Snapshot of the algorithm and data collected for the RNN-LSTM with attention

Ongoing Application: High Frequency Quant Trading strategies using machine learning.

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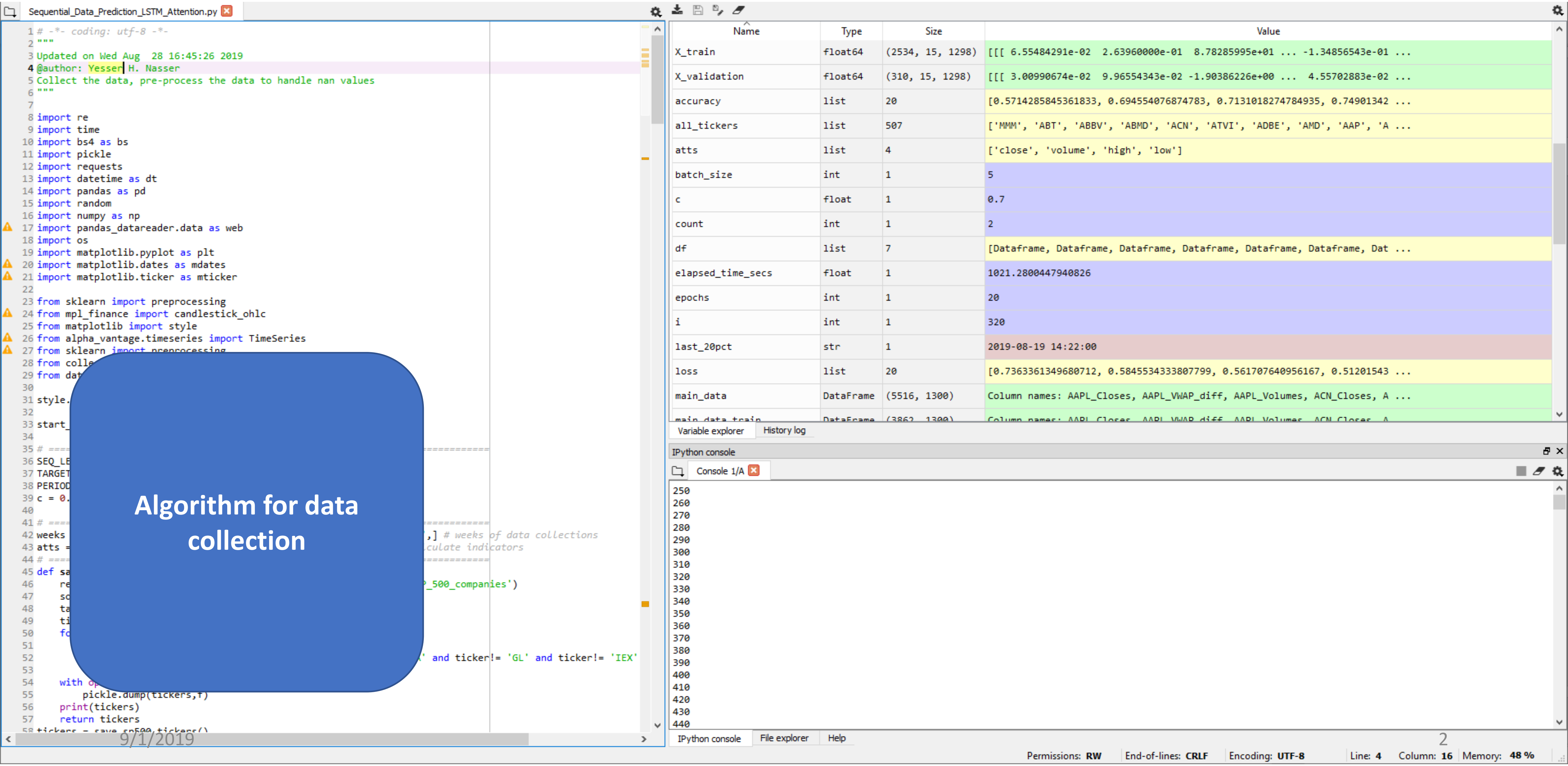
Algorithm Part 1: data collection

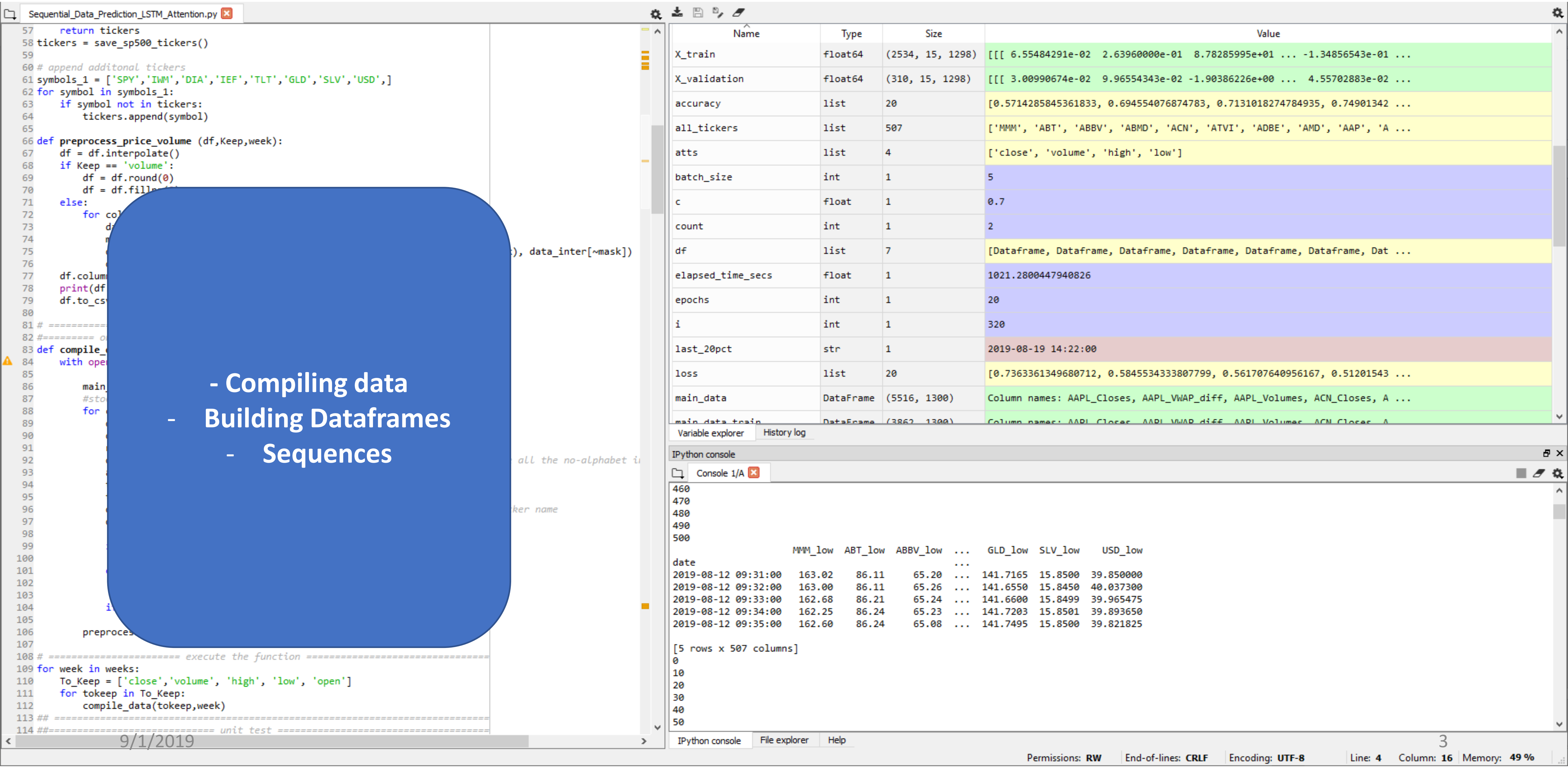


```
# -*- coding: utf-8 -*-
"""
Updated on Wed Aug  28 16:45:26 2019
@author: Yesser H. Nasser
Collect the data, pre-process the data to handle nan values
"""

import re
import time
import bs4 as bs
import pickle
import requests
import datetime as dt
import pandas as pd
import random
import numpy as np
import pandas_datareader.data as web
import os
import matplotlib.pyplot as plt
import matplotlib.dates as mdates
import matplotlib.ticker as mticker

from sklearn import preprocessing
from mpl_finance import candlestick_ohlc
from matplotlib import style
from alpha_vantage.timeseries import TimeSeries
from sklearn import preprocessing
from colle
from dat

style.

start_

# ===                                                        ============
SEQ_LE
TARGET
PERIOD
c = 0.

# ===                                                        ============
weeks                                                        ,] # weeks of data collections
atts =                                                       culate indicators
# ===                                                        ============
def sa
    re                                                       _500_companies')
    sc
    ta
    ti
    fo

                                                             ' and ticker!= 'GL' and ticker!= 'IEX'

    with op
        pickle.dump(tickers,f)
    print(tickers)
    return tickers
tickers = save_sp500_tickers()
```

Name	Type	Size	Value
X_train	float64	(2534, 15, 1298)	[[[6.55484291e-02 2.63960000e-01 8.78285995e+01 ... -1.34856543e-01 ...
X_validation	float64	(310, 15, 1298)	[[[3.00990674e-02 9.96554343e-02 -1.90386226e+00 ... 4.55702883e-02 ...
accuracy	list	20	[0.5714285845361833, 0.694554076874783, 0.7131018274784935, 0.74901342 ...
all_tickers	list	507	['MMM', 'ABT', 'ABBV', 'ABMD', 'ACN', 'ATVI', 'ADBE', 'AMD', 'AAP', 'A ...
atts	list	4	['close', 'volume', 'high', 'low']
batch_size	int	1	5
c	float	1	0.7
count	int	1	2
df	list	7	[Dataframe, Dataframe, Dataframe, Dataframe, Dataframe, Dataframe, Dat ...
elapsed_time_secs	float	1	1021.2800447940826
epochs	int	1	20
i	int	1	320
last_20pct	str	1	2019-08-19 14:22:00
loss	list	20	[0.7363361349680712, 0.5845534333807799, 0.561707640956167, 0.51201543 ...
main_data	DataFrame	(5516, 1300)	Column names: AAPL_Closes, AAPL_VWAP_diff, AAPL_Volumes, ACN_Closes, A ...
main_data_train	DataFrame	(3862, 1300)	Column names: AAPL_Closes, AAPL_VWAP_diff, AAPL_Volumes, ACN_Closes, A

```
250
260
270
280
290
300
310
320
330
340
350
360
370
380
390
400
410
420
430
440
```

