

## 13.gru-seq2seq

September 29, 2021

```
[1]: import sys
import warnings

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

```
[2]: 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]: df = pd.read_csv('../dataset/G00G-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]: 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.GRUCell(size_layer)

        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))
```

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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 * size_layer)
)
_, last_state = tf.nn.dynamic_rnn(
    drop, self.X, initial_state = self.hidden_layer, dtype = tf.float32
)

with tf.variable_scope('decoder', reuse = False):
    rnn_cells_dec = tf.nn.rnn_cell.MultiRNNCell(
        [lstm_cell(size_layer) for _ in range(num_layers)],
        state_is_tuple = False
    )
    drop_dec = tf.contrib.rnn.DropoutWrapper(
        rnn_cells_dec, output_keep_prob = forget_bias
    )
    self.outputs, self.last_state = tf.nn.dynamic_rnn(
        drop_dec, self.X, initial_state = last_state, 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 * 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 * 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.

W0816 17:29:50.622041 140611410274112 deprecation.py:323] From <ipython-input-6-7a2cc302036d>:12: GRUCell.\_\_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.GRUCell, and will be replaced by that in Tensorflow 2.0.

W0816 17:29:50.624857 140611410274112 deprecation.py:323] From <ipython-input-6-7a2cc302036d>: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

W0816 17:29:50.941864 140611410274112 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.

W0816 17:29:50.945153 140611410274112 deprecation.py:323] From <ipython-input-6-7a2cc302036d>: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

W0816 17:29:51.137009 140611410274112 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

W0816 17:29:51.144164 140611410274112 deprecation.py:506] From /usr/local/lib/python3.6/dist-packages/tensorflow/python/ops/rnn\_cell\_impl.py:564: calling Constant.\_\_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

```
W0816 17:29:51.155159 140611410274112 deprecation.py:506] From
/usr/local/lib/python3.6/dist-
packages/tensorflow/python/ops/rnn_cell_impl.py:574: 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

```
W0816 17:29:51.387444 140611410274112 deprecation.py:323] From <ipython-
input-6-7a2cc302036d>:41: 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 [01:36<00:00,  3.15it/s, acc=97.7,
cost=0.00125]
```

simulation 2

```
train loop: 100%|          | 300/300 [01:37<00:00,  3.07it/s, acc=98.1,
cost=0.000968]
```

simulation 3

```
train loop: 100%|          | 300/300 [01:34<00:00,  3.14it/s, acc=97.3,
cost=0.00201]
```

simulation 4

```
train loop: 100%|          | 300/300 [01:36<00:00,  3.12it/s, acc=97.8,
cost=0.00113]
```

simulation 5

```
train loop: 100%|          | 300/300 [01:36<00:00,  3.15it/s, acc=97.6,
cost=0.00147]
```

simulation 6

```
train loop: 100%|          | 300/300 [01:36<00:00,  3.11it/s, acc=98.2,
cost=0.000856]
```

simulation 7

```
train loop: 100%|          | 300/300 [01:35<00:00,  3.14it/s, acc=97.7,
cost=0.00139]
```

simulation 8

```
train loop: 100%|          | 300/300 [01:36<00:00,  3.11it/s, acc=97.1,
cost=0.002]
```

simulation 9

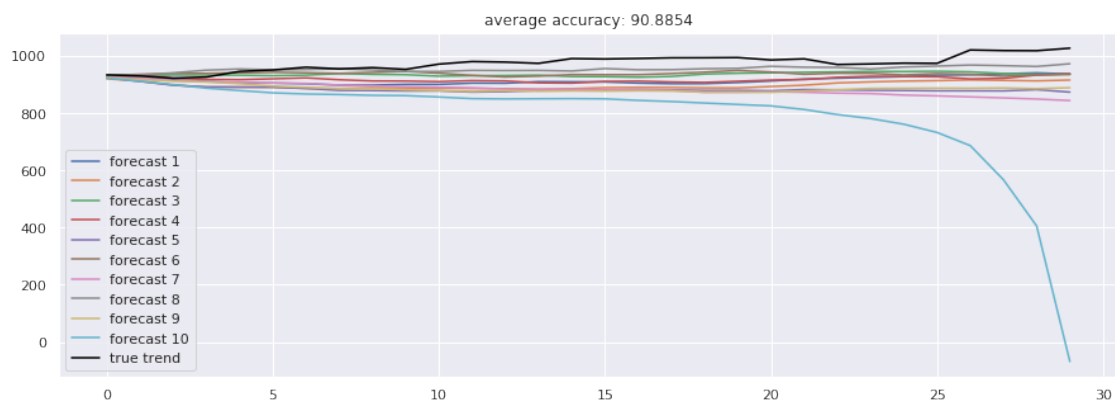
```
train loop: 100%|      | 300/300 [01:36<00:00, 3.13it/s, acc=97.8,  
cost=0.00111]
```

```
simulation 10
```

```
train loop: 100%|      | 300/300 [01:37<00:00, 3.06it/s, acc=97.4,  
cost=0.00152]
```

```
[12]: 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()
```



```
[ ]:
```