.] - ETA: 0s - loss: 881.3018 - mape:
81.7770

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

129/129 [==============================] - 20s 99ms/step - loss: 871.0332 -
mape: 81.3483 - val_loss: 333.8148 - val_mape: 13.5796
Epoch 2/15
129/129 [==============================] - 2s 15ms/step - loss: 157.1144 - mape:
42.5586 - val_loss: 650.6488 - val_mape: 18.8606
Epoch 3/15
129/129 [==============================] - 2s 14ms/step - loss: 121.3946 - mape:
35.3555 - val_loss: 2433.7915 - val_mape: 38.3953
Epoch 4/15
129/129 [==============================] - 2s 14ms/step - loss: 113.9369 - mape:
32.4203 - val_loss: 1096.9984 - val_mape: 24.8669
Epoch 5/15
129/129 [==============================] - 2s 14ms/step - loss: 110.4340 - mape:
31.6332 - val_loss: 2048.1885 - val_mape: 35.2588
Epoch 6/15
129/129 [==============================] - 2s 17ms/step - loss: 102.3196 - mape:
28.2461 - val_loss: 1678.1948 - val_mape: 31.9012
Epoch 7/15
129/129 [==============================] - 2s 19ms/step - loss: 100.0063 - mape:
27.2569 - val_loss: 1327.2432 - val_mape: 27.5215
Epoch 8/15
129/129 [==============================] - 2s 15ms/step - loss: 89.7029 - mape:
26.4669 - val_loss: 1546.7439 - val_mape: 29.9208
```

```
Epoch 9/15
129/129 [==============================] - 2s 16ms/step - loss: 83.0794 - mape:
25.6574 - val_loss: 1514.3887 - val_mape: 29.6112
Epoch 10/15
129/129 [==============================] - ETA: 0s - loss: 80.0014 - mape:
25.1476

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

129/129 [==============================] - 11s 82ms/step - loss: 80.0014 - mape:
25.1476 - val_loss: 245.1320 - val_mape: 11.5586
Epoch 11/15
129/129 [==============================] - 2s 16ms/step - loss: 79.4326 - mape:
25.6569 - val_loss: 437.7352 - val_mape: 16.1823
Epoch 12/15
129/129 [==============================] - 2s 15ms/step - loss: 77.7241 - mape:
25.1646 - val_loss: 1074.0062 - val_mape: 25.1905
Epoch 13/15
129/129 [==============================] - 2s 15ms/step - loss: 69.5123 - mape:
24.7707 - val_loss: 323.7838 - val_mape: 13.4846
Epoch 14/15
129/129 [==============================] - 2s 16ms/step - loss: 66.2457 - mape:
23.9706 - val_loss: 1139.6680 - val_mape: 26.4754
Epoch 15/15
129/129 [==============================] - 2s 19ms/step - loss: 69.9168 - mape:
23.7950 - val_loss: 594.1260 - val_mape: 19.1430
count_1 9
Epoch 1/15
126/129 [===========================>.] - ETA: 0s - loss: 755.5112 - mape:
73.7537

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

129/129 [==============================] - 18s 91ms/step - loss: 742.6364 -
mape: 73.1818 - val_loss: 13086.4160 - val_mape: 80.9475
Epoch 2/15
126/129 [===========================>.] - ETA: 0s - loss: 100.5636 - mape:
32.4133

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

129/129 [==============================] - 11s 86ms/step - loss: 100.0267 -
mape: 32.3116 - val_loss: 2055.3916 - val_mape: 29.4644
Epoch 3/15
129/129 [==============================] - ETA: 0s - loss: 80.6786 - mape:
29.0013

WARNING:absl:Found untraced functions such as _update_step_xla while saving
```

(showing 1 of 1). These functions will not be directly callable after loading.

129/129 [==============================] - 12s 95ms/step - loss: 80.6786 - mape: 29.0013 - val_loss: 1182.5741 - val_mape: 21.6682
Epoch 4/15
129/129 [==============================] - ETA: 0s - loss: 72.0574 - mape: 26.3098

WARNING:absl:Found untraced functions such as _update_step_xla while saving (showing 1 of 1). These functions will not be directly callable after loading.

129/129 [==============================] - 11s 85ms/step - loss: 72.0574 - mape: 26.3098 - val_loss: 553.1965 - val_mape: 14.8241
Epoch 5/15
129/129 [==============================] - 2s 14ms/step - loss: 63.1541 - mape: 23.3688 - val_loss: 708.7888 - val_mape: 17.3348
Epoch 6/15
129/129 [==============================] - ETA: 0s - loss: 54.3548 - mape: 21.8887

WARNING:absl:Found untraced functions such as _update_step_xla while saving (showing 1 of 1). These functions will not be directly callable after loading.

129/129 [==============================] - 11s 88ms/step - loss: 54.3548 - mape: 21.8887 - val_loss: 406.0430 - val_mape: 12.7962
Epoch 7/15
129/129 [==============================] - ETA: 0s - loss: 49.3990 - mape: 20.8633

WARNING:absl:Found untraced functions such as _update_step_xla while saving (showing 1 of 1). These functions will not be directly callable after loading.

129/129 [==============================] - 12s 90ms/step - loss: 49.3990 - mape: 20.8633 - val_loss: 159.5759 - val_mape: 7.8701
Epoch 8/15
127/129 [===========================>.] - ETA: 0s - loss: 48.2927 - mape: 19.9543

WARNING:absl:Found untraced functions such as _update_step_xla while saving (showing 1 of 1). These functions will not be directly callable after loading.

129/129 [==============================] - 11s 84ms/step - loss: 48.0090 - mape: 19.8945 - val_loss: 108.6791 - val_mape: 7.3255
Epoch 9/15
129/129 [==============================] - 2s 15ms/step - loss: 45.2328 - mape: 19.3643 - val_loss: 155.8314 - val_mape: 9.0343
Epoch 10/15
129/129 [==============================] - 2s 15ms/step - loss: 43.4720 - mape: 18.6430 - val_loss: 116.1205 - val_mape: 7.7005
Epoch 11/15
129/129 [==============================] - 2s 15ms/step - loss: 40.3626 - mape: 17.9783 - val_loss: 244.1365 - val_mape: 11.6579

```
Epoch 12/15
129/129 [==============================] - 2s 15ms/step - loss: 42.0328 - mape:
17.6881 - val_loss: 148.3695 - val_mape: 8.7989
Epoch 13/15
129/129 [==============================] - 2s 16ms/step - loss: 40.7021 - mape:
16.9481 - val_loss: 318.9382 - val_mape: 13.5730
Epoch 14/15
129/129 [==============================] - 3s 21ms/step - loss: 41.4756 - mape:
17.3408 - val_loss: 136.5496 - val_mape: 8.3341
Epoch 15/15
129/129 [==============================] - 2s 17ms/step - loss: 39.7591 - mape:
17.1973 - val_loss: 424.9669 - val_mape: 15.8281
count_1 10
count_2 5
Epoch 1/15
129/129 [==============================] - ETA: 0s - loss: 1009.6121 - mape:
90.6140

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

129/129 [==============================] - 20s 100ms/step - loss: 1009.6121 -
mape: 90.6140 - val_loss: 21183.3066 - val_mape: 106.5595
Epoch 2/15
129/129 [==============================] - ETA: 0s - loss: 192.8711 - mape:
38.4432

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

129/129 [==============================] - 11s 85ms/step - loss: 192.8711 -
mape: 38.4432 - val_loss: 97.1903 - val_mape: 6.4095
Epoch 3/15
127/129 [===========================>.] - ETA: 0s - loss: 150.7869 - mape:
32.4066

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

129/129 [==============================] - 12s 96ms/step - loss: 151.0483 -
mape: 32.3894 - val_loss: 88.9448 - val_mape: 6.3341
Epoch 4/15
129/129 [==============================] - 2s 14ms/step - loss: 141.8115 - mape:
32.3166 - val_loss: 743.4461 - val_mape: 21.5070
Epoch 5/15
129/129 [==============================] - 2s 16ms/step - loss: 127.2385 - mape:
30.5406 - val_loss: 890.7318 - val_mape: 23.5025
Epoch 6/15
129/129 [==============================] - 3s 20ms/step - loss: 106.4718 - mape:
28.9110 - val_loss: 754.0087 - val_mape: 21.7401
Epoch 7/15
```