Algorithm for data collection



```
    return tickers
tickers = save_sp500_tickers()

# append additonal tickers
symbols_1 = ['SPY','IWM','DIA','IEF','TLT','GLD','SLV','USD',]
for symbol in symbols_1:
    if symbol not in tickers:
        tickers.append(symbol)

def preprocess_price_volume (df,Keep,week):
    df = df.interpolate()
    if Keep == 'volume':
        df = df.round(0)
        df = df.fill
    else:
        for col
            d
            n
                                                       ), data_inter[~mask])

    df.colum
    print(df
    df.to_cs

# =========
#========= o
def compile_
    with ope

        main_
        #sto
        for



                                                       all the no-alphabet i




                                                       ker name







            i

        preproces

# ====================== execute the function ================================
for week in weeks:
    To_Keep = ['close','volume', 'high', 'low', 'open']
    for tokeep in To_Keep:
        compile_data(tokeep,week)
## ==========================================================================
##=========================== unit test ====================================
```

Name	Type	Size	Value
X_train	float64	(2534, 15, 1298)	[[[6.55484291e-02 2.63960000e-01 8.78285995e+01 ... -1.34856543e-01 ...
X_validation	float64	(310, 15, 1298)	[[[3.00990674e-02 9.96554343e-02 -1.90386226e+00 ... 4.55702883e-02 ...
accuracy	list	20	[0.5714285845361833, 0.694554076874783, 0.7131018274784935, 0.74901342 ...
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atts	list	4	['close', 'volume', 'high', 'low']
batch_size	int	1	5
c	float	1	0.7
count	int	1	2
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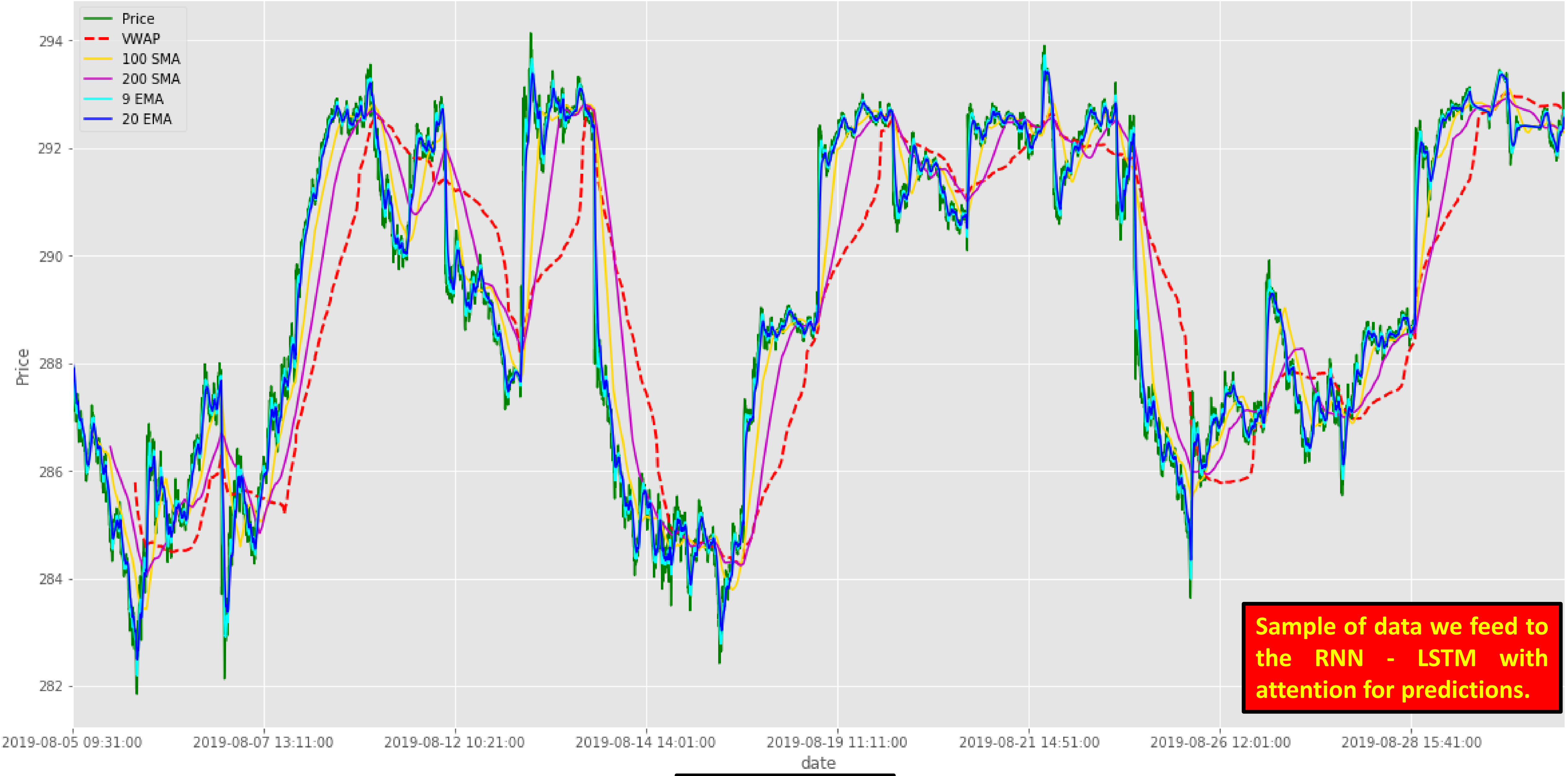
```
460
470
480
490
500
                     MMM_low  ABT_low  ABBV_low  ...   GLD_low  SLV_low    USD_low
date                                             ...
2019-08-12 09:31:00   163.02    86.11     65.20  ...  141.7165  15.8500  39.850000
2019-08-12 09:32:00   163.00    86.11     65.26  ...  141.6550  15.8450  40.037300
2019-08-12 09:33:00   162.68    86.21     65.24  ...  141.6600  15.8499  39.965475
2019-08-12 09:34:00   162.25    86.24     65.23  ...  141.7203  15.8501  39.893650
2019-08-12 09:35:00   162.60    86.24     65.08  ...  141.7495  15.8500  39.821825

[5 rows x 507 columns]
0
10
20
30
40
50
```

Permissions: RW   End-of-lines: CRLF   Encoding: UTF-8   Line: 4   Column: 16   Memory: 49 %

- Compiling data
- Building Dataframes
- Sequences

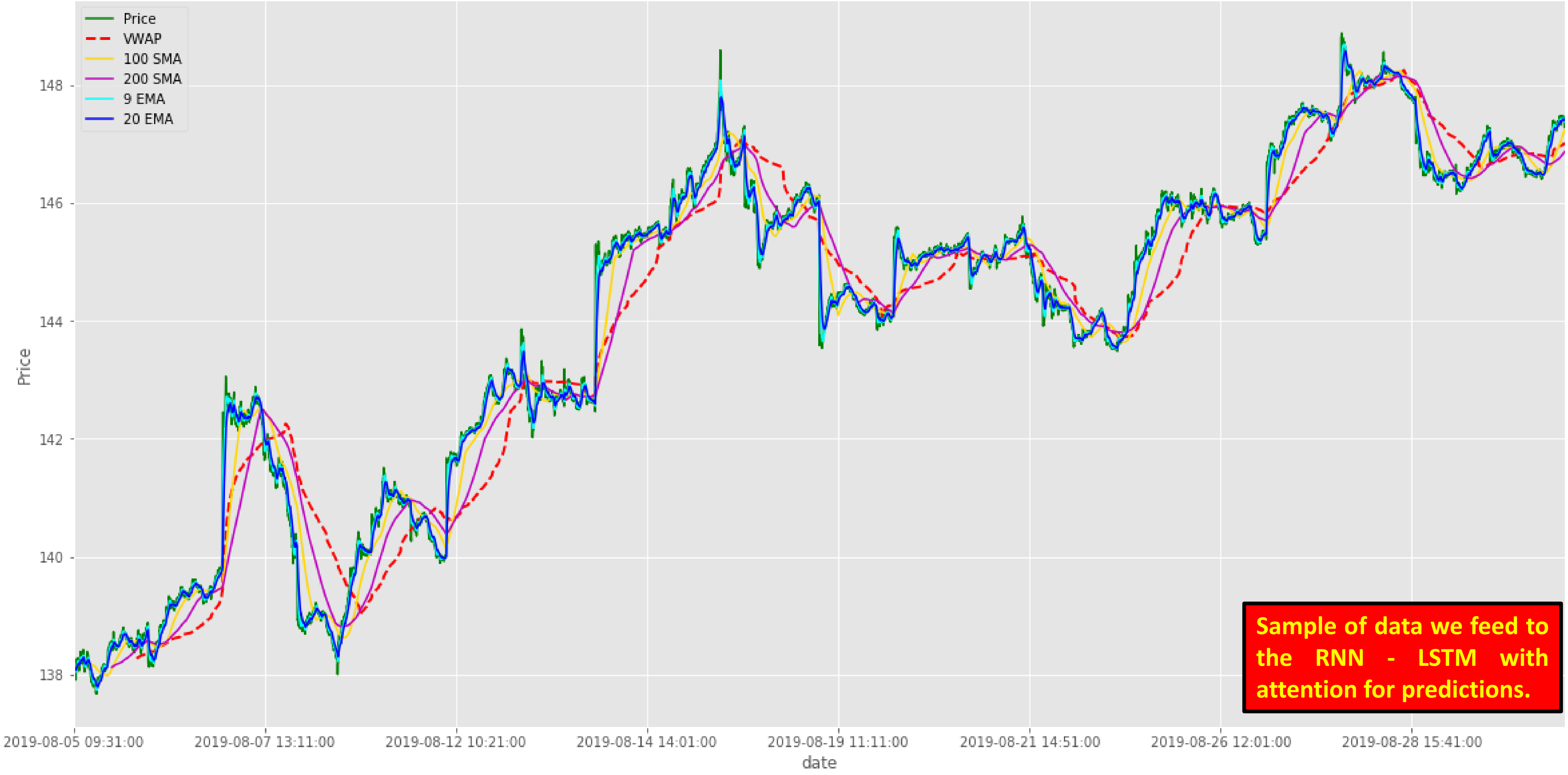
SPY



Sample of data we feed to the RNN - LSTM with attention for predictions.

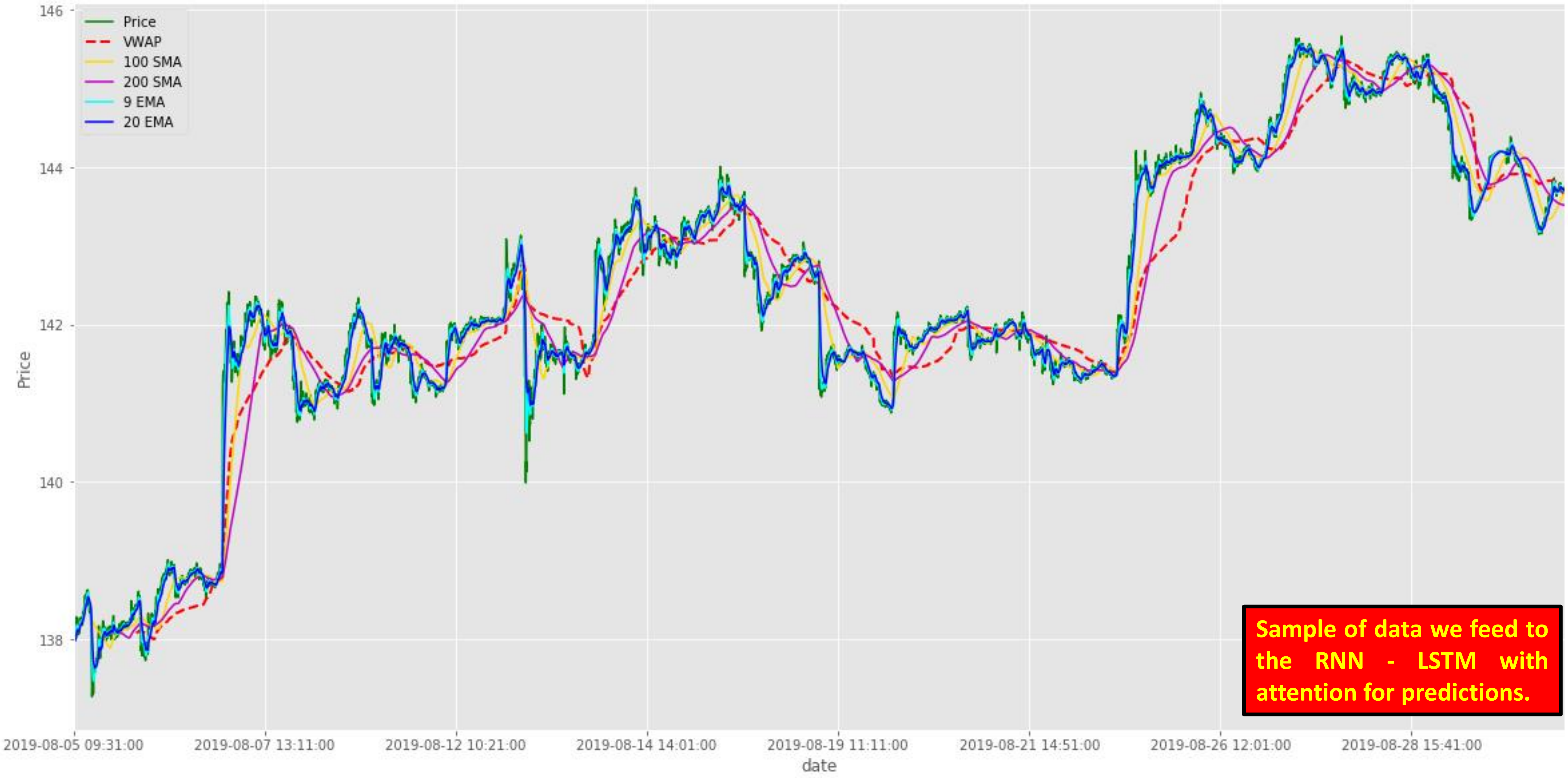
Very resent data!

TLT



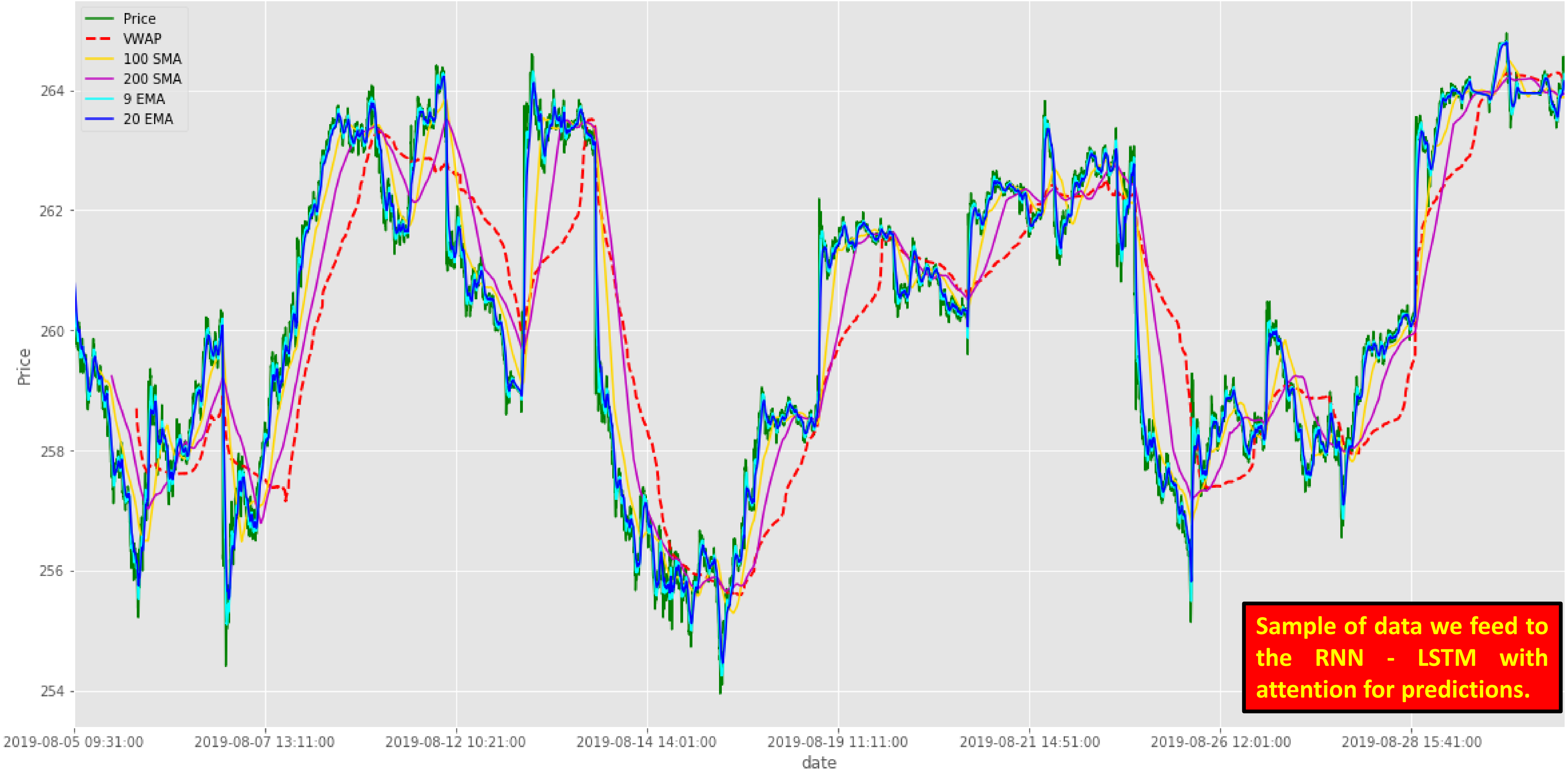
Sample of data we feed to the RNN - LSTM with attention for predictions.

