1.lstm

September 29, 2021

[1]:
```python
import sys
import warnings

if not sys.warnoptions:
    warnings.simplefilter('ignore')
```

[2]:
```python
import tensorflow as tf
import numpy as np
import matplotlib.pyplot as plt
import seaborn as sns
import pandas as pd
from sklearn.preprocessing import MinMaxScaler
from datetime import datetime
from datetime import timedelta
from tqdm import tqdm
sns.set()
tf.compat.v1.random.set_random_seed(1234)
```

[3]:
```python
df = pd.read_csv('../dataset/GOOG-year.csv')
df.head()
```

[3]:
```
         Date        Open        High         Low       Close   Adj Close  \
0  2016-11-02  778.200012  781.650024  763.450012  768.700012  768.700012
1  2016-11-03  767.250000  769.950012  759.030029  762.130005  762.130005
2  2016-11-04  750.659973  770.359985  750.560974  762.020020  762.020020
3  2016-11-07  774.500000  785.190002  772.549988  782.520020  782.520020
4  2016-11-08  783.400024  795.632996  780.190002  790.510010  790.510010

    Volume
0  1872400
1  1943200
2  2134800
3  1585100
4  1350800
```

[4]:
```python
minmax = MinMaxScaler().fit(df.iloc[:, 4:5].astype('float32')) # Close index
df_log = minmax.transform(df.iloc[:, 4:5].astype('float32')) # Close index
```

```
df_log = pd.DataFrame(df_log)
df_log.head()
```

[4]:

	0
0	0.112708
1	0.090008
2	0.089628
3	0.160459
4	0.188066

0.1 Split train and test

I will cut the dataset to train and test datasets,

1. Train dataset derived from starting timestamp until last 30 days
2. Test dataset derived from last 30 days until end of the dataset

So we will let the model do forecasting based on last 30 days, and we will going to repeat the experiment for 10 times. You can increase it locally if you want, and tuning parameters will help you by a lot.

[5]:
```
test_size = 30
simulation_size = 10

df_train = df_log.iloc[:-test_size]
df_test = df_log.iloc[-test_size:]
df.shape, df_train.shape, df_test.shape
```

[5]: ((252, 7), (222, 1), (30, 1))

[6]:
```
class Model:
    def __init__(
        self,
        learning_rate,
        num_layers,
        size,
        size_layer,
        output_size,
        forget_bias = 0.1,
    ):
        def lstm_cell(size_layer):
            return tf.nn.rnn_cell.LSTMCell(size_layer, state_is_tuple = False)

        rnn_cells = tf.nn.rnn_cell.MultiRNNCell(
            [lstm_cell(size_layer) for _ in range(num_layers)],
            state_is_tuple = False,
        )
        self.X = tf.placeholder(tf.float32, (None, None, size))
```

```
        self.Y = tf.placeholder(tf.float32, (None, output_size))
        drop = tf.contrib.rnn.DropoutWrapper(
            rnn_cells, output_keep_prob = forget_bias
        )
        self.hidden_layer = tf.placeholder(
            tf.float32, (None, num_layers * 2 * size_layer)
        )
        self.outputs, self.last_state = tf.nn.dynamic_rnn(
            drop, self.X, initial_state = self.hidden_layer, dtype = tf.float32
        )
        self.logits = tf.layers.dense(self.outputs[-1], output_size)
        self.cost = tf.reduce_mean(tf.square(self.Y - self.logits))
        self.optimizer = tf.train.AdamOptimizer(learning_rate).minimize(
            self.cost
        )

def calculate_accuracy(real, predict):
    real = np.array(real) + 1
    predict = np.array(predict) + 1
    percentage = 1 - np.sqrt(np.mean(np.square((real - predict) / real)))
    return percentage * 100

def anchor(signal, weight):
    buffer = []
    last = signal[0]
    for i in signal:
        smoothed_val = last * weight + (1 - weight) * i
        buffer.append(smoothed_val)
        last = smoothed_val
    return buffer
```

[7]:
```
num_layers = 1
size_layer = 128
timestamp = 5
epoch = 300
dropout_rate = 0.8
future_day = test_size
learning_rate = 0.01
```

[8]:
```
def forecast():
    tf.reset_default_graph()
    modelnn = Model(
        learning_rate, num_layers, df_log.shape[1], size_layer, df_log.
 ↪shape[1], dropout_rate
    )
    sess = tf.InteractiveSession()
    sess.run(tf.global_variables_initializer())
```

```
    date_ori = pd.to_datetime(df.iloc[:, 0]).tolist()

    pbar = tqdm(range(epoch), desc = 'train loop')
    for i in pbar:
        init_value = np.zeros((1, num_layers * 2 * size_layer))
        total_loss, total_acc = [], []
        for k in range(0, df_train.shape[0] - 1, timestamp):
            index = min(k + timestamp, df_train.shape[0] - 1)
            batch_x = np.expand_dims(
                df_train.iloc[k : index, :].values, axis = 0
            )
            batch_y = df_train.iloc[k + 1 : index + 1, :].values
            logits, last_state, _, loss = sess.run(
                [modelnn.logits, modelnn.last_state, modelnn.optimizer, modelnn.
↪cost],
                feed_dict = {
                    modelnn.X: batch_x,
                    modelnn.Y: batch_y,
                    modelnn.hidden_layer: init_value,
                },
            )
            init_value = last_state
            total_loss.append(loss)
            total_acc.append(calculate_accuracy(batch_y[:, 0], logits[:, 0]))
        pbar.set_postfix(cost = np.mean(total_loss), acc = np.mean(total_acc))

    future_day = test_size

    output_predict = np.zeros((df_train.shape[0] + future_day, df_train.
↪shape[1]))
    output_predict[0] = df_train.iloc[0]
    upper_b = (df_train.shape[0] // timestamp) * timestamp
    init_value = np.zeros((1, num_layers * 2 * size_layer))

    for k in range(0, (df_train.shape[0] // timestamp) * timestamp, timestamp):
        out_logits, last_state = sess.run(
            [modelnn.logits, modelnn.last_state],
            feed_dict = {
                modelnn.X: np.expand_dims(
                    df_train.iloc[k : k + timestamp], axis = 0
                ),
                modelnn.hidden_layer: init_value,
            },
        )
        init_value = last_state
        output_predict[k + 1 : k + timestamp + 1] = out_logits
```

```
    if upper_b != df_train.shape[0]:
        out_logits, last_state = sess.run(
            [modelnn.logits, modelnn.last_state],
            feed_dict = {
                modelnn.X: np.expand_dims(df_train.iloc[upper_b:], axis = 0),
                modelnn.hidden_layer: init_value,
            },
        )
        output_predict[upper_b + 1 : df_train.shape[0] + 1] = out_logits
        future_day -= 1
        date_ori.append(date_ori[-1] + timedelta(days = 1))

    init_value = last_state

    for i in range(future_day):
        o = output_predict[-future_day - timestamp + i:-future_day + i]
        out_logits, last_state = sess.run(
            [modelnn.logits, modelnn.last_state],
            feed_dict = {
                modelnn.X: np.expand_dims(o, axis = 0),
                modelnn.hidden_layer: init_value,
            },
        )
        init_value = last_state
        output_predict[-future_day + i] = out_logits[-1]
        date_ori.append(date_ori[-1] + timedelta(days = 1))

    output_predict = minmax.inverse_transform(output_predict)
    deep_future = anchor(output_predict[:, 0], 0.3)

    return deep_future[-test_size:]
```

[9]:
```
results = []
for i in range(simulation_size):
    print('simulation %d'%(i + 1))
    results.append(forecast())
```

```
WARNING: Logging before flag parsing goes to stderr.
W0812 10:02:17.549519 140290267916096 deprecation.py:323] From <ipython-
input-6-d01d21f09afe>:12: LSTMCell.__init__ (from
tensorflow.python.ops.rnn_cell_impl) is deprecated and will be removed in a
future version.
Instructions for updating:
This class is equivalent as tf.keras.layers.LSTMCell, and will be replaced by
that in Tensorflow 2.0.
W0812 10:02:17.551540 140290267916096 rnn_cell_impl.py:893]
<tensorflow.python.ops.rnn_cell_impl.LSTMCell object at 0x7f975091ada0>: Using a
```

```
concatenated state is slower and will soon be deprecated.  Use
state_is_tuple=True.
W0812 10:02:17.552432 140290267916096 deprecation.py:323] From <ipython-
input-6-d01d21f09afe>:16: MultiRNNCell.__init__ (from
tensorflow.python.ops.rnn_cell_impl) is deprecated and will be removed in a
future version.
Instructions for updating:
This class is equivalent as tf.keras.layers.StackedRNNCells, and will be
replaced by that in Tensorflow 2.0.
```

```
simulation 1
```

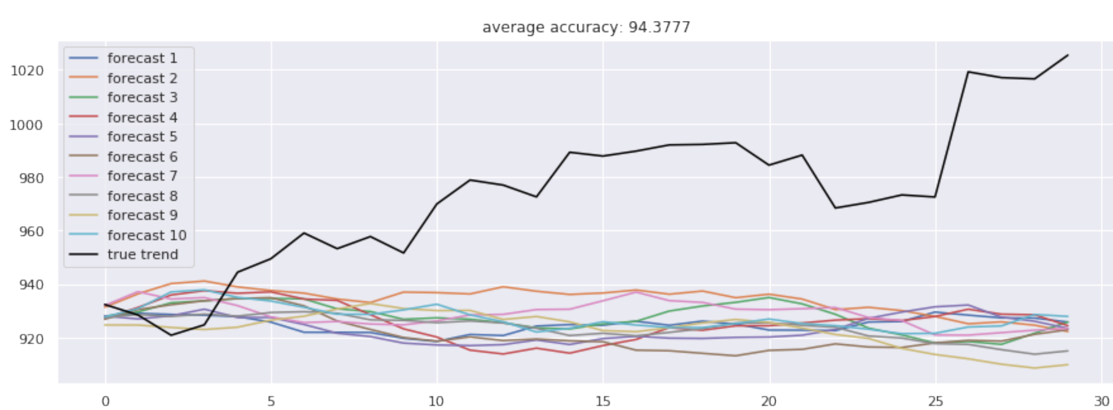
```
W0812 10:02:19.808033 140290267916096 lazy_loader.py:50]
The TensorFlow contrib module will not be included in TensorFlow 2.0.
For more information, please see:
  * https://github.com/tensorflow/community/blob/master/rfcs/20180907-contrib-
sunset.md
  * https://github.com/tensorflow/addons
  * https://github.com/tensorflow/io (for I/O related ops)
If you depend on functionality not listed there, please file an issue.

W0812 10:02:19.816455 140290267916096 deprecation.py:323] From <ipython-
input-6-d01d21f09afe>:27: dynamic_rnn (from tensorflow.python.ops.rnn) is
deprecated and will be removed in a future version.
Instructions for updating:
Please use `keras.layers.RNN(cell)`, which is equivalent to this API
W0812 10:02:20.147778 140290267916096 deprecation.py:506] From
/usr/local/lib/python3.6/dist-packages/tensorflow/python/ops/init_ops.py:1251:
calling VarianceScaling.__init__ (from tensorflow.python.ops.init_ops) with
dtype is deprecated and will be removed in a future version.
Instructions for updating:
Call initializer instance with the dtype argument instead of passing it to the
constructor
W0812 10:02:20.154457 140290267916096 deprecation.py:506] From
/usr/local/lib/python3.6/dist-
packages/tensorflow/python/ops/rnn_cell_impl.py:961: calling Zeros.__init__
(from tensorflow.python.ops.init_ops) with dtype is deprecated and will be
removed in a future version.
Instructions for updating:
Call initializer instance with the dtype argument instead of passing it to the
constructor
W0812 10:02:20.564182 140290267916096 deprecation.py:323] From <ipython-
input-6-d01d21f09afe>:29: dense (from tensorflow.python.layers.core) is
deprecated and will be removed in a future version.
Instructions for updating:
Use keras.layers.dense instead.
train loop: 100%|     | 300/300 [01:10<00:00,  4.33it/s, acc=97.2,
cost=0.00221]
W0812 10:03:39.929984 140290267916096 rnn_cell_impl.py:893]
```

```
<tensorflow.python.ops.rnn_cell_impl.LSTMCell object at 0x7f975091add8>: Using a
concatenated state is slower and will soon be deprecated.  Use
state_is_tuple=True.

simulation 2

train loop: 100%|     | 300/300 [01:09<00:00,  4.33it/s, acc=97.4,
cost=0.00193]
W0812 10:04:50.024182 140290267916096 rnn_cell_impl.py:893]
<tensorflow.python.ops.rnn_cell_impl.LSTMCell object at 0x7f974694f240>: Using a
concatenated state is slower and will soon be deprecated.  Use
state_is_tuple=True.

simulation 3

train loop: 100%|     | 300/300 [01:09<00:00,  4.34it/s, acc=97.2,
cost=0.00212]
W0812 10:05:59.904235 140290267916096 rnn_cell_impl.py:893]