```
129/129 [==============================] - 2s 14ms/step - loss: 102.5756 - mape:
27.3374 - val_loss: 526.5107 - val_mape: 17.4282
Epoch 8/15
129/129 [==============================] - 2s 14ms/step - loss: 85.5169 - mape:
26.0517 - val_loss: 1116.9513 - val_mape: 26.3071
Epoch 9/15
129/129 [==============================] - 2s 14ms/step - loss: 84.5702 - mape:
26.0238 - val_loss: 1430.9248 - val_mape: 29.8591
Epoch 10/15
129/129 [==============================] - 2s 14ms/step - loss: 77.6350 - mape:
25.3073 - val_loss: 795.3586 - val_mape: 22.2011
Epoch 11/15
129/129 [==============================] - 2s 16ms/step - loss: 82.9134 - mape:
25.0134 - val_loss: 1471.0479 - val_mape: 29.9837
Epoch 12/15
129/129 [==============================] - 3s 21ms/step - loss: 73.9511 - mape:
24.0921 - val_loss: 946.3447 - val_mape: 23.9924
Epoch 13/15
129/129 [==============================] - 2s 14ms/step - loss: 71.2630 - mape:
23.4920 - val_loss: 1419.2104 - val_mape: 29.5870
Epoch 14/15
129/129 [==============================] - 2s 14ms/step - loss: 65.2725 - mape:
22.8534 - val_loss: 1556.3625 - val_mape: 31.2575
Epoch 15/15
129/129 [==============================] - 2s 14ms/step - loss: 64.1015 - mape:
22.7945 - val_loss: 1872.8114 - val_mape: 34.1936
count_1 11
Epoch 1/15
125/128 [===========================>.] - ETA: 0s - loss: 647.9061 - mape:
68.7547

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

128/128 [==============================] - 18s 91ms/step - loss: 634.6601 -
mape: 68.0153 - val_loss: 6858.3716 - val_mape: 56.0154
Epoch 2/15
128/128 [==============================] - ETA: 0s - loss: 121.5750 - mape:
33.7583

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

128/128 [==============================] - 11s 89ms/step - loss: 121.5750 -
mape: 33.7583 - val_loss: 358.7669 - val_mape: 11.8324
Epoch 3/15
128/128 [==============================] - 2s 19ms/step - loss: 96.1196 - mape:
29.6224 - val_loss: 502.4892 - val_mape: 14.7176
Epoch 4/15
127/128 [==========================>.] - ETA: 0s - loss: 76.4106 - mape:
```

25.9544

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

128/128 [==============================] - 12s 94ms/step - loss: 76.1230 - mape:
25.9492 - val_loss: 117.7498 - val_mape: 7.3510
Epoch 5/15
128/128 [==============================] - 2s 16ms/step - loss: 67.9177 - mape:
24.4409 - val_loss: 139.1196 - val_mape: 8.2865
Epoch 6/15
128/128 [==============================] - 3s 22ms/step - loss: 63.6704 - mape:
23.9492 - val_loss: 263.8934 - val_mape: 12.1390
Epoch 7/15
128/128 [==============================] - 2s 15ms/step - loss: 56.7406 - mape:
22.0494 - val_loss: 445.7223 - val_mape: 16.3298
Epoch 8/15
128/128 [==============================] - 2s 14ms/step - loss: 53.4190 - mape:
21.4251 - val_loss: 510.8817 - val_mape: 17.7380
Epoch 9/15
128/128 [==============================] - 2s 14ms/step - loss: 48.2355 - mape:
20.4043 - val_loss: 255.5850 - val_mape: 11.9485
Epoch 10/15
128/128 [==============================] - 2s 14ms/step - loss: 50.3533 - mape:
20.0579 - val_loss: 310.4363 - val_mape: 13.3050
Epoch 11/15
128/128 [==============================] - 2s 15ms/step - loss: 44.4106 - mape:
19.3705 - val_loss: 837.3033 - val_mape: 23.2248
Epoch 12/15
128/128 [==============================] - 2s 18ms/step - loss: 50.8355 - mape:
20.1475 - val_loss: 500.2334 - val_mape: 17.4635
Epoch 13/15
128/128 [==============================] - 2s 18ms/step - loss: 45.2331 - mape:
19.5753 - val_loss: 701.1188 - val_mape: 21.0765
Epoch 14/15
128/128 [==============================] - 2s 15ms/step - loss: 45.9374 - mape:
19.2764 - val_loss: 380.5201 - val_mape: 14.9943
Epoch 15/15
128/128 [==============================] - 2s 14ms/step - loss: 41.6437 - mape:
18.2301 - val_loss: 508.8809 - val_mape: 17.6403
count_1 12
count_2 6
count_3 2
Epoch 1/15
127/128 [===========================>.] - ETA: 0s - loss: 974.6777 - mape:
92.2238

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

```
128/128 [==============================] - 23s 105ms/step - loss: 970.8934 -
mape: 91.9735 - val_loss: 32798.3281 - val_mape: 127.4572
Epoch 2/15
126/128 [============================>.] - ETA: 0s - loss: 221.4091 - mape:
58.6088

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

128/128 [==============================] - 12s 97ms/step - loss: 220.2110 -
mape: 58.5129 - val_loss: 665.3299 - val_mape: 16.0416
Epoch 3/15
128/128 [==============================] - ETA: 0s - loss: 100.6368 - mape:
30.1396

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

128/128 [==============================] - 13s 100ms/step - loss: 100.6368 -
mape: 30.1396 - val_loss: 336.8234 - val_mape: 12.2870
Epoch 4/15
128/128 [==============================] - 2s 19ms/step - loss: 87.3638 - mape:
25.6925 - val_loss: 701.6189 - val_mape: 16.6099
Epoch 5/15
128/128 [==============================] - 2s 17ms/step - loss: 77.4254 - mape:
25.2625 - val_loss: 722.6816 - val_mape: 17.2845
Epoch 6/15
128/128 [==============================] - ETA: 0s - loss: 74.2037 - mape:
25.0279

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

128/128 [==============================] - 12s 98ms/step - loss: 74.2037 - mape:
25.0279 - val_loss: 378.7099 - val_mape: 12.0957
Epoch 7/15
128/128 [==============================] - 2s 17ms/step - loss: 68.0479 - mape:
25.2564 - val_loss: 611.0264 - val_mape: 15.5896
Epoch 8/15
125/128 [============================>.] - ETA: 0s - loss: 64.8131 - mape:
24.4525

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.
Exception ignored in: <function ConcreteFunctionGarbageCollector.__del__ at
0x7f4350c400d0>
Traceback (most recent call last):
  File "/usr/local/lib/python3.10/dist-
packages/tensorflow/python/eager/polymorphic_function/monomorphic_function.py",
line 2317, in __del__
    def __del__(self):
```

```
KeyboardInterrupt:

128/128 [==============================] - 12s 98ms/step - loss: 65.5572 - mape:
24.5289 - val_loss: 200.6124 - val_mape: 8.6495
Epoch 9/15
128/128 [==============================] - 2s 17ms/step - loss: 65.7638 - mape:
24.8986 - val_loss: 456.2079 - val_mape: 13.3536
Epoch 10/15
128/128 [==============================] - ETA: 0s - loss: 68.6449 - mape:
24.5819

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.

128/128 [==============================] - 12s 95ms/step - loss: 68.6449 - mape:
24.5819 - val_loss: 172.4734 - val_mape: 8.2677
Epoch 11/15
128/128 [==============================] - ETA: 0s - loss: 62.7278 - mape:
24.4127

WARNING:absl:Found untraced functions such as _update_step_xla while saving
(showing 1 of 1). These functions will not be directly callable after loading.
```

```
---------------------------------------------------------------------------
KeyboardInterrupt                         Traceback (most recent call last)
<ipython-input-17-330b3a615c4c> in <cell line: 2>()
     43
     44                   # Train model
---> 45                   model.fit(X_train, y_train, batch_size=32, epochs=15,␣
  ↪validation_data=(X_test, y_test), callbacks=[checkpoint])
     46                   count_1 += 1
     47                   print('count_1', count_1)


/usr/local/lib/python3.10/dist-packages/keras/utils/traceback_utils.py in␣
  ↪error_handler(*args, **kwargs)
     63          filtered_tb = None
     64          try:
---> 65              return fn(*args, **kwargs)
     66          except Exception as e:
     67              filtered_tb = _process_traceback_frames(e.__traceback__)


/usr/local/lib/python3.10/dist-packages/keras/engine/training.py in fit(self, x␣
  ↪y, batch_size, epochs, verbose, callbacks, validation_split, validation_data,␣
  ↪shuffle, class_weight, sample_weight, initial_epoch, steps_per_epoch,␣
  ↪validation_steps, validation_batch_size, validation_freq, max_queue_size,␣
  ↪workers, use_multiprocessing)
   1745                   epoch_logs.update(val_logs)
   1746
-> 1747                   callbacks.on_epoch_end(epoch, epoch_logs)
   1748                   training_logs = epoch_logs
```