GLD



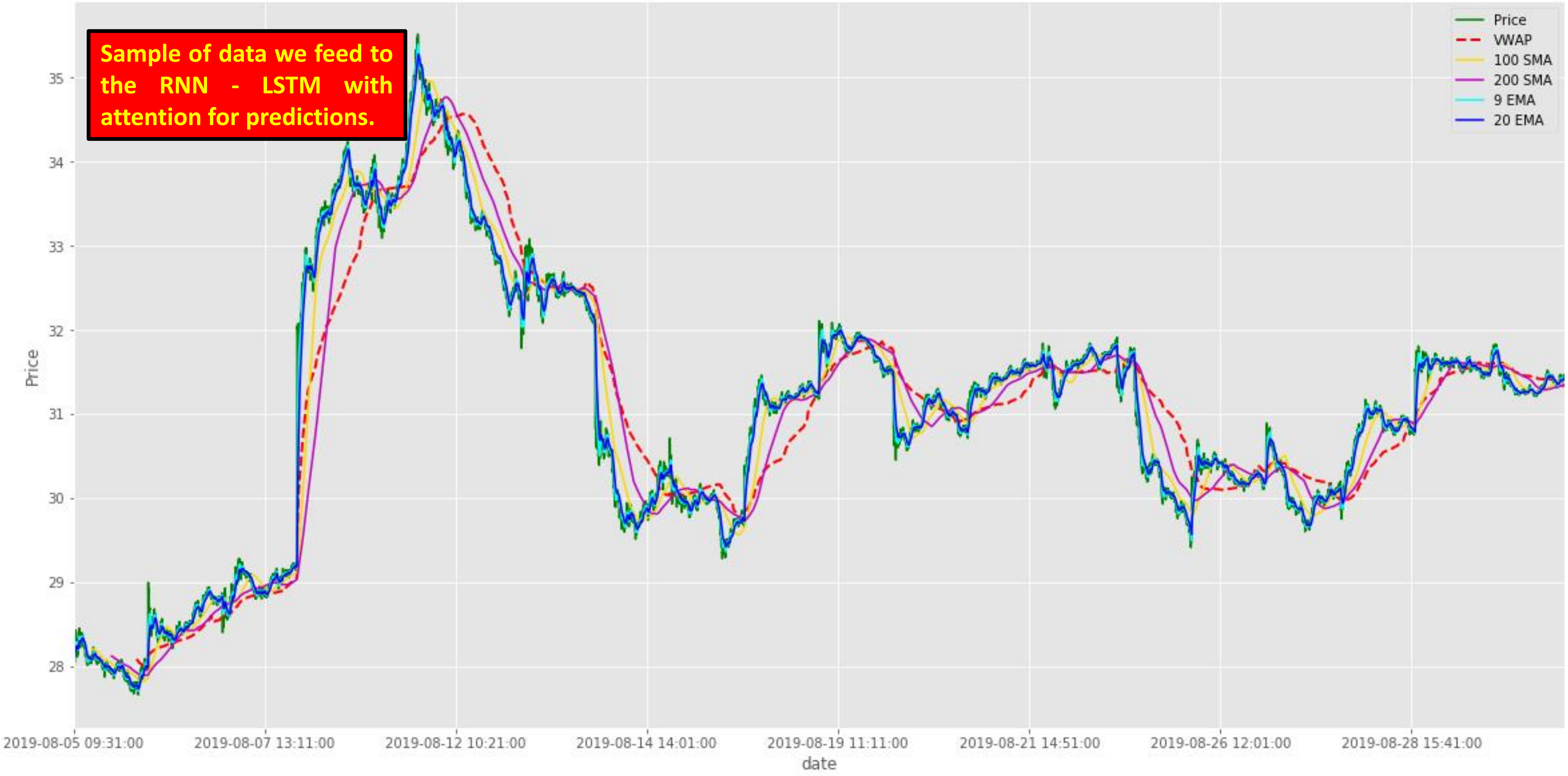
Sample of data we feed to the RNN - LSTM with attention for predictions.

DIA



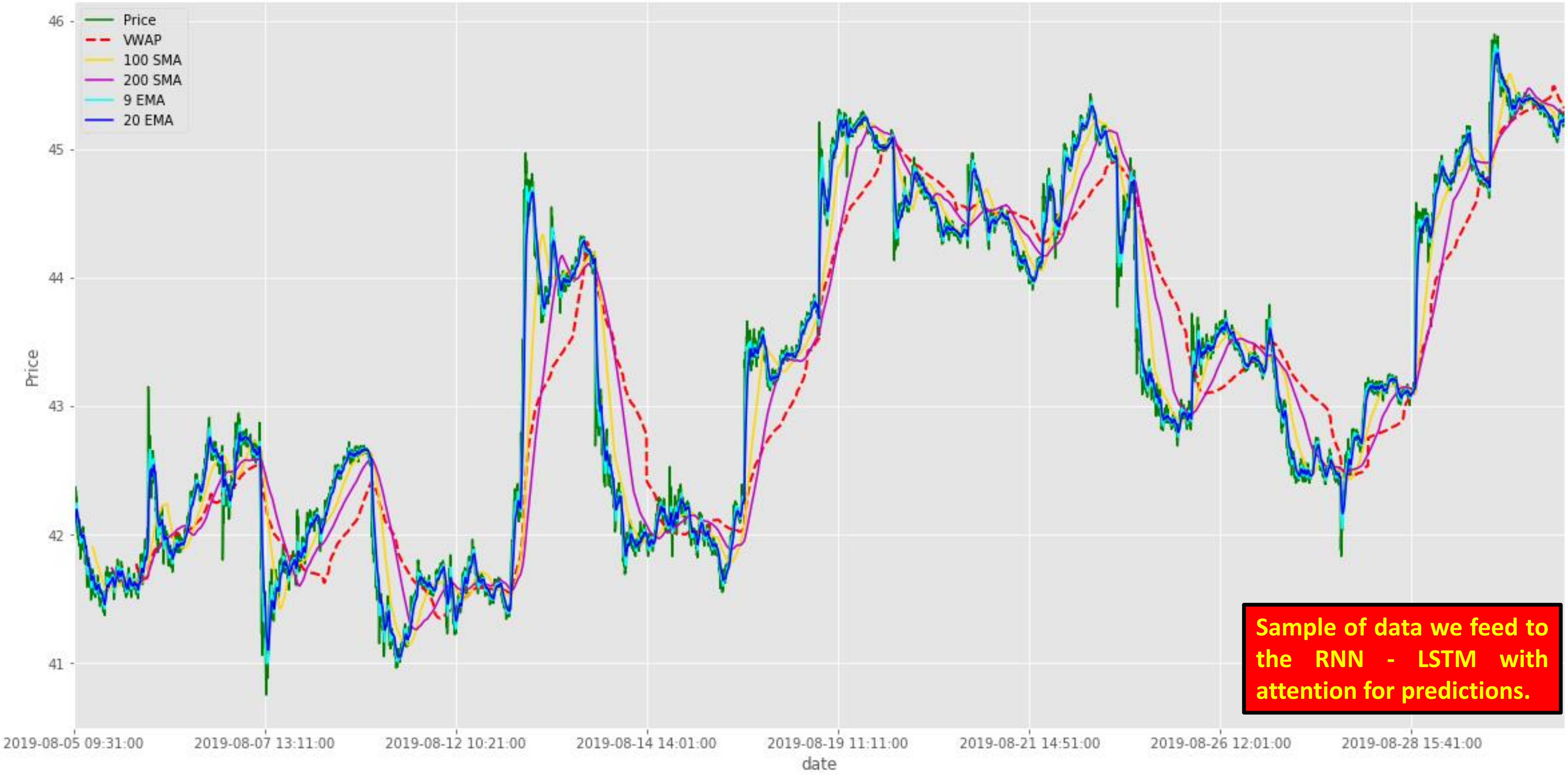
Sample of data we feed to the RNN - LSTM with attention for predictions.

Stock Price - AMD



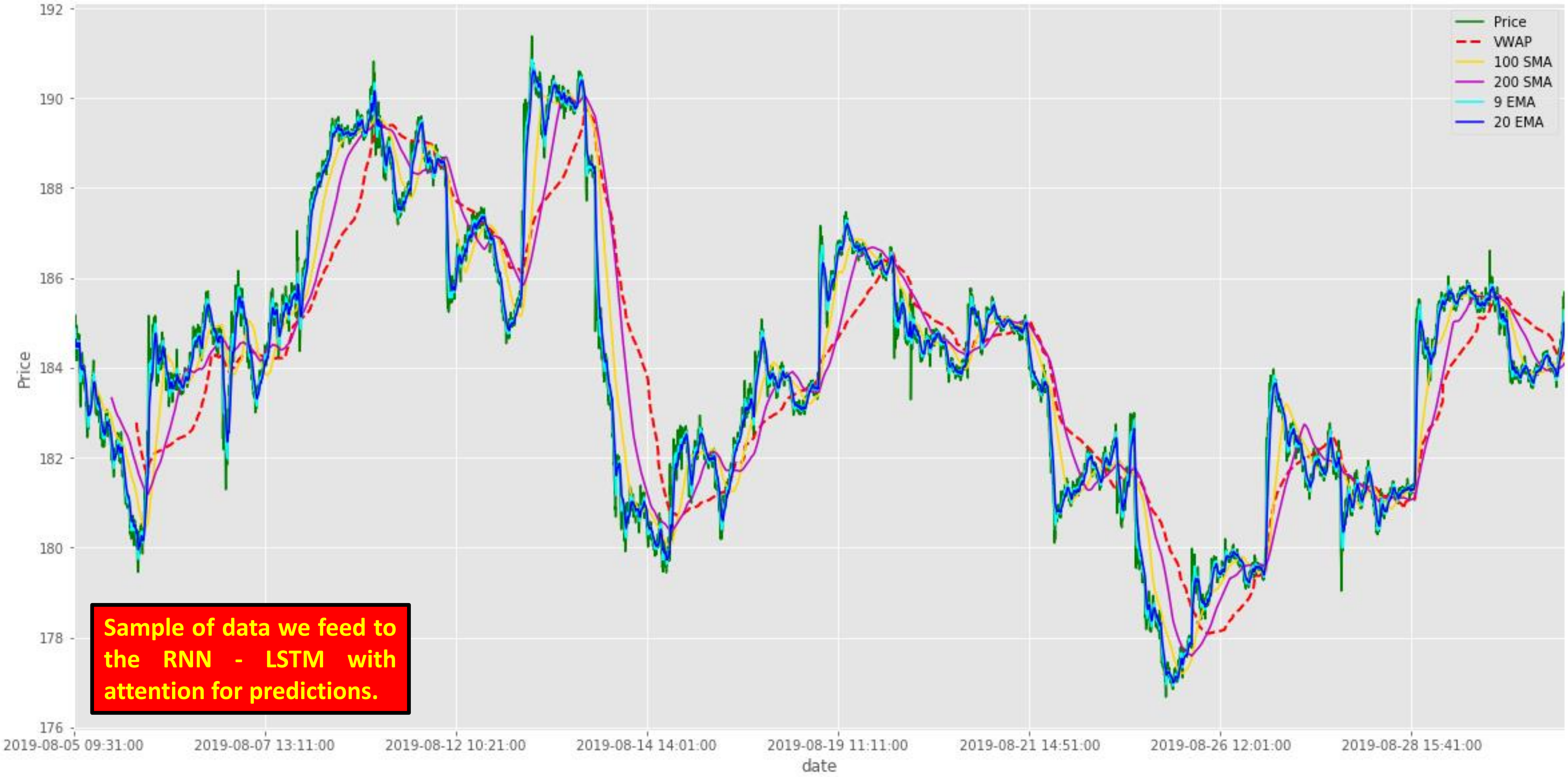
Sample of data we feed to the RNN - LSTM with attention for predictions.

Stock Price - MU



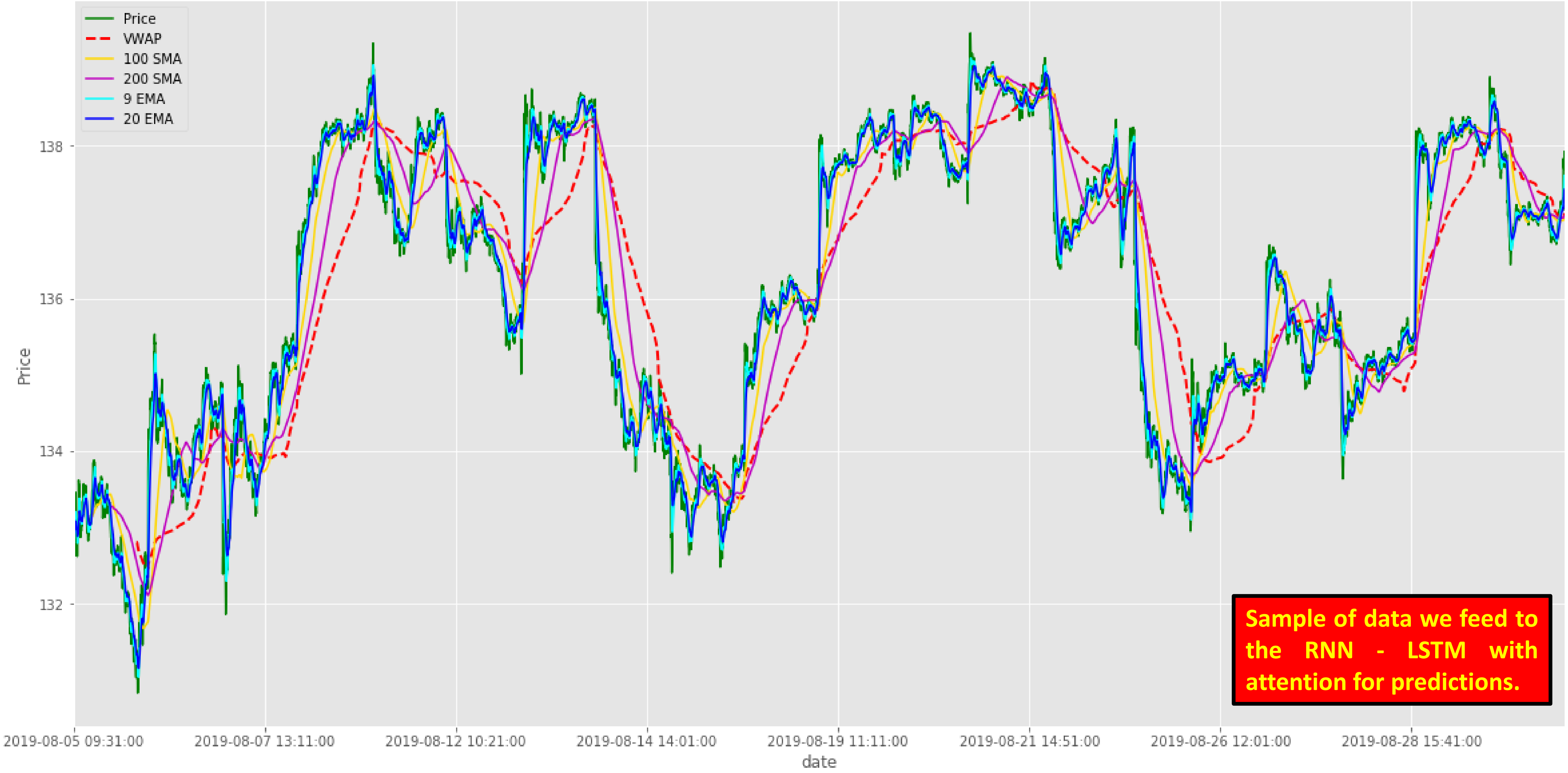
Sample of data we feed to the RNN - LSTM with attention for predictions.

Stock Price - FB



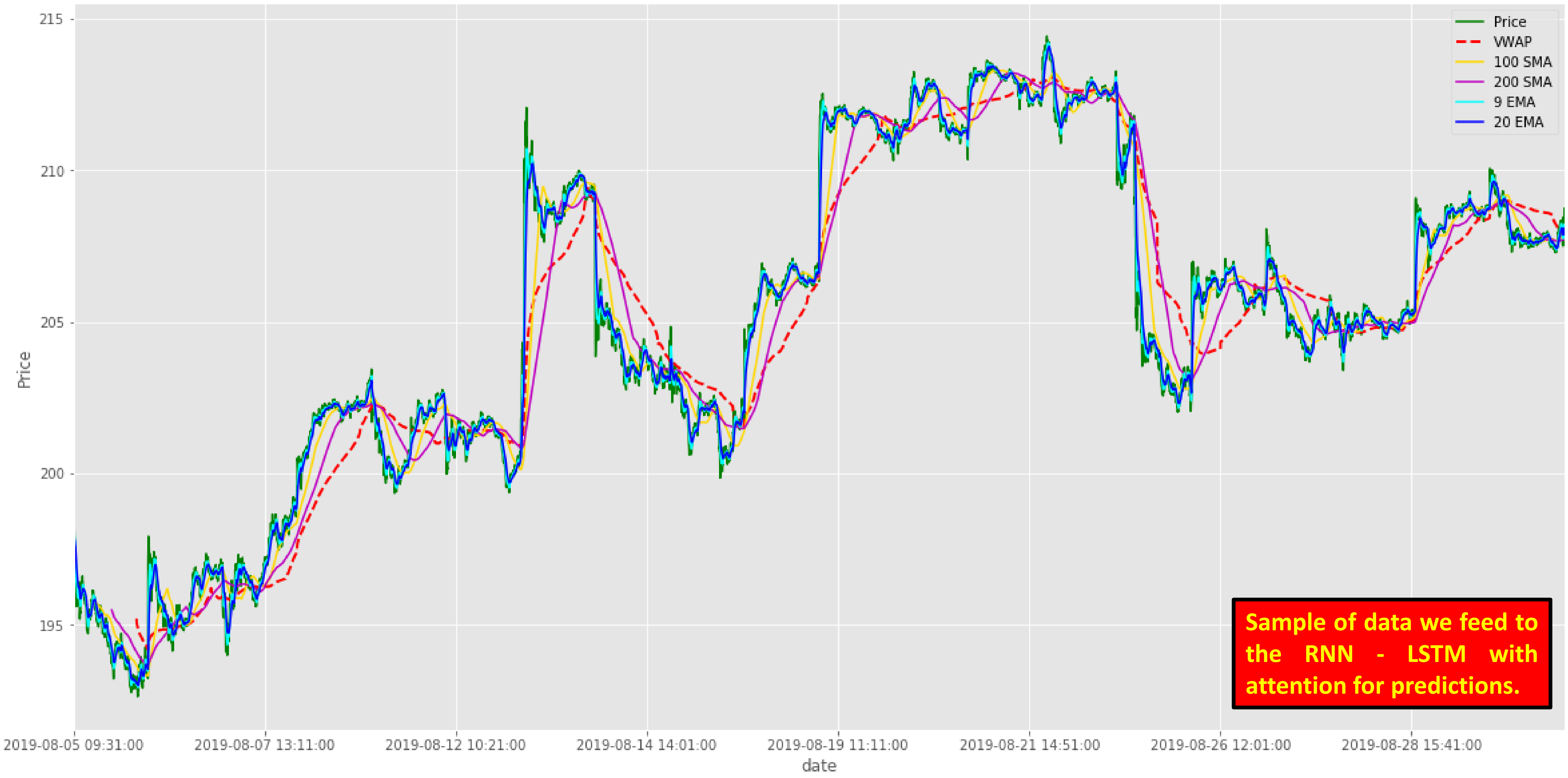
Sample of data we feed to the RNN - LSTM with attention for predictions.

Stock Price - MSFT



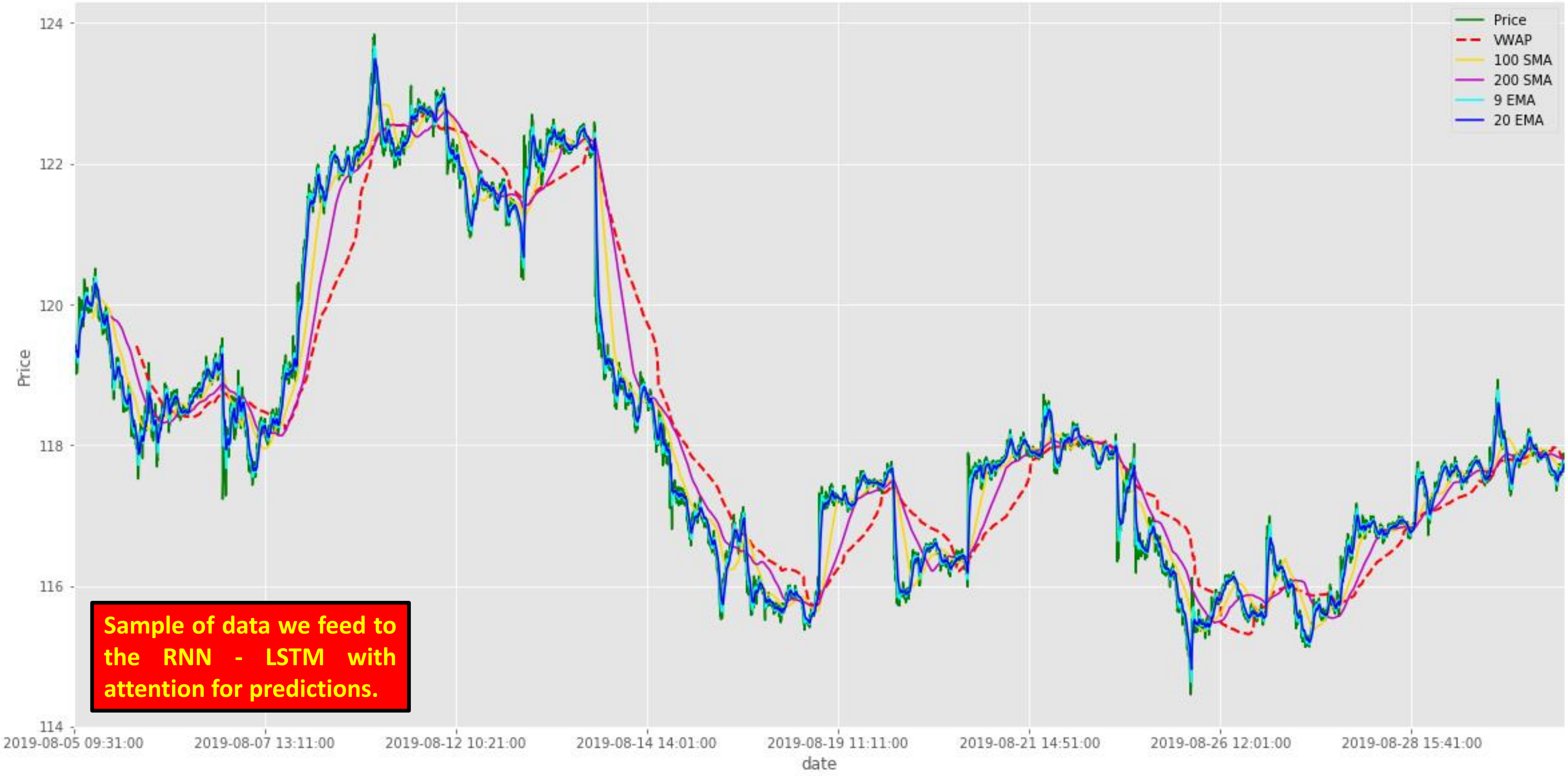
Sample of data we feed to the RNN - LSTM with attention for predictions.

Stock Price - AAPL



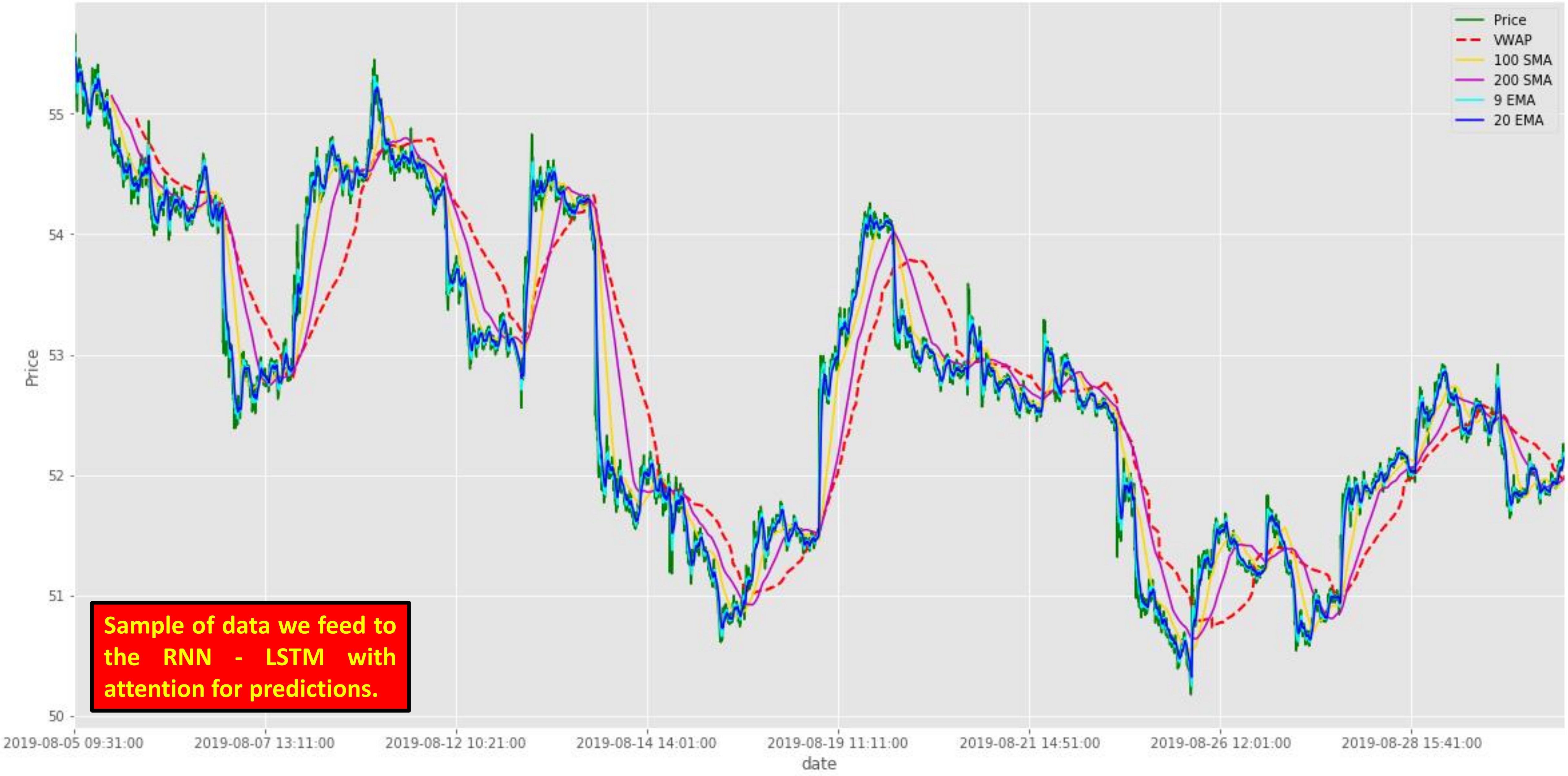
Sample of data we feed to the RNN - LSTM with attention for predictions.

Stock Price - CVX



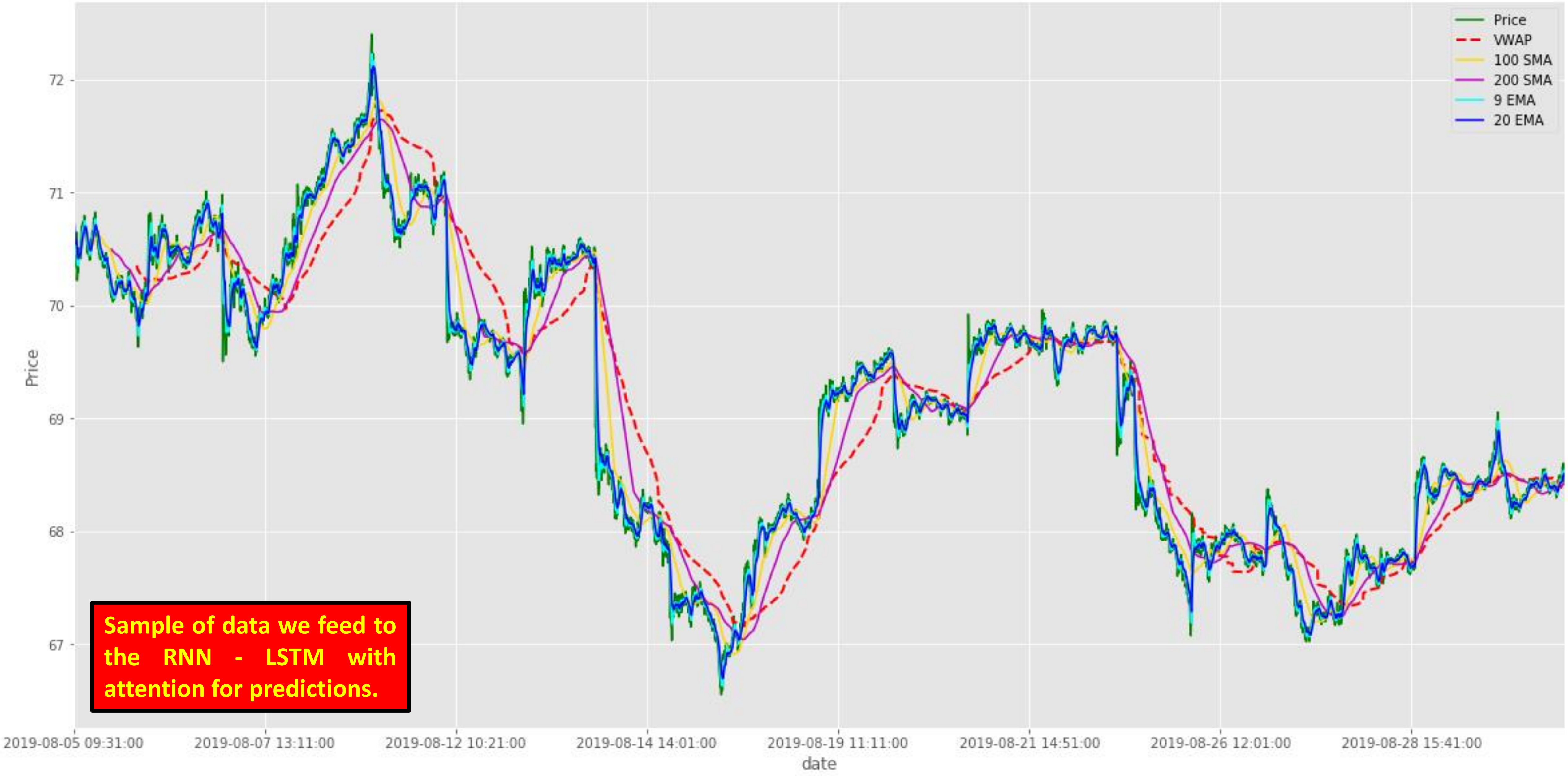
Sample of data we feed to the RNN - LSTM with attention for predictions.

Stock Price - COP



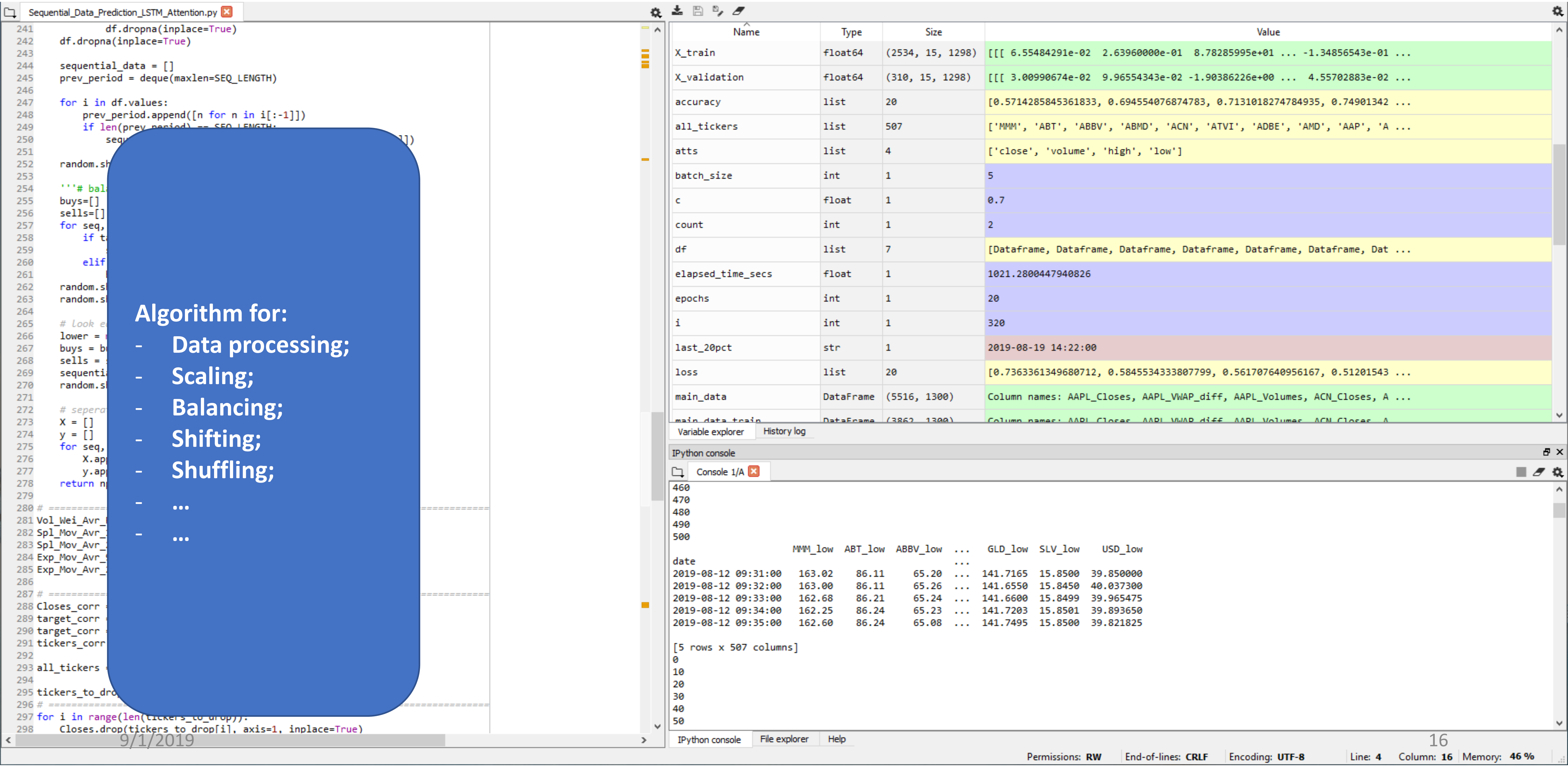
Sample of data we feed to the RNN - LSTM with attention for predictions.

Stock Price - XOM



Sample of data we feed to the RNN - LSTM with attention for predictions.

Algorithm Part 2: Data preprocessing



Sequential_Data_Prediction_LSTM_Attention.py

```
            df.dropna(inplace=True)
    df.dropna(inplace=True)

    sequential_data = []
    prev_period = deque(maxlen=SEQ_LENGTH)

    for i in df.values:
        prev_period.append([n for n in i[:-1]])
        if len(prev_period) == SEQ_LENGTH:
            seq                                                 ]])

    random.sh

    '''# bal
    buys=[]
    sells=[]
    for seq,
        if t

        elif

    random.s
    random.s

    # look e
    lower = 
    buys = b
    sells = 
    sequenti
    random.s

    # sepera
    X = []
    y = []
    for seq,
        X.ap
        y.ap
    return n

# ==========                                        ============
Vol_Wei_Avr_
Spl_Mov_Avr_
Spl_Mov_Avr_
Exp_Mov_Avr_
Exp_Mov_Avr_

# ==========                                        ============
Closes_corr 
target_corr 
target_corr 
tickers_corr

all_tickers 

tickers_to_dro
# ==========                                        ============
for i in range(len(tickers_to_drop)):
    Closes.drop(tickers_to_drop[i], axis=1, inplace=True)
```

Algorithm for:

- Data processing;
- Scaling;
- Balancing;
- Shifting;
- Shuffling;
- …
- …

Name	Type	Size	Value
X_train	float64	(2534, 15, 1298)	[[[6.55484291e-02 2.63960000e-01 8.78285995e+01 ... -1.34856543e-01 ...
X_validation	float64	(310, 15, 1298)	[[[3.00990674e-02 9.96554343e-02 -1.90386226e+00 ... 4.55702883e-02 ...
accuracy	list	20	[0.5714285845361833, 0.694554076874783, 0.7131018274784935, 0.74901342 ...
all_tickers	list	507	['MMM', 'ABT', 'ABBV', 'ABMD', 'ACN', 'ATVI', 'ADBE', 'AMD', 'AAP', 'A ...
atts	list	4	['close', 'volume', 'high', 'low']
batch_size	int	1	5
c	float	1	0.7
count	int	1	2
df	list	7	[Dataframe, Dataframe, Dataframe, Dataframe, Dataframe, Dataframe, Dat ...
elapsed_time_secs	float	1	1021.2800447940826
epochs	int	1	20
i	int	1	320
last_20pct	str	1	2019-08-19 14:22:00
loss	list	20	[0.7363361349680712, 0.5845534333807799, 0.561707640956167, 0.51201543 ...
main_data	DataFrame	(5516, 1300)	Column names: AAPL_Closes, AAPL_VWAP_diff, AAPL_Volumes, ACN_Closes, A ...
main_data_train	DataFrame	(3862, 1300)	Column names: AAPL_Closes, AAPL_VWAP_diff, AAPL_Volumes, ACN_Closes, A

```
460
470
480
490
500
                     MMM_low  ABT_low  ABBV_low  ...   GLD_low  SLV_low    USD_low
date                                             ...
2019-08-12 09:31:00   163.02    86.11     65.20  ...  141.7165  15.8500  39.850000
2019-08-12 09:32:00   163.00    86.11     65.26  ...  141.6550  15.8450  40.037300
2019-08-12 09:33:00   162.68    86.21     65.24  ...  141.6600  15.8499  39.965475
2019-08-12 09:34:00   162.25    86.24     65.23  ...  141.7203  15.8501  39.893650
2019-08-12 09:35:00   162.60    86.24     65.08  ...  141.7495  15.8500  39.821825

[5 rows x 507 columns]
0
10
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50
```
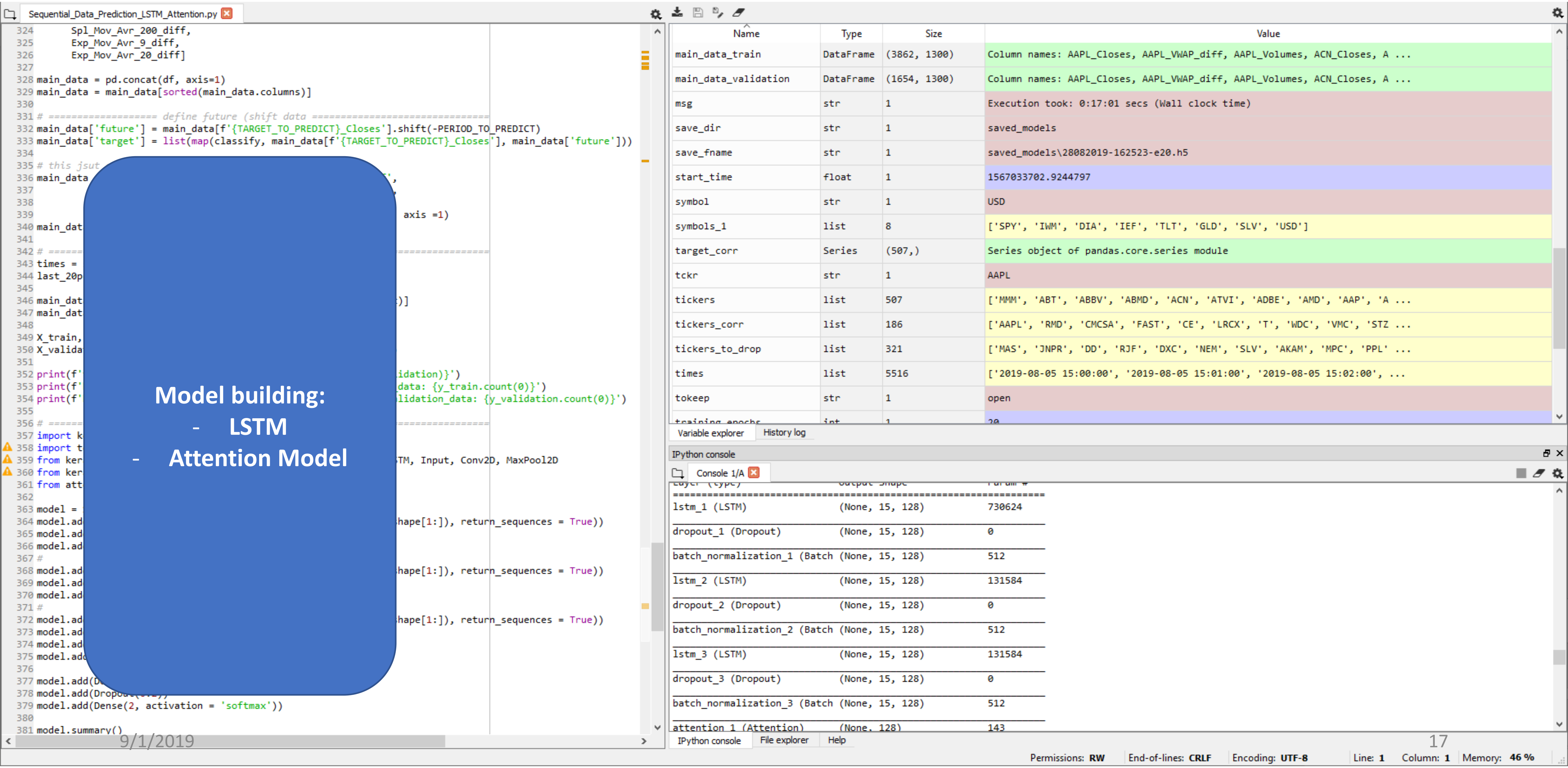

Permissions: RW End-of-lines: CRLF Encoding: UTF-8 Line: 4 Column: 16 Memory: 46 %

Algorithm Part 2: Model building



```
        Spl_Mov_Avr_200_diff,
        Exp_Mov_Avr_9_diff,
        Exp_Mov_Avr_20_diff]

main_data = pd.concat(df, axis=1)
main_data = main_data[sorted(main_data.columns)]

# =================== define future (shift data ===============================
main_data['future'] = main_data[f'{TARGET_TO_PREDICT}_Closes'].shift(-PERIOD_TO_PREDICT)
main_data['target'] = list(map(classify, main_data[f'{TARGET_TO_PREDICT}_Closes'], main_data['future']))

# this jsut
main_data                                                    ',
                                                             ,
                                                               axis =1)
main_dat

# =====                                                      ================
times =
last_20p

main_dat                                                     )]
main_dat

X_train,
X_valida

print(f'                                                     idation)}')
print(f'                                                     data: {y_train.count(0)}')
print(f'                                                     lidation_data: {y_validation.count(0)}')

# =====                                                      ================
import k
import t
from ker                                                     TM, Input, Conv2D, MaxPool2D
from ker
from att

model =
model.ad                                                     hape[1:]), return_sequences = True))
model.ad
model.ad
#
model.ad                                                     hape[1:]), return_sequences = True))
model.ad
model.ad
#
model.ad                                                     hape[1:]), return_sequences = True))
model.ad
model.ad
model.add

model.add(D
model.add(Dropo
model.add(Dense(2, activation = 'softmax'))

model.summary()
```

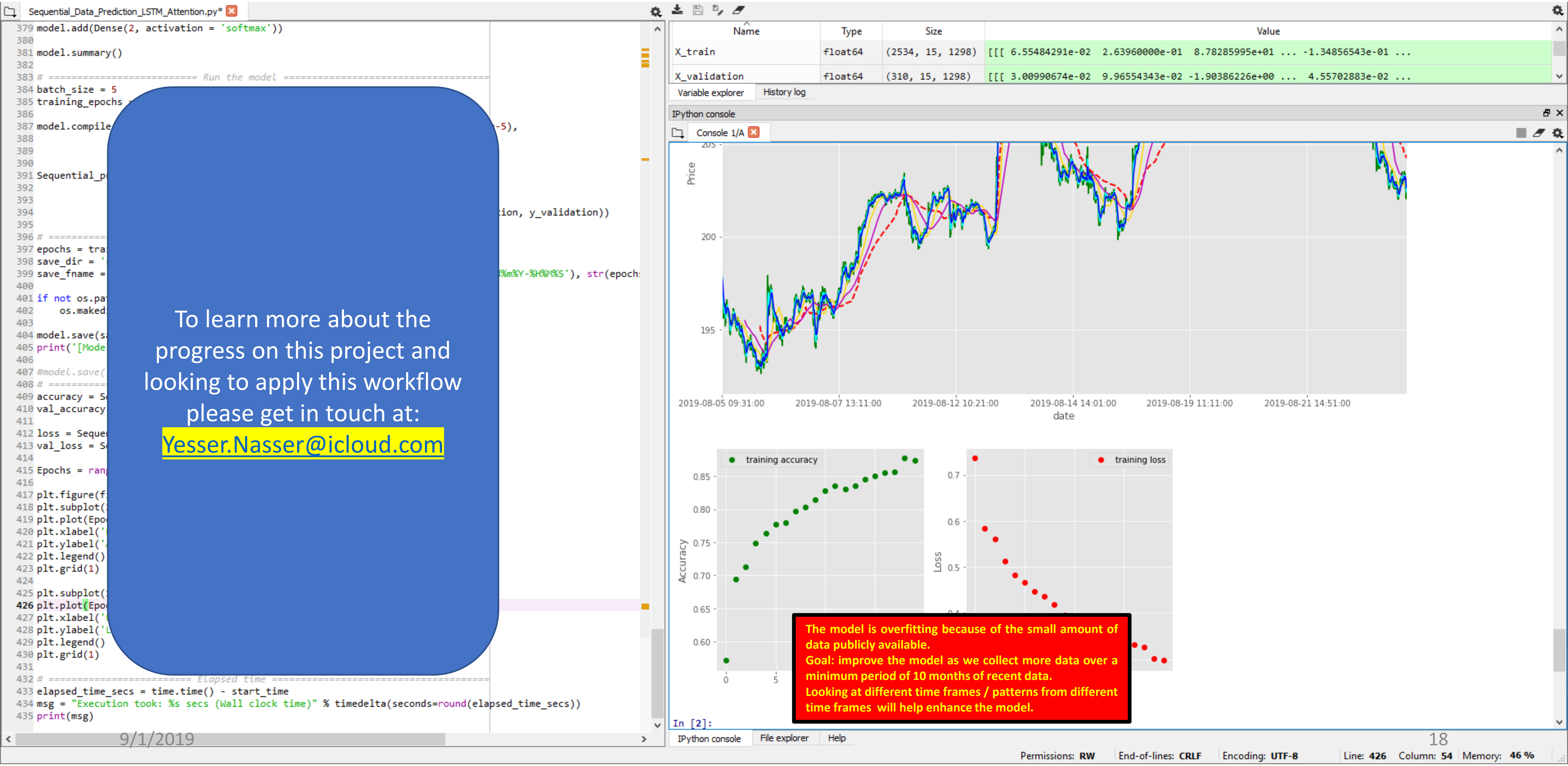
Name	Type	Size	Value
main_data_train	DataFrame	(3862, 1300)	Column names: AAPL_Closes, AAPL_VWAP_diff, AAPL_Volumes, ACN_Closes, A ...
main_data_validation	DataFrame	(1654, 1300)	Column names: AAPL_Closes, AAPL_VWAP_diff, AAPL_Volumes, ACN_Closes, A ...
msg	str	1	Execution took: 0:17:01 secs (Wall clock time)
save_dir	str	1	saved_models
save_fname	str	1	saved_models\28082019-162523-e20.h5
start_time	float	1	1567033702.9244797
symbol	str	1	USD
symbols_1	list	8	['SPY', 'IWM', 'DIA', 'IEF', 'TLT', 'GLD', 'SLV', 'USD']
target_corr	Series	(507,)	Series object of pandas.core.series module
tckr	str	1	AAPL
tickers	list	507	['MMM', 'ABT', 'ABBV', 'ABMD', 'ACN', 'ATVI', 'ADBE', 'AMD', 'AAP', 'A ...
tickers_corr	list	186	['AAPL', 'RMD', 'CMCSA', 'FAST', 'CE', 'LRCX', 'T', 'WDC', 'VMC', 'STZ ...
tickers_to_drop	list	321	['MAS', 'JNPR', 'DD', 'RJF', 'DXC', 'NEM', 'SLV', 'AKAM', 'MPC', 'PPL' ...
times	list	5516	['2019-08-05 15:00:00', '2019-08-05 15:01:00', '2019-08-05 15:02:00', ...
tokeep	str	1	open
training_epochs	int	1	20

```
Layer (type)                 Output Shape              Param #
=================================================================
lstm_1 (LSTM)                (None, 15, 128)           730624
_________________________________________________________________
dropout_1 (Dropout)          (None, 15, 128)           0
_________________________________________________________________
batch_normalization_1 (Batch (None, 15, 128)           512
_________________________________________________________________
lstm_2 (LSTM)                (None, 15, 128)           131584
_________________________________________________________________
dropout_2 (Dropout)          (None, 15, 128)           0
_________________________________________________________________
batch_normalization_2 (Batch (None, 15, 128)           512
_________________________________________________________________
lstm_3 (LSTM)                (None, 15, 128)           131584
_________________________________________________________________
dropout_3 (Dropout)          (None, 15, 128)           0
_________________________________________________________________
batch_normalization_3 (Batch (None, 15, 128)           512
_________________________________________________________________
attention_1 (Attention)      (None, 128)               143
```

Model building:

- LSTM
- Attention Model

Algorithm Part 3: Running Model – preliminary results



```
model.add(Dense(2, activation = 'softmax'))

model.summary()

# ========================= Run the model ===================================
batch_size = 5
training_epochs 

model.compile                                   -5)),



Sequential_p


                                                 ion, y_validation))

# =========
epochs = tra
save_dir = '
save_fname =                                    %m%Y-%H%M%S'), str(epoch:

if not os.pa
    os.maked

model.save(s
print('[Mode

#model.save(
# =========
accuracy = S
val_accuracy

loss = Seque
val_loss = S

Epochs = ran

plt.figure(f
plt.subplot(
plt.plot(Epo
plt.xlabel('
plt.ylabel('
plt.legend()
plt.grid(1)

plt.subplot(
plt.plot(Epo
plt.xlabel('
plt.ylabel('L
plt.legend()
plt.grid(1)

# ======================== Elapsed time =====================================
elapsed_time_secs = time.time() - start_time
msg = "Execution took: %s secs (Wall clock time)" % timedelta(seconds=round(elapsed_time_secs))
print(msg)
```

Name	Type	Size	Value
X_train	float64	(2534, 15, 1298)	[[[6.55484291e-02 2.63960000e-01 8.78285995e+01 ... -1.34856543e-01 ...
X_validation	float64	(310, 15, 1298)	[[[3.00990674e-02 9.96554343e-02 -1.90386226e+00 ... 4.55702883e-02 ...

```
In [2]:
```

Permissions: RW   End-of-lines: CRLF   Encoding: UTF-8   Line: 426   Column: 54   Memory: 46 %

To learn more about the progress on this project and looking to apply this workflow please get in touch at: Yesser.Nasser@icloud.com

The model is overfitting because of the small amount of data publicly available.
Goal: improve the model as we collect more data over a minimum period of 10 months of recent data.
Looking at different time frames / patterns from different time frames will help enhance the model.