<tensorflow.python.ops.rnn_cell_impl.LSTMCell object at 0x7f9746a5af28>: Using a
concatenated state is slower and will soon be deprecated.  Use
state_is_tuple=True.

simulation 4

train loop: 100%|     | 300/300 [01:09<00:00,  4.30it/s, acc=97.3,
cost=0.00195]
W0812 10:07:10.197728 140290267916096 rnn_cell_impl.py:893]
<tensorflow.python.ops.rnn_cell_impl.LSTMCell object at 0x7f9704151390>: Using a
concatenated state is slower and will soon be deprecated.  Use
state_is_tuple=True.

simulation 5

train loop: 100%|     | 300/300 [01:09<00:00,  4.31it/s, acc=97.2,
cost=0.00208]
W0812 10:08:20.024446 140290267916096 rnn_cell_impl.py:893]
<tensorflow.python.ops.rnn_cell_impl.LSTMCell object at 0x7f96b8051f98>: Using a
concatenated state is slower and will soon be deprecated.  Use
state_is_tuple=True.

simulation 6

train loop: 100%|     | 300/300 [01:09<00:00,  4.31it/s, acc=97.1,
cost=0.00224]
W0812 10:09:30.567560 140290267916096 rnn_cell_impl.py:893]
<tensorflow.python.ops.rnn_cell_impl.LSTMCell object at 0x7f96a40a6fd0>: Using a
concatenated state is slower and will soon be deprecated.  Use
state_is_tuple=True.

simulation 7

train loop: 100%|     | 300/300 [01:09<00:00,  4.30it/s, acc=97,
cost=0.00229]
W0812 10:10:40.653531 140290267916096 rnn_cell_impl.py:893]
```

```
<tensorflow.python.ops.rnn_cell_impl.LSTMCell object at 0x7f968d66ac88>: Using a
concatenated state is slower and will soon be deprecated.  Use
state_is_tuple=True.

simulation 8

train loop: 100%|      | 300/300 [01:09<00:00,  4.23it/s, acc=97.5,
cost=0.00168]
W0812 10:11:50.874499 140290267916096 rnn_cell_impl.py:893]
<tensorflow.python.ops.rnn_cell_impl.LSTMCell object at 0x7f96941b8438>: Using a
concatenated state is slower and will soon be deprecated.  Use
state_is_tuple=True.

simulation 9

train loop: 100%|      | 300/300 [01:10<00:00,  4.32it/s, acc=97.3,
cost=0.00193]
W0812 10:13:01.677561 140290267916096 rnn_cell_impl.py:893]
<tensorflow.python.ops.rnn_cell_impl.LSTMCell object at 0x7f968b7442e8>: Using a
concatenated state is slower and will soon be deprecated.  Use
state_is_tuple=True.

simulation 10

train loop: 100%|      | 300/300 [01:09<00:00,  4.28it/s, acc=97.8,
cost=0.00115]
```

[10]:

```
accuracies = [calculate_accuracy(df['Close'].iloc[-test_size:].values, r) for r␣
 ↪in results]

plt.figure(figsize = (15, 5))
for no, r in enumerate(results):
    plt.plot(r, label = 'forecast %d'%(no + 1))
plt.plot(df['Close'].iloc[-test_size:].values, label = 'true trend', c =␣
 ↪'black')
plt.legend()
plt.title('average accuracy: %.4f'%(np.mean(accuracies)))
plt.show()
```



```
[ ]:
```