```
1749                    if self.stop_training:


/usr/local/lib/python3.10/dist-packages/keras/callbacks.py in on_epoch_end(self ⌐
 ↪epoch, logs)
    451            logs = self._process_logs(logs)
    452            for callback in self.callbacks:
--> 453                callback.on_epoch_end(epoch, logs)
    454
    455        def on_train_batch_begin(self, batch, logs=None):


/usr/local/lib/python3.10/dist-packages/keras/callbacks.py in on_epoch_end(self ⌐
 ↪epoch, logs)
   1473
   1474            if self.save_freq == "epoch":
-> 1475                self._save_model(epoch=epoch, batch=None, logs=logs)
   1476
   1477        def _should_save_on_batch(self, batch):


/usr/local/lib/python3.10/dist-packages/keras/callbacks.py in _save_model(self, ⌐
 ↪epoch, batch, logs)
   1543                                )
   1544                            else:
-> 1545                                self.model.save(

   1546                                    filepath,
   1547                                    overwrite=True,


/usr/local/lib/python3.10/dist-packages/keras/utils/traceback_utils.py in ⌐
 ↪error_handler(*args, **kwargs)
     63            filtered_tb = None
     64            try:
---> 65                return fn(*args, **kwargs)
     66            except Exception as e:
     67                filtered_tb = _process_traceback_frames(e.__traceback__)


/usr/local/lib/python3.10/dist-packages/keras/engine/training.py in save(self, ⌐
 ↪filepath, overwrite, save_format, **kwargs)
   2824            Note that `model.save()` is an alias for `tf.keras.models.
 ↪save_model()`.
   2825            """
-> 2826            saving_api.save_model(

   2827                self,
   2828                filepath=filepath,


/usr/local/lib/python3.10/dist-packages/keras/saving/saving_api.py in ⌐
 ↪save_model(model, filepath, overwrite, save_format, **kwargs)
    143        else:
    144            # Legacy case
```

```
--> 145            return legacy_sm_saving_lib.save_model(

    146                model,
    147                filepath,


/usr/local/lib/python3.10/dist-packages/keras/utils/traceback_utils.py in␣
 ↪error_handler(*args, **kwargs)
     63            filtered_tb = None
     64            try:
---> 65                return fn(*args, **kwargs)
     66            except Exception as e:
     67                filtered_tb = _process_traceback_frames(e.__traceback__)


/usr/local/lib/python3.10/dist-packages/keras/saving/legacy/save.py in␣
 ↪save_model(model, filepath, overwrite, include_optimizer, save_format,␣
 ↪signatures, options, save_traces)
    166                save_traces=save_traces, in_tf_saved_model_scope=True
    167            ):
--> 168                saved_model_save.save(

    169                    model,
    170                    filepath,


/usr/local/lib/python3.10/dist-packages/keras/saving/legacy/saved_model/save.py␣
 ↪in save(model, filepath, overwrite, include_optimizer, signatures, options,␣
 ↪save_traces)
     96        with backend.deprecated_internal_learning_phase_scope(0):
     97            with utils.keras_option_scope(save_traces):
---> 98                saved_nodes, node_paths = save_lib.save_and_return_nodes(

     99                    model, filepath, signatures, options
    100                )


KeyboardInterrupt:
```

5.3 Load Best Model   Use `os` module to get all sub-folders in the model folder and find the minimum value of `MAPE`, which is the best model. Get the name of that folder as model name we are going to load. Use `load_model` to load the best model, and in this name of model folder, we can easily figure out all parameters this best model use. Reference keras load_model link

5.3.1 Find the model name with minimum value of `MAPE`

```python
[34]: dir_list = os.listdir('./models')
mape_list = []
for dir in dir_list:
    if dir.__contains__('checkpoints'):
        continue
    else:
        mape_list.append(float(dir.split('_')[1]))
```

```python
min_mape = min(mape_list)
best_model_name = ''
for dir in dir_list:
    if dir.__contains__(str(min_mape)):
        best_model_name = dir
        break
```

```
5.46
GOOGL_5.46_11_mem_5_lstm_1_dense_1_unit_8
```

5.3.2 Load Best Model

[36]:
```python
best_model = load_model(f'./models/{best_model_name}')
```

[37]:
```python
best_model.summary()
```

```
Model: "sequential_2"

_____
 Layer (type)                Output Shape              Param #
=================================================================
 lstm_6 (LSTM)               (None, 5, 8)              448

 dropout_8 (Dropout)         (None, 5, 8)              0

 lstm_7 (LSTM)               (None, 5, 8)              544

 dropout_9 (Dropout)         (None, 5, 8)              0

 lstm_8 (LSTM)               (None, 8)                 544

 dropout_10 (Dropout)        (None, 8)                 0

 dense_4 (Dense)             (None, 8)                 72

 dropout_11 (Dropout)        (None, 8)                 0

 dense_5 (Dense)             (None, 1)                 9

=================================================================
Total params: 1,617
Trainable params: 1,617
Non-trainable params: 0
_____
```

[38]:
```python
best_model.evaluate(X_test, y_test)
```

```
15/15 [==============================] - 1s 4ms/step - loss: 52.3332 - mape:
4.7546
```

```
[38]: [52.33316421508789, 4.754550933837891]
```

```
[43]: pred = best_model.predict(X_test)
```

```
15/15 [==============================] - 1s 5ms/step
```

0.7 6. Prediction and Visualization

Use `matplotlib` to display prediction results.

```
[45]: df_time = df.index[-len(y_test): ]
      plt.plot(df_time, y_test, color='red', label='price')
      plt.plot(df_time, pred, color='green', label='predict')
      plt.show()
```
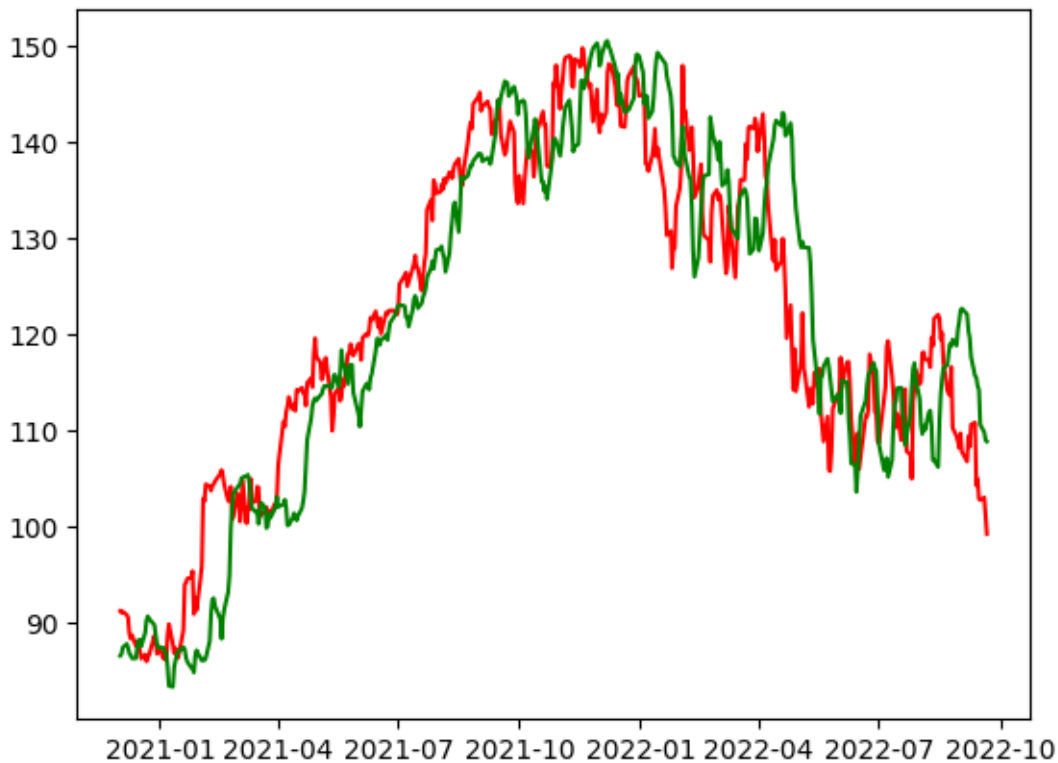


```
[49]: !zip -r /content/models.zip /content/models
```

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  adding: content/models/ (stored 0%)
  adding: content/models/GOOGL_8.45_03_mem_5_lstm_1_dense_1_unit_16/ (stored 0%)
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content/models/GOOGL_5.46_11_mem_5_lstm_1_dense_1_unit_8/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_5.46_11_mem_5_lstm_1_dense_1_unit_8/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_5.46_11_mem_5_lstm_1_dense_1_unit_8/assets/
(stored 0%)
  adding: content/models/GOOGL_5.46_11_mem_5_lstm_1_dense_1_unit_8/variables/
(stored 0%)
  adding: content/models/GOOGL_5.46_11_mem_5_lstm_1_dense_1_unit_8/variables/var
iables.data-00000-of-00001 (deflated 36%)
  adding: content/models/GOOGL_5.46_11_mem_5_lstm_1_dense_1_unit_8/variables/var
iables.index (deflated 67%)
  adding: content/models/GOOGL_52.05_01_mem_5_lstm_1_dense_1_unit_8/ (stored 0%)
  adding:
content/models/GOOGL_52.05_01_mem_5_lstm_1_dense_1_unit_8/keras_metadata.pb
(deflated 92%)
  adding:
content/models/GOOGL_52.05_01_mem_5_lstm_1_dense_1_unit_8/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_52.05_01_mem_5_lstm_1_dense_1_unit_8/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_52.05_01_mem_5_lstm_1_dense_1_unit_8/assets/
(stored 0%)
  adding: content/models/GOOGL_52.05_01_mem_5_lstm_1_dense_1_unit_8/variables/
(stored 0%)
  adding: content/models/GOOGL_52.05_01_mem_5_lstm_1_dense_1_unit_8/variables/va
riables.data-00000-of-00001 (deflated 35%)
  adding: content/models/GOOGL_52.05_01_mem_5_lstm_1_dense_1_unit_8/variables/va
riables.index (deflated 67%)
  adding: content/models/GOOGL_8.27_10_mem_5_lstm_3_dense_1_unit_8/ (stored 0%)
  adding:
content/models/GOOGL_8.27_10_mem_5_lstm_3_dense_1_unit_8/keras_metadata.pb
(deflated 94%)
  adding:
content/models/GOOGL_8.27_10_mem_5_lstm_3_dense_1_unit_8/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_8.27_10_mem_5_lstm_3_dense_1_unit_8/saved_model.pb
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(deflated 91%)
  adding: content/models/GOOGL_8.27_10_mem_5_lstm_3_dense_1_unit_8/assets/
(stored 0%)
  adding: content/models/GOOGL_8.27_10_mem_5_lstm_3_dense_1_unit_8/variables/
(stored 0%)
  adding: content/models/GOOGL_8.27_10_mem_5_lstm_3_dense_1_unit_8/variables/var
iables.data-00000-of-00001 (deflated 35%)
  adding: content/models/GOOGL_8.27_10_mem_5_lstm_3_dense_1_unit_8/variables/var
iables.index (deflated 69%)
  adding: content/models/GOOGL_27.67_01_mem_5_lstm_2_dense_1_unit_8/ (stored 0%)
  adding:
content/models/GOOGL_27.67_01_mem_5_lstm_2_dense_1_unit_8/keras_metadata.pb
(deflated 93%)
  adding:
content/models/GOOGL_27.67_01_mem_5_lstm_2_dense_1_unit_8/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_27.67_01_mem_5_lstm_2_dense_1_unit_8/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_27.67_01_mem_5_lstm_2_dense_1_unit_8/assets/
(stored 0%)
  adding: content/models/GOOGL_27.67_01_mem_5_lstm_2_dense_1_unit_8/variables/
(stored 0%)
  adding: content/models/GOOGL_27.67_01_mem_5_lstm_2_dense_1_unit_8/variables/va
riables.data-00000-of-00001 (deflated 34%)
  adding: content/models/GOOGL_27.67_01_mem_5_lstm_2_dense_1_unit_8/variables/va
riables.index (deflated 68%)
  adding: content/models/GOOGL_6.41_02_mem_5_lstm_1_dense_2_unit_8/ (stored 0%)
  adding:
content/models/GOOGL_6.41_02_mem_5_lstm_1_dense_2_unit_8/keras_metadata.pb
(deflated 93%)
  adding:
content/models/GOOGL_6.41_02_mem_5_lstm_1_dense_2_unit_8/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_6.41_02_mem_5_lstm_1_dense_2_unit_8/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_6.41_02_mem_5_lstm_1_dense_2_unit_8/assets/
(stored 0%)
  adding: content/models/GOOGL_6.41_02_mem_5_lstm_1_dense_2_unit_8/variables/
(stored 0%)
  adding: content/models/GOOGL_6.41_02_mem_5_lstm_1_dense_2_unit_8/variables/var
iables.data-00000-of-00001 (deflated 37%)
  adding: content/models/GOOGL_6.41_02_mem_5_lstm_1_dense_2_unit_8/variables/var
iables.index (deflated 67%)
  adding: content/models/GOOGL_29.46_02_mem_5_lstm_2_dense_2_unit_16/ (stored
0%)
  adding:
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content/models/GOOGL_29.46_02_mem_5_lstm_2_dense_2_unit_16/keras_metadata.pb
(deflated 93%)
  adding:
content/models/GOOGL_29.46_02_mem_5_lstm_2_dense_2_unit_16/fingerprint.pb
(stored 0%)
  adding:
content/models/GOOGL_29.46_02_mem_5_lstm_2_dense_2_unit_16/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_29.46_02_mem_5_lstm_2_dense_2_unit_16/assets/
(stored 0%)
  adding: content/models/GOOGL_29.46_02_mem_5_lstm_2_dense_2_unit_16/variables/
(stored 0%)
  adding: content/models/GOOGL_29.46_02_mem_5_lstm_2_dense_2_unit_16/variables/v
ariables.data-00000-of-00001 (deflated 17%)
  adding: content/models/GOOGL_29.46_02_mem_5_lstm_2_dense_2_unit_16/variables/v
ariables.index (deflated 68%)
  adding: content/models/GOOGL_5.62_03_mem_5_lstm_1_dense_2_unit_16/ (stored 0%)
  adding:
content/models/GOOGL_5.62_03_mem_5_lstm_1_dense_2_unit_16/keras_metadata.pb
(deflated 93%)
  adding:
content/models/GOOGL_5.62_03_mem_5_lstm_1_dense_2_unit_16/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_5.62_03_mem_5_lstm_1_dense_2_unit_16/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_5.62_03_mem_5_lstm_1_dense_2_unit_16/assets/
(stored 0%)
  adding: content/models/GOOGL_5.62_03_mem_5_lstm_1_dense_2_unit_16/variables/
(stored 0%)
  adding: content/models/GOOGL_5.62_03_mem_5_lstm_1_dense_2_unit_16/variables/va
riables.data-00000-of-00001 (deflated 18%)
  adding: content/models/GOOGL_5.62_03_mem_5_lstm_1_dense_2_unit_16/variables/va
riables.index (deflated 67%)
  adding: content/models/GOOGL_7.31_02_mem_5_lstm_2_dense_1_unit_8/ (stored 0%)
  adding:
content/models/GOOGL_7.31_02_mem_5_lstm_2_dense_1_unit_8/keras_metadata.pb
(deflated 93%)
  adding:
content/models/GOOGL_7.31_02_mem_5_lstm_2_dense_1_unit_8/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_7.31_02_mem_5_lstm_2_dense_1_unit_8/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_7.31_02_mem_5_lstm_2_dense_1_unit_8/assets/
(stored 0%)
  adding: content/models/GOOGL_7.31_02_mem_5_lstm_2_dense_1_unit_8/variables/
(stored 0%)
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  adding: content/models/GOOGL_7.31_02_mem_5_lstm_2_dense_1_unit_8/variables/var
iables.data-00000-of-00001 (deflated 34%)
  adding: content/models/GOOGL_7.31_02_mem_5_lstm_2_dense_1_unit_8/variables/var
iables.index (deflated 68%)
  adding: content/models/GOOGL_5.54_08_mem_5_lstm_1_dense_1_unit_8/ (stored 0%)
  adding:
content/models/GOOGL_5.54_08_mem_5_lstm_1_dense_1_unit_8/keras_metadata.pb
(deflated 92%)
  adding:
content/models/GOOGL_5.54_08_mem_5_lstm_1_dense_1_unit_8/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_5.54_08_mem_5_lstm_1_dense_1_unit_8/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_5.54_08_mem_5_lstm_1_dense_1_unit_8/assets/
(stored 0%)
  adding: content/models/GOOGL_5.54_08_mem_5_lstm_1_dense_1_unit_8/variables/
(stored 0%)
  adding: content/models/GOOGL_5.54_08_mem_5_lstm_1_dense_1_unit_8/variables/var
iables.data-00000-of-00001 (deflated 35%)
  adding: content/models/GOOGL_5.54_08_mem_5_lstm_1_dense_1_unit_8/variables/var
iables.index (deflated 67%)
  adding: content/models/GOOGL_80.95_01_mem_5_lstm_2_dense_2_unit_16/ (stored
0%)
  adding:
content/models/GOOGL_80.95_01_mem_5_lstm_2_dense_2_unit_16/keras_metadata.pb
(deflated 93%)
  adding:
content/models/GOOGL_80.95_01_mem_5_lstm_2_dense_2_unit_16/fingerprint.pb
(stored 0%)
  adding:
content/models/GOOGL_80.95_01_mem_5_lstm_2_dense_2_unit_16/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_80.95_01_mem_5_lstm_2_dense_2_unit_16/assets/
(stored 0%)
  adding: content/models/GOOGL_80.95_01_mem_5_lstm_2_dense_2_unit_16/variables/
(stored 0%)
  adding: content/models/GOOGL_80.95_01_mem_5_lstm_2_dense_2_unit_16/variables/v
ariables.data-00000-of-00001 (deflated 17%)
  adding: content/models/GOOGL_80.95_01_mem_5_lstm_2_dense_2_unit_16/variables/v
ariables.index (deflated 68%)
  adding: content/models/GOOGL_12.80_06_mem_5_lstm_2_dense_2_unit_16/ (stored
0%)
  adding:
content/models/GOOGL_12.80_06_mem_5_lstm_2_dense_2_unit_16/keras_metadata.pb
(deflated 93%)
  adding:
content/models/GOOGL_12.80_06_mem_5_lstm_2_dense_2_unit_16/fingerprint.pb
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(stored 0%)
  adding:
content/models/GOOGL_12.80_06_mem_5_lstm_2_dense_2_unit_16/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_12.80_06_mem_5_lstm_2_dense_2_unit_16/assets/
(stored 0%)
  adding: content/models/GOOGL_12.80_06_mem_5_lstm_2_dense_2_unit_16/variables/
(stored 0%)
  adding: content/models/GOOGL_12.80_06_mem_5_lstm_2_dense_2_unit_16/variables/v
ariables.data-00000-of-00001 (deflated 17%)
  adding: content/models/GOOGL_12.80_06_mem_5_lstm_2_dense_2_unit_16/variables/v
ariables.index (deflated 68%)
  adding: content/models/GOOGL_7.77_02_mem_5_lstm_1_dense_3_unit_16/ (stored 0%)
  adding:
content/models/GOOGL_7.77_02_mem_5_lstm_1_dense_3_unit_16/keras_metadata.pb
(deflated 93%)
  adding:
content/models/GOOGL_7.77_02_mem_5_lstm_1_dense_3_unit_16/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_7.77_02_mem_5_lstm_1_dense_3_unit_16/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_7.77_02_mem_5_lstm_1_dense_3_unit_16/assets/
(stored 0%)
  adding: content/models/GOOGL_7.77_02_mem_5_lstm_1_dense_3_unit_16/variables/
(stored 0%)
  adding: content/models/GOOGL_7.77_02_mem_5_lstm_1_dense_3_unit_16/variables/va
riables.data-00000-of-00001 (deflated 20%)
  adding: content/models/GOOGL_7.77_02_mem_5_lstm_1_dense_3_unit_16/variables/va
riables.index (deflated 68%)
  adding: content/models/GOOGL_16.04_01_mem_5_lstm_1_dense_2_unit_16/ (stored
0%)
  adding:
content/models/GOOGL_16.04_01_mem_5_lstm_1_dense_2_unit_16/keras_metadata.pb
(deflated 93%)
  adding:
content/models/GOOGL_16.04_01_mem_5_lstm_1_dense_2_unit_16/fingerprint.pb
(stored 0%)
  adding:
content/models/GOOGL_16.04_01_mem_5_lstm_1_dense_2_unit_16/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_16.04_01_mem_5_lstm_1_dense_2_unit_16/assets/
(stored 0%)
  adding: content/models/GOOGL_16.04_01_mem_5_lstm_1_dense_2_unit_16/variables/
(stored 0%)
  adding: content/models/GOOGL_16.04_01_mem_5_lstm_1_dense_2_unit_16/variables/v
ariables.data-00000-of-00001 (deflated 18%)
  adding: content/models/GOOGL_16.04_01_mem_5_lstm_1_dense_2_unit_16/variables/v
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ariables.index (deflated 67%)
  adding: content/models/GOOGL_7.76_09_mem_5_lstm_2_dense_1_unit_16/ (stored 0%)
  adding:
content/models/GOOGL_7.76_09_mem_5_lstm_2_dense_1_unit_16/keras_metadata.pb
(deflated 93%)
  adding:
content/models/GOOGL_7.76_09_mem_5_lstm_2_dense_1_unit_16/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_7.76_09_mem_5_lstm_2_dense_1_unit_16/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_7.76_09_mem_5_lstm_2_dense_1_unit_16/assets/
(stored 0%)
  adding: content/models/GOOGL_7.76_09_mem_5_lstm_2_dense_1_unit_16/variables/
(stored 0%)
  adding: content/models/GOOGL_7.76_09_mem_5_lstm_2_dense_1_unit_16/variables/va
riables.data-00000-of-00001 (deflated 16%)
  adding: content/models/GOOGL_7.76_09_mem_5_lstm_2_dense_1_unit_16/variables/va
riables.index (deflated 68%)
  adding: content/models/GOOGL_12.10_06_mem_5_lstm_3_dense_1_unit_8/ (stored 0%)
  adding:
content/models/GOOGL_12.10_06_mem_5_lstm_3_dense_1_unit_8/keras_metadata.pb
(deflated 94%)
  adding:
content/models/GOOGL_12.10_06_mem_5_lstm_3_dense_1_unit_8/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_12.10_06_mem_5_lstm_3_dense_1_unit_8/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_12.10_06_mem_5_lstm_3_dense_1_unit_8/assets/
(stored 0%)
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(stored 0%)
  adding: content/models/GOOGL_12.10_06_mem_5_lstm_3_dense_1_unit_8/variables/va
riables.data-00000-of-00001 (deflated 34%)
  adding: content/models/GOOGL_12.10_06_mem_5_lstm_3_dense_1_unit_8/variables/va
riables.index (deflated 69%)
  adding: content/models/GOOGL_127.46_01_mem_5_lstm_3_dense_1_unit_8/ (stored
0%)
  adding:
content/models/GOOGL_127.46_01_mem_5_lstm_3_dense_1_unit_8/keras_metadata.pb
(deflated 94%)
  adding:
content/models/GOOGL_127.46_01_mem_5_lstm_3_dense_1_unit_8/fingerprint.pb
(stored 0%)
  adding:
content/models/GOOGL_127.46_01_mem_5_lstm_3_dense_1_unit_8/saved_model.pb
(deflated 92%)
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  adding: content/models/GOOGL_127.46_01_mem_5_lstm_3_dense_1_unit_8/assets/
(stored 0%)
  adding: content/models/GOOGL_127.46_01_mem_5_lstm_3_dense_1_unit_8/variables/
(stored 0%)
  adding: content/models/GOOGL_127.46_01_mem_5_lstm_3_dense_1_unit_8/variables/v
ariables.data-00000-of-00001 (deflated 34%)
  adding: content/models/GOOGL_127.46_01_mem_5_lstm_3_dense_1_unit_8/variables/v
ariables.index (deflated 69%)
  adding: content/models/GOOGL_11.56_10_mem_5_lstm_2_dense_2_unit_8/ (stored 0%)
  adding:
content/models/GOOGL_11.56_10_mem_5_lstm_2_dense_2_unit_8/keras_metadata.pb
(deflated 93%)
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content/models/GOOGL_11.56_10_mem_5_lstm_2_dense_2_unit_8/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_11.56_10_mem_5_lstm_2_dense_2_unit_8/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_11.56_10_mem_5_lstm_2_dense_2_unit_8/assets/
(stored 0%)
  adding: content/models/GOOGL_11.56_10_mem_5_lstm_2_dense_2_unit_8/variables/
(stored 0%)
  adding: content/models/GOOGL_11.56_10_mem_5_lstm_2_dense_2_unit_8/variables/va
riables.data-00000-of-00001 (deflated 36%)
  adding: content/models/GOOGL_11.56_10_mem_5_lstm_2_dense_2_unit_8/variables/va
riables.index (deflated 68%)
  adding: content/models/GOOGL_144.69_01_mem_5_lstm_1_dense_2_unit_8/ (stored
0%)
  adding:
content/models/GOOGL_144.69_01_mem_5_lstm_1_dense_2_unit_8/keras_metadata.pb
(deflated 93%)
  adding:
content/models/GOOGL_144.69_01_mem_5_lstm_1_dense_2_unit_8/fingerprint.pb
(stored 0%)
  adding:
content/models/GOOGL_144.69_01_mem_5_lstm_1_dense_2_unit_8/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_144.69_01_mem_5_lstm_1_dense_2_unit_8/assets/
(stored 0%)
  adding: content/models/GOOGL_144.69_01_mem_5_lstm_1_dense_2_unit_8/variables/
(stored 0%)
  adding: content/models/GOOGL_144.69_01_mem_5_lstm_1_dense_2_unit_8/variables/v
ariables.data-00000-of-00001 (deflated 37%)
  adding: content/models/GOOGL_144.69_01_mem_5_lstm_1_dense_2_unit_8/variables/v
ariables.index (deflated 67%)
  adding: content/models/GOOGL_12.29_03_mem_5_lstm_3_dense_1_unit_8/ (stored 0%)
  adding:
content/models/GOOGL_12.29_03_mem_5_lstm_3_dense_1_unit_8/keras_metadata.pb
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(deflated 94%)
  adding:
content/models/GOOGL_12.29_03_mem_5_lstm_3_dense_1_unit_8/fingerprint.pb (stored
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  adding:
content/models/GOOGL_12.29_03_mem_5_lstm_3_dense_1_unit_8/saved_model.pb
(deflated 92%)
  adding: content/models/GOOGL_12.29_03_mem_5_lstm_3_dense_1_unit_8/assets/
(stored 0%)
  adding: content/models/GOOGL_12.29_03_mem_5_lstm_3_dense_1_unit_8/variables/
(stored 0%)
  adding: content/models/GOOGL_12.29_03_mem_5_lstm_3_dense_1_unit_8/variables/va
riables.data-00000-of-00001 (deflated 34%)
  adding: content/models/GOOGL_12.29_03_mem_5_lstm_3_dense_1_unit_8/variables/va
riables.index (deflated 69%)
  adding: content/models/GOOGL_5.86_03_mem_5_lstm_1_dense_3_unit_16/ (stored 0%)
  adding:
content/models/GOOGL_5.86_03_mem_5_lstm_1_dense_3_unit_16/keras_metadata.pb
(deflated 93%)
  adding:
content/models/GOOGL_5.86_03_mem_5_lstm_1_dense_3_unit_16/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_5.86_03_mem_5_lstm_1_dense_3_unit_16/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_5.86_03_mem_5_lstm_1_dense_3_unit_16/assets/
(stored 0%)
  adding: content/models/GOOGL_5.86_03_mem_5_lstm_1_dense_3_unit_16/variables/
(stored 0%)
  adding: content/models/GOOGL_5.86_03_mem_5_lstm_1_dense_3_unit_16/variables/va
riables.data-00000-of-00001 (deflated 20%)
  adding: content/models/GOOGL_5.86_03_mem_5_lstm_1_dense_3_unit_16/variables/va
riables.index (deflated 68%)
  adding: content/models/GOOGL_6.33_03_mem_5_lstm_2_dense_3_unit_8/ (stored 0%)
  adding:
content/models/GOOGL_6.33_03_mem_5_lstm_2_dense_3_unit_8/keras_metadata.pb
(deflated 94%)
  adding:
content/models/GOOGL_6.33_03_mem_5_lstm_2_dense_3_unit_8/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_6.33_03_mem_5_lstm_2_dense_3_unit_8/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_6.33_03_mem_5_lstm_2_dense_3_unit_8/assets/
(stored 0%)
  adding: content/models/GOOGL_6.33_03_mem_5_lstm_2_dense_3_unit_8/variables/
(stored 0%)
  adding: content/models/GOOGL_6.33_03_mem_5_lstm_2_dense_3_unit_8/variables/var
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iables.data-00000-of-00001 (deflated 37%)
  adding: content/models/GOOGL_6.33_03_mem_5_lstm_2_dense_3_unit_8/variables/var
iables.index (deflated 69%)
  adding: content/models/GOOGL_9.97_08_mem_5_lstm_2_dense_1_unit_16/ (stored 0%)
  adding:
content/models/GOOGL_9.97_08_mem_5_lstm_2_dense_1_unit_16/keras_metadata.pb
(deflated 93%)
  adding:
content/models/GOOGL_9.97_08_mem_5_lstm_2_dense_1_unit_16/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_9.97_08_mem_5_lstm_2_dense_1_unit_16/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_9.97_08_mem_5_lstm_2_dense_1_unit_16/assets/
(stored 0%)
  adding: content/models/GOOGL_9.97_08_mem_5_lstm_2_dense_1_unit_16/variables/
(stored 0%)
  adding: content/models/GOOGL_9.97_08_mem_5_lstm_2_dense_1_unit_16/variables/va
riables.data-00000-of-00001 (deflated 16%)
  adding: content/models/GOOGL_9.97_08_mem_5_lstm_2_dense_1_unit_16/variables/va
riables.index (deflated 67%)
  adding: content/models/GOOGL_7.35_04_mem_5_lstm_2_dense_3_unit_16/ (stored 0%)
  adding:
content/models/GOOGL_7.35_04_mem_5_lstm_2_dense_3_unit_16/keras_metadata.pb
(deflated 94%)
  adding:
content/models/GOOGL_7.35_04_mem_5_lstm_2_dense_3_unit_16/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_7.35_04_mem_5_lstm_2_dense_3_unit_16/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_7.35_04_mem_5_lstm_2_dense_3_unit_16/assets/
(stored 0%)
  adding: content/models/GOOGL_7.35_04_mem_5_lstm_2_dense_3_unit_16/variables/
(stored 0%)
  adding: content/models/GOOGL_7.35_04_mem_5_lstm_2_dense_3_unit_16/variables/va
riables.data-00000-of-00001 (deflated 19%)
  adding: content/models/GOOGL_7.35_04_mem_5_lstm_2_dense_3_unit_16/variables/va
riables.index (deflated 69%)
  adding: content/models/GOOGL_6.54_11_mem_5_lstm_3_dense_1_unit_8/ (stored 0%)
  adding:
content/models/GOOGL_6.54_11_mem_5_lstm_3_dense_1_unit_8/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_6.54_11_mem_5_lstm_3_dense_1_unit_8/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_6.54_11_mem_5_lstm_3_dense_1_unit_8/assets/
(stored 0%)
```

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  adding: content/models/GOOGL_6.54_11_mem_5_lstm_3_dense_1_unit_8/variables/
(stored 0%)
  adding: content/models/GOOGL_6.54_11_mem_5_lstm_3_dense_1_unit_8/variables/var
iables.data-00000-of-00001 (deflated 35%)
  adding: content/models/GOOGL_6.54_11_mem_5_lstm_3_dense_1_unit_8/variables/var
iables.index (deflated 69%)
  adding: content/models/GOOGL_6.41_02_mem_5_lstm_2_dense_3_unit_8/ (stored 0%)
  adding:
content/models/GOOGL_6.41_02_mem_5_lstm_2_dense_3_unit_8/keras_metadata.pb
(deflated 94%)
  adding:
content/models/GOOGL_6.41_02_mem_5_lstm_2_dense_3_unit_8/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_6.41_02_mem_5_lstm_2_dense_3_unit_8/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_6.41_02_mem_5_lstm_2_dense_3_unit_8/assets/
(stored 0%)
  adding: content/models/GOOGL_6.41_02_mem_5_lstm_2_dense_3_unit_8/variables/
(stored 0%)
  adding: content/models/GOOGL_6.41_02_mem_5_lstm_2_dense_3_unit_8/variables/var
iables.data-00000-of-00001 (deflated 37%)
  adding: content/models/GOOGL_6.41_02_mem_5_lstm_2_dense_3_unit_8/variables/var
iables.index (deflated 69%)
  adding: content/models/GOOGL_23.65_02_mem_5_lstm_2_dense_1_unit_16/ (stored
0%)
  adding:
content/models/GOOGL_23.65_02_mem_5_lstm_2_dense_1_unit_16/keras_metadata.pb
(deflated 93%)
  adding:
content/models/GOOGL_23.65_02_mem_5_lstm_2_dense_1_unit_16/fingerprint.pb
(stored 0%)
  adding:
content/models/GOOGL_23.65_02_mem_5_lstm_2_dense_1_unit_16/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_23.65_02_mem_5_lstm_2_dense_1_unit_16/assets/
(stored 0%)
  adding: content/models/GOOGL_23.65_02_mem_5_lstm_2_dense_1_unit_16/variables/
(stored 0%)
  adding: content/models/GOOGL_23.65_02_mem_5_lstm_2_dense_1_unit_16/variables/v
ariables.data-00000-of-00001 (deflated 16%)
  adding: content/models/GOOGL_23.65_02_mem_5_lstm_2_dense_1_unit_16/variables/v
ariables.index (deflated 68%)
  adding: content/models/GOOGL_78.47_01_mem_5_lstm_1_dense_1_unit_16/ (stored
0%)
  adding:
content/models/GOOGL_78.47_01_mem_5_lstm_1_dense_1_unit_16/keras_metadata.pb
(deflated 92%)
```

```
  adding:
content/models/GOOGL_78.47_01_mem_5_lstm_1_dense_1_unit_16/fingerprint.pb
(stored 0%)
  adding:
content/models/GOOGL_78.47_01_mem_5_lstm_1_dense_1_unit_16/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_78.47_01_mem_5_lstm_1_dense_1_unit_16/assets/
(stored 0%)
  adding: content/models/GOOGL_78.47_01_mem_5_lstm_1_dense_1_unit_16/variables/
(stored 0%)
  adding: content/models/GOOGL_78.47_01_mem_5_lstm_1_dense_1_unit_16/variables/v
ariables.data-00000-of-00001 (deflated 17%)
  adding: content/models/GOOGL_78.47_01_mem_5_lstm_1_dense_1_unit_16/variables/v
ariables.index (deflated 66%)
  adding: content/models/GOOGL_5.80_14_mem_5_lstm_1_dense_1_unit_16/ (stored 0%)
  adding:
content/models/GOOGL_5.80_14_mem_5_lstm_1_dense_1_unit_16/keras_metadata.pb
(deflated 92%)
  adding:
content/models/GOOGL_5.80_14_mem_5_lstm_1_dense_1_unit_16/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_5.80_14_mem_5_lstm_1_dense_1_unit_16/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_5.80_14_mem_5_lstm_1_dense_1_unit_16/assets/
(stored 0%)
  adding: content/models/GOOGL_5.80_14_mem_5_lstm_1_dense_1_unit_16/variables/
(stored 0%)
  adding: content/models/GOOGL_5.80_14_mem_5_lstm_1_dense_1_unit_16/variables/va
riables.data-00000-of-00001 (deflated 18%)
  adding: content/models/GOOGL_5.80_14_mem_5_lstm_1_dense_1_unit_16/variables/va
riables.index (deflated 66%)
  adding: content/models/GOOGL_16.04_02_mem_5_lstm_3_dense_1_unit_8/ (stored 0%)
  adding:
content/models/GOOGL_16.04_02_mem_5_lstm_3_dense_1_unit_8/keras_metadata.pb
(deflated 94%)
  adding:
content/models/GOOGL_16.04_02_mem_5_lstm_3_dense_1_unit_8/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_16.04_02_mem_5_lstm_3_dense_1_unit_8/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_16.04_02_mem_5_lstm_3_dense_1_unit_8/assets/
(stored 0%)
  adding: content/models/GOOGL_16.04_02_mem_5_lstm_3_dense_1_unit_8/variables/
(stored 0%)
  adding: content/models/GOOGL_16.04_02_mem_5_lstm_3_dense_1_unit_8/variables/va
riables.data-00000-of-00001 (deflated 35%)
```

```
  adding: content/models/GOOGL_16.04_02_mem_5_lstm_3_dense_1_unit_8/variables/va
riables.index (deflated 69%)
  adding: content/models/GOOGL_13.58_01_mem_5_lstm_2_dense_2_unit_8/ (stored 0%)
  adding:
content/models/GOOGL_13.58_01_mem_5_lstm_2_dense_2_unit_8/keras_metadata.pb
(deflated 93%)
  adding:
content/models/GOOGL_13.58_01_mem_5_lstm_2_dense_2_unit_8/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_13.58_01_mem_5_lstm_2_dense_2_unit_8/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_13.58_01_mem_5_lstm_2_dense_2_unit_8/assets/
(stored 0%)
  adding: content/models/GOOGL_13.58_01_mem_5_lstm_2_dense_2_unit_8/variables/
(stored 0%)
  adding: content/models/GOOGL_13.58_01_mem_5_lstm_2_dense_2_unit_8/variables/va
riables.data-00000-of-00001 (deflated 35%)
  adding: content/models/GOOGL_13.58_01_mem_5_lstm_2_dense_2_unit_8/variables/va
riables.index (deflated 68%)
  adding: content/models/GOOGL_8.65_08_mem_5_lstm_3_dense_1_unit_8/ (stored 0%)
  adding:
content/models/GOOGL_8.65_08_mem_5_lstm_3_dense_1_unit_8/keras_metadata.pb
(deflated 94%)
  adding:
content/models/GOOGL_8.65_08_mem_5_lstm_3_dense_1_unit_8/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_8.65_08_mem_5_lstm_3_dense_1_unit_8/saved_model.pb
(deflated 92%)
  adding: content/models/GOOGL_8.65_08_mem_5_lstm_3_dense_1_unit_8/assets/
(stored 0%)
  adding: content/models/GOOGL_8.65_08_mem_5_lstm_3_dense_1_unit_8/variables/
(stored 0%)
  adding: content/models/GOOGL_8.65_08_mem_5_lstm_3_dense_1_unit_8/variables/var
iables.data-00000-of-00001 (deflated 35%)
  adding: content/models/GOOGL_8.65_08_mem_5_lstm_3_dense_1_unit_8/variables/var
iables.index (deflated 69%)
  adding: content/models/GOOGL_5.72_04_mem_5_lstm_1_dense_3_unit_16/ (stored 0%)
  adding:
content/models/GOOGL_5.72_04_mem_5_lstm_1_dense_3_unit_16/keras_metadata.pb
(deflated 93%)
  adding:
content/models/GOOGL_5.72_04_mem_5_lstm_1_dense_3_unit_16/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_5.72_04_mem_5_lstm_1_dense_3_unit_16/saved_model.pb
(deflated 91%)
```

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  adding: content/models/GOOGL_5.72_04_mem_5_lstm_1_dense_3_unit_16/assets/
(stored 0%)
  adding: content/models/GOOGL_5.72_04_mem_5_lstm_1_dense_3_unit_16/variables/
(stored 0%)
  adding: content/models/GOOGL_5.72_04_mem_5_lstm_1_dense_3_unit_16/variables/va
riables.data-00000-of-00001 (deflated 20%)
  adding: content/models/GOOGL_5.72_04_mem_5_lstm_1_dense_3_unit_16/variables/va
riables.index (deflated 68%)
  adding: content/models/GOOGL_14.82_04_mem_5_lstm_2_dense_2_unit_16/ (stored
0%)
  adding:
content/models/GOOGL_14.82_04_mem_5_lstm_2_dense_2_unit_16/keras_metadata.pb
(deflated 93%)
  adding:
content/models/GOOGL_14.82_04_mem_5_lstm_2_dense_2_unit_16/fingerprint.pb
(stored 0%)
  adding:
content/models/GOOGL_14.82_04_mem_5_lstm_2_dense_2_unit_16/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_14.82_04_mem_5_lstm_2_dense_2_unit_16/assets/
(stored 0%)
  adding: content/models/GOOGL_14.82_04_mem_5_lstm_2_dense_2_unit_16/variables/
(stored 0%)
  adding: content/models/GOOGL_14.82_04_mem_5_lstm_2_dense_2_unit_16/variables/v
ariables.data-00000-of-00001 (deflated 17%)
  adding: content/models/GOOGL_14.82_04_mem_5_lstm_2_dense_2_unit_16/variables/v
ariables.index (deflated 68%)
  adding: content/models/GOOGL_7.33_08_mem_5_lstm_2_dense_2_unit_16/ (stored 0%)
  adding:
content/models/GOOGL_7.33_08_mem_5_lstm_2_dense_2_unit_16/keras_metadata.pb
(deflated 93%)
  adding:
content/models/GOOGL_7.33_08_mem_5_lstm_2_dense_2_unit_16/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_7.33_08_mem_5_lstm_2_dense_2_unit_16/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_7.33_08_mem_5_lstm_2_dense_2_unit_16/assets/
(stored 0%)
  adding: content/models/GOOGL_7.33_08_mem_5_lstm_2_dense_2_unit_16/variables/
(stored 0%)
  adding: content/models/GOOGL_7.33_08_mem_5_lstm_2_dense_2_unit_16/variables/va
riables.data-00000-of-00001 (deflated 17%)
  adding: content/models/GOOGL_7.33_08_mem_5_lstm_2_dense_2_unit_16/variables/va
riables.index (deflated 68%)
  adding: content/models/GOOGL_5.89_02_mem_5_lstm_1_dense_1_unit_8/ (stored 0%)
  adding:
content/models/GOOGL_5.89_02_mem_5_lstm_1_dense_1_unit_8/keras_metadata.pb
```

```
(deflated 92%)
  adding:
content/models/GOOGL_5.89_02_mem_5_lstm_1_dense_1_unit_8/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_5.89_02_mem_5_lstm_1_dense_1_unit_8/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_5.89_02_mem_5_lstm_1_dense_1_unit_8/assets/
(stored 0%)
  adding: content/models/GOOGL_5.89_02_mem_5_lstm_1_dense_1_unit_8/variables/
(stored 0%)
  adding: content/models/GOOGL_5.89_02_mem_5_lstm_1_dense_1_unit_8/variables/var
iables.data-00000-of-00001 (deflated 35%)
  adding: content/models/GOOGL_5.89_02_mem_5_lstm_1_dense_1_unit_8/variables/var
iables.index (deflated 66%)
  adding: content/models/GOOGL_6.29_09_mem_5_lstm_1_dense_1_unit_16/ (stored 0%)
  adding:
content/models/GOOGL_6.29_09_mem_5_lstm_1_dense_1_unit_16/keras_metadata.pb
(deflated 92%)
  adding:
content/models/GOOGL_6.29_09_mem_5_lstm_1_dense_1_unit_16/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_6.29_09_mem_5_lstm_1_dense_1_unit_16/saved_model.pb
(deflated 90%)
  adding: content/models/GOOGL_6.29_09_mem_5_lstm_1_dense_1_unit_16/assets/
(stored 0%)
  adding: content/models/GOOGL_6.29_09_mem_5_lstm_1_dense_1_unit_16/variables/
(stored 0%)
  adding: content/models/GOOGL_6.29_09_mem_5_lstm_1_dense_1_unit_16/variables/va
riables.data-00000-of-00001 (deflated 18%)
  adding: content/models/GOOGL_6.29_09_mem_5_lstm_1_dense_1_unit_16/variables/va
riables.index (deflated 66%)
  adding: content/models/GOOGL_84.65_01_mem_5_lstm_2_dense_1_unit_16/ (stored
0%)
  adding:
content/models/GOOGL_84.65_01_mem_5_lstm_2_dense_1_unit_16/keras_metadata.pb
(deflated 93%)
  adding:
content/models/GOOGL_84.65_01_mem_5_lstm_2_dense_1_unit_16/fingerprint.pb
(stored 0%)
  adding:
content/models/GOOGL_84.65_01_mem_5_lstm_2_dense_1_unit_16/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_84.65_01_mem_5_lstm_2_dense_1_unit_16/assets/
(stored 0%)
  adding: content/models/GOOGL_84.65_01_mem_5_lstm_2_dense_1_unit_16/variables/
(stored 0%)
```

adding: content/models/GOOGL_84.65_01_mem_5_lstm_2_dense_1_unit_16/variables/v
ariables.data-00000-of-00001 (deflated 16%)
  adding: content/models/GOOGL_84.65_01_mem_5_lstm_2_dense_1_unit_16/variables/v
ariables.index (deflated 67%)
  adding: content/models/GOOGL_56.02_01_mem_5_lstm_2_dense_3_unit_16/ (stored
0%)
  adding:
content/models/GOOGL_56.02_01_mem_5_lstm_2_dense_3_unit_16/keras_metadata.pb
(deflated 94%)
  adding:
content/models/GOOGL_56.02_01_mem_5_lstm_2_dense_3_unit_16/fingerprint.pb
(stored 0%)
  adding:
content/models/GOOGL_56.02_01_mem_5_lstm_2_dense_3_unit_16/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_56.02_01_mem_5_lstm_2_dense_3_unit_16/assets/
(stored 0%)
  adding: content/models/GOOGL_56.02_01_mem_5_lstm_2_dense_3_unit_16/variables/
(stored 0%)
  adding: content/models/GOOGL_56.02_01_mem_5_lstm_2_dense_3_unit_16/variables/v
ariables.data-00000-of-00001 (deflated 19%)
  adding: content/models/GOOGL_56.02_01_mem_5_lstm_2_dense_3_unit_16/variables/v
ariables.index (deflated 69%)
  adding: content/models/GOOGL_8.10_04_mem_5_lstm_1_dense_1_unit_16/ (stored 0%)
  adding:
content/models/GOOGL_8.10_04_mem_5_lstm_1_dense_1_unit_16/keras_metadata.pb
(deflated 92%)
  adding:
content/models/GOOGL_8.10_04_mem_5_lstm_1_dense_1_unit_16/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_8.10_04_mem_5_lstm_1_dense_1_unit_16/saved_model.pb
(deflated 90%)
  adding: content/models/GOOGL_8.10_04_mem_5_lstm_1_dense_1_unit_16/assets/
(stored 0%)
  adding: content/models/GOOGL_8.10_04_mem_5_lstm_1_dense_1_unit_16/variables/
(stored 0%)
  adding: content/models/GOOGL_8.10_04_mem_5_lstm_1_dense_1_unit_16/variables/va
riables.data-00000-of-00001 (deflated 18%)
  adding: content/models/GOOGL_8.10_04_mem_5_lstm_1_dense_1_unit_16/variables/va
riables.index (deflated 66%)
  adding: content/models/GOOGL_18.23_02_mem_5_lstm_1_dense_3_unit_8/ (stored 0%)
  adding:
content/models/GOOGL_18.23_02_mem_5_lstm_1_dense_3_unit_8/keras_metadata.pb
(deflated 93%)
  adding:
content/models/GOOGL_18.23_02_mem_5_lstm_1_dense_3_unit_8/fingerprint.pb (stored
0%)

```
  adding:
content/models/GOOGL_18.23_02_mem_5_lstm_1_dense_3_unit_8/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_18.23_02_mem_5_lstm_1_dense_3_unit_8/assets/
(stored 0%)
  adding: content/models/GOOGL_18.23_02_mem_5_lstm_1_dense_3_unit_8/variables/
(stored 0%)
  adding: content/models/GOOGL_18.23_02_mem_5_lstm_1_dense_3_unit_8/variables/va
riables.data-00000-of-00001 (deflated 39%)
  adding: content/models/GOOGL_18.23_02_mem_5_lstm_1_dense_3_unit_8/variables/va
riables.index (deflated 68%)
  adding: content/models/GOOGL_6.36_12_mem_5_lstm_2_dense_1_unit_8/ (stored 0%)
  adding:
content/models/GOOGL_6.36_12_mem_5_lstm_2_dense_1_unit_8/keras_metadata.pb
(deflated 93%)
  adding:
content/models/GOOGL_6.36_12_mem_5_lstm_2_dense_1_unit_8/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_6.36_12_mem_5_lstm_2_dense_1_unit_8/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_6.36_12_mem_5_lstm_2_dense_1_unit_8/assets/
(stored 0%)
  adding: content/models/GOOGL_6.36_12_mem_5_lstm_2_dense_1_unit_8/variables/
(stored 0%)
  adding: content/models/GOOGL_6.36_12_mem_5_lstm_2_dense_1_unit_8/variables/var
iables.data-00000-of-00001 (deflated 34%)
  adding: content/models/GOOGL_6.36_12_mem_5_lstm_2_dense_1_unit_8/variables/var
iables.index (deflated 68%)
  adding: content/models/GOOGL_7.87_07_mem_5_lstm_2_dense_2_unit_16/ (stored 0%)
  adding:
content/models/GOOGL_7.87_07_mem_5_lstm_2_dense_2_unit_16/keras_metadata.pb
(deflated 93%)
  adding:
content/models/GOOGL_7.87_07_mem_5_lstm_2_dense_2_unit_16/fingerprint.pb (stored
0%)
  adding:
content/models/GOOGL_7.87_07_mem_5_lstm_2_dense_2_unit_16/saved_model.pb
(deflated 91%)
  adding: content/models/GOOGL_7.87_07_mem_5_lstm_2_dense_2_unit_16/assets/
(stored 0%)
  adding: content/models/GOOGL_7.87_07_mem_5_lstm_2_dense_2_unit_16/variables/
(stored 0%)
  adding: content/models/GOOGL_7.87_07_mem_5_lstm_2_dense_2_unit_16/variables/va
riables.data-00000-of-00001 (deflated 18%)
  adding: content/models/GOOGL_7.87_07_mem_5_lstm_2_dense_2_unit_16/variables/va
riables.index (deflated 68%)
```

[ ]: