# 17.cnn-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/GOOG-year.csv')
df.head()
```

[3]:

| | Date | Open | High | Low | Close | Adj Close | Volume |
|---|---|---|---|---|---|---|---|
| 0 | 2016-11-02 | 778.200012 | 781.650024 | 763.450012 | 768.700012 | 768.700012 | 1872400 |
| 1 | 2016-11-03 | 767.250000 | 769.950012 | 759.030029 | 762.130005 | 762.130005 | 1943200 |
| 2 | 2016-11-04 | 750.659973 | 770.359985 | 750.560974 | 762.020020 | 762.020020 | 2134800 |
| 3 | 2016-11-07 | 774.500000 | 785.190002 | 772.549988 | 782.520020 | 782.520020 | 1585100 |
| 4 | 2016-11-08 | 783.400024 | 795.632996 | 780.190002 | 790.510010 | 790.510010 | 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]:
```
def encoder_block(inp, n_hidden, filter_size):
    inp = tf.expand_dims(inp, 2)
    inp = tf.pad(
        inp,
        [
            [0, 0],
            [(filter_size[0] - 1) // 2, (filter_size[0] - 1) // 2],
            [0, 0],
            [0, 0],
        ],
    )
    conv = tf.layers.conv2d(
        inp, n_hidden, filter_size, padding = 'VALID', activation = None
    )
    conv = tf.squeeze(conv, 2)
    return conv
```

```
def decoder_block(inp, n_hidden, filter_size):
    inp = tf.expand_dims(inp, 2)
    inp = tf.pad(inp, [[0, 0], [filter_size[0] - 1, 0], [0, 0], [0, 0]])
    conv = tf.layers.conv2d(
        inp, n_hidden, filter_size, padding = 'VALID', activation = None
    )
    conv = tf.squeeze(conv, 2)
    return conv


def glu(x):
    return tf.multiply(
        x[:, :, : tf.shape(x)[2] // 2],
        tf.sigmoid(x[:, :, tf.shape(x)[2] // 2 :]),
    )


def layer(inp, conv_block, kernel_width, n_hidden, residual = None):
    z = conv_block(inp, n_hidden, (kernel_width, 1))
    return glu(z) + (residual if residual is not None else 0)

class Model:
    def __init__(
        self,
        learning_rate,
        num_layers,
        size,
        size_layer,
        output_size,
        kernel_size = 3,
        n_attn_heads = 16,
        dropout = 0.9,
    ):
        self.X = tf.placeholder(tf.float32, (None, None, size))
        self.Y = tf.placeholder(tf.float32, (None, output_size))

        encoder_embedded = tf.layers.dense(self.X, size_layer)

        e = tf.identity(encoder_embedded)
        for i in range(num_layers):
            z = layer(
                encoder_embedded,
                encoder_block,
                kernel_size,
                size_layer * 2,
                encoder_embedded,
            )
```

```
            z = tf.nn.dropout(z, keep_prob = dropout)
            encoder_embedded = z

        encoder_output, output_memory = z, z + e
        g = tf.identity(encoder_embedded)

        for i in range(num_layers):
            attn_res = h = layer(
                encoder_embedded,
                decoder_block,
                kernel_size,
                size_layer * 2,
                residual = tf.zeros_like(encoder_embedded),
            )
            C = []
            for j in range(n_attn_heads):
                h_ = tf.layers.dense(h, size_layer // n_attn_heads)
                g_ = tf.layers.dense(g, size_layer // n_attn_heads)
                zu_ = tf.layers.dense(
                    encoder_output, size_layer // n_attn_heads
                )
                ze_ = tf.layers.dense(output_memory, size_layer // n_attn_heads)

                d = tf.layers.dense(h_, size_layer // n_attn_heads) + g_
                dz = tf.matmul(d, tf.transpose(zu_, [0, 2, 1]))
                a = tf.nn.softmax(dz)
                c_ = tf.matmul(a, ze_)
                C.append(c_)

            c = tf.concat(C, 2)
            h = tf.layers.dense(attn_res + c, size_layer)
            h = tf.nn.dropout(h, keep_prob = dropout)
            encoder_embedded = h

        encoder_embedded = tf.sigmoid(encoder_embedded[-1])
        self.logits = tf.layers.dense(encoder_embedded, 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 = test_size
epoch = 300
dropout_rate = 0.7
future_day = test_size
learning_rate = 1e-3
```

[8]:
```
def forecast():
    tf.reset_default_graph()
    modelnn = Model(
        learning_rate, num_layers, df_log.shape[1], size_layer, df_log.shape[1],
        dropout = 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, _, loss = sess.run(
                [modelnn.logits, modelnn.optimizer, modelnn.cost],
                feed_dict = {modelnn.X: batch_x, modelnn.Y: batch_y},
            )
            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
```

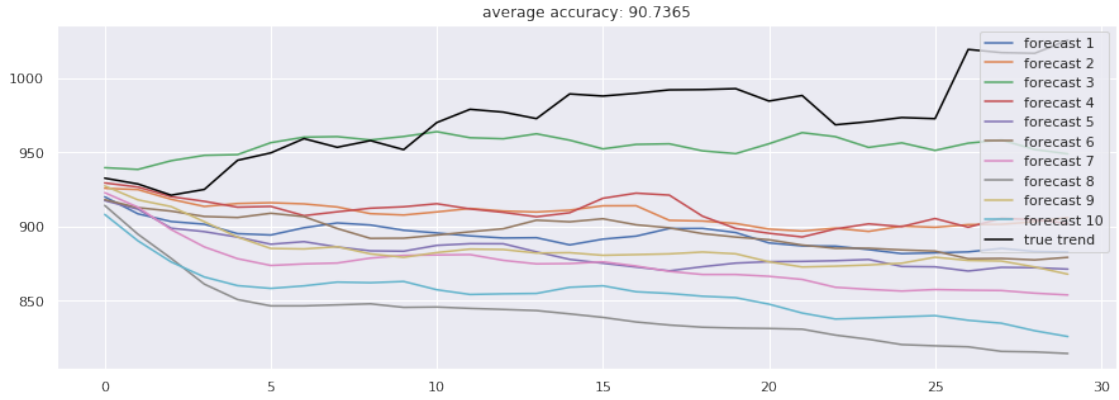
```
    output_predict = np.zeros((df_train.shape[0] + future_day, df_train.
↪shape[1]))
    output_predict[0] = df_train.iloc[0]
    upper_b = (df_train.shape[0] // timestamp) * timestamp

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

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

    for i in range(future_day):
        o = output_predict[-future_day - timestamp + i:-future_day + i]
        out_logits = sess.run(
            modelnn.logits,
            feed_dict = {
                modelnn.X: np.expand_dims(o, axis = 0)
            },
        )
        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.
W0818 16:16:28.504163 139649888855872 deprecation.py:323] From <ipython-
input-6-6c0655f4345e>:55: dense (from tensorflow.python.layers.core) is
deprecated and will be removed in a future version.
Instructions for updating:
Use keras.layers.dense instead.
W0818 16:16:28.507718 139649888855872 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
W0818 16:16:28.696973 139649888855872 deprecation.py:323] From <ipython-
input-6-6c0655f4345e>:13: conv2d (from tensorflow.python.layers.convolutional)
is deprecated and will be removed in a future version.
Instructions for updating:
Use `tf.keras.layers.Conv2D` instead.

simulation 1

W0818 16:16:28.910956 139649888855872 deprecation.py:506] From <ipython-
input-6-6c0655f4345e>:66: calling dropout (from tensorflow.python.ops.nn_ops)
with keep_prob is deprecated and will be removed in a future version.
Instructions for updating:
Please use `rate` instead of `keep_prob`. Rate should be set to `rate = 1 -
keep_prob`.
train loop: 100%|      | 300/300 [00:43<00:00,  7.09it/s, acc=96.6,
cost=0.00251]

simulation 2

train loop: 100%|      | 300/300 [00:43<00:00,  7.08it/s, acc=96.9,
cost=0.00232]

simulation 3

train loop: 100%|      | 300/300 [00:43<00:00,  6.99it/s, acc=94.1,
cost=0.00764]

simulation 4

train loop: 100%|      | 300/300 [00:43<00:00,  6.98it/s, acc=96.6,
cost=0.00273]

simulation 5

train loop: 100%|      | 300/300 [00:43<00:00,  7.02it/s, acc=97.7,
cost=0.00113]

simulation 6

train loop: 100%|      | 300/300 [00:43<00:00,  7.06it/s, acc=97.7,
cost=0.00117]
```

```
simulation 7

train loop: 100%|      | 300/300 [00:43<00:00,  6.98it/s, acc=96.4,
cost=0.00286]

simulation 8

train loop: 100%|      | 300/300 [00:43<00:00,  6.97it/s, acc=94.7,
cost=0.00573]

simulation 9

train loop: 100%|      | 300/300 [00:43<00:00,  6.94it/s, acc=93.9,
cost=0.00807]

simulation 10

train loop: 100%|      | 300/300 [00:43<00:00,  7.05it/s, acc=94.6,
cost=0.006]
```

[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()
```




[ ]: