```
from keras.layers import Input, Dense, LSTM
from keras.models import Model
from keras.layers import *
from keras.models import *
from keras.optimizers import Adam
from keras.callbacks import EarlyStopping
```

```
Using TensorFlow backend.
```

```
import pandas as pd
import numpy as np
import tensorflow as tf
import matplotlib.pyplot as plt
%matplotlib inline
from sklearn.preprocessing import MinMaxScaler
import time
```

```
df = pd.read_csv("data/沪深300天级别数
据.csv",header=0,index_col=None,sep='\s+',parse_dates=[0])
```

```
df.head(8)
```

```
        time     open    close     high      low      volume
money
0 2012-01-04  2361.50  2298.75  2365.99  2298.30  3434456700
32572551267
1 2012-01-05  2290.78  2276.39  2316.66  2272.15  4301648000
37635272074
2 2012-01-06  2274.35  2290.60  2291.89  2254.57  3519899200
31079362325
3 2012-01-09  2291.18  2368.57  2368.89  2271.72  5472734100
51478126954
4 2012-01-10  2365.77  2447.35  2449.95  2361.28  8115498900
75249157103
5 2012-01-11  2444.76  2435.61  2453.15  2423.32  5870567400
57587219272
6 2012-01-12  2426.82  2435.22  2464.38  2423.32  4712127500
47877407259
7 2012-01-13  2438.41  2394.33  2445.79  2374.55  4551399700
47228338588
```

```
df.shape
```

```
(2024, 7)
```

```
df_feature = df[['close','open','high', 'low', 'volume',
'money']].astype('float')
```

```
sample_num = df.shape[0]
```

```
train_num = int(df.shape[0] * 0.8)
```

```
test_num = df.shape[0] - train_num

sample_num,train_num,test_num
```

```
(2024, 1619, 405)
```

```
data_train = df_feature.iloc[:train_num, :]
data_test = df_feature.iloc[train_num:, :]
print(data_train.shape, data_test.shape)
```

```
(1619, 6) (405, 6)
```

```
scaler = MinMaxScaler(feature_range=(0, 1))
scaler.fit(data_train)
```

```
MinMaxScaler(copy=True, feature_range=(0, 1))
```

```
data_train = scaler.transform(data_train)
data_test = scaler.transform(data_test)

data_train_y = np.array(df_feature.iloc[:train_num, 0])
data_test_y = np.array(df_feature.iloc[train_num:, 0])
print(data_train_y.shape, data_test_y.shape)
```

```
(1619,) (405,)
```

```
PAST_TIME_STEPS = 10
NEXT_TIME_STEPS = 3

X_train = np.array([data_train[i : i + PAST_TIME_STEPS, :] for i in
range(0,data_train.shape[0] - (NEXT_TIME_STEPS+ PAST_TIME_STEPS),1)])
X_test = np.array([data_test[i : i + PAST_TIME_STEPS, :] for i in
range(0,data_test.shape[0] - (NEXT_TIME_STEPS+ PAST_TIME_STEPS),1)])

y_train_class = np.array([1 if data_train_y[i + PAST_TIME_STEPS +
NEXT_TIME_STEPS] - data_train_y[i + PAST_TIME_STEPS] > 0 else 0 for i
in range(0,data_train.shape[0] - (NEXT_TIME_STEPS+
PAST_TIME_STEPS),1)])
y_test_class = np.array([1 if data_test_y[i + PAST_TIME_STEPS +
NEXT_TIME_STEPS]- data_test_y[i + PAST_TIME_STEPS] > 0 else 0 for i in
range(0,data_test.shape[0] - (NEXT_TIME_STEPS+ PAST_TIME_STEPS),1)])

print(X_train.shape, y_train_class.shape,
X_test.shape,y_test_class.shape)
```

```
(1606, 10, 6) (1606,) (392, 10, 6) (392,)
```

```
INPUT_DIM = data_train.shape[1]
output_dim = 1
batch_size = 32 #每轮训练模型时，样本的数量
epochs = 100 #训练60轮次
hidden_size = 64
lstm_units = 32
```

```
inputs = Input(shape=(PAST_TIME_STEPS, INPUT_DIM))
#drop1 = Dropout(0.3)(inputs)
x = Conv1D(filters = 64, kernel_size = 1, activation = 'relu')(inputs)
#, padding = 'same'
#x = Conv1D(filters=128, kernel_size=5, activation='relu')
(output1)#embedded_sequences
x = MaxPooling1D(pool_size = PAST_TIME_STEPS)(x)
x = Dropout(0.1)(x)
print(x.shape)
```

```
(?, 1, 64)
```

```
lstm_out = Bidirectional(LSTM(lstm_units, activation='relu'),
name='bilstm')(x)
#lstm_out = LSTM(lstm_units,activation='relu')(x)
print(lstm_out.shape)
```

```
(?, 64)
```

```
# ATTENTION PART STARTS HERE
attention_probs = Dense(64, activation='sigmoid',
name='attention_vec')(lstm_out)
#attention_mul=layers.merge([stm_out,attention_probs],
output_shape],mode='concat',concat_axis=1))
attention_mul =Multiply()([lstm_out, attention_probs])
#attention_mul = merge([lstm_out, attention_probs],output_shape=32,
name='attention_mul', mode='mul')

output_class = Dense(1, activation='sigmoid')(attention_mul)
#output = Dense(10, activation='sigmoid')(drop2)

model_class = Model(inputs=inputs, outputs=output_class)
print(model_class.summary())
```

```
_________________________________________________________________
_____________________________
Layer (type)                 Output Shape              Param #
Connected to
==================================================================
============================
input_1 (InputLayer)         (None, 10, 6)             0

_________________________________________________________________
_____________________________
conv1d_1 (Conv1D)            (None, 10, 64)            448
input_1[0][0]
_________________________________________________________________
_____________________________
max_pooling1d_1 (MaxPooling1D)  (None, 1, 64)          0
conv1d_1[0][0]
_________________________________________________________________
```

```
_____
dropout_1 (Dropout)             (None, 1, 64)        0
max_pooling1d_1[0][0]
_____
_____
bilstm (Bidirectional)          (None, 64)           24832
dropout_1[0][0]
_____
_____
attention_vec (Dense)           (None, 64)           4160
bilstm[0][0]
_____
_____
multiply_1 (Multiply)           (None, 64)           0
bilstm[0][0]

attention_vec[0][0]
_____
_____
dense_1 (Dense)                 (None, 1)            65
multiply_1[0][0]
==================================================================
============================
Total params: 29,505
Trainable params: 29,505
Non-trainable params: 0
_____
_____
None
```

```
#model_class.compile(loss='binary_crossentropy', optimizer='adam',
metrics=['accuracy'])
model_class.compile(optimizer='rmsprop',loss='binary_crossentropy',met
rics=['accuracy'])
# simple early stopping
es = EarlyStopping(monitor='val_loss', mode='min', verbose=1,
patience=10)
# fit model
history_class = model_class.fit(X_train,
y_train_class,validation_data=(X_test, y_test_class), epochs=epochs,
batch_size=batch_size, shuffle=False, callbacks=[es])
y_pred_class = model_class.predict(X_test)
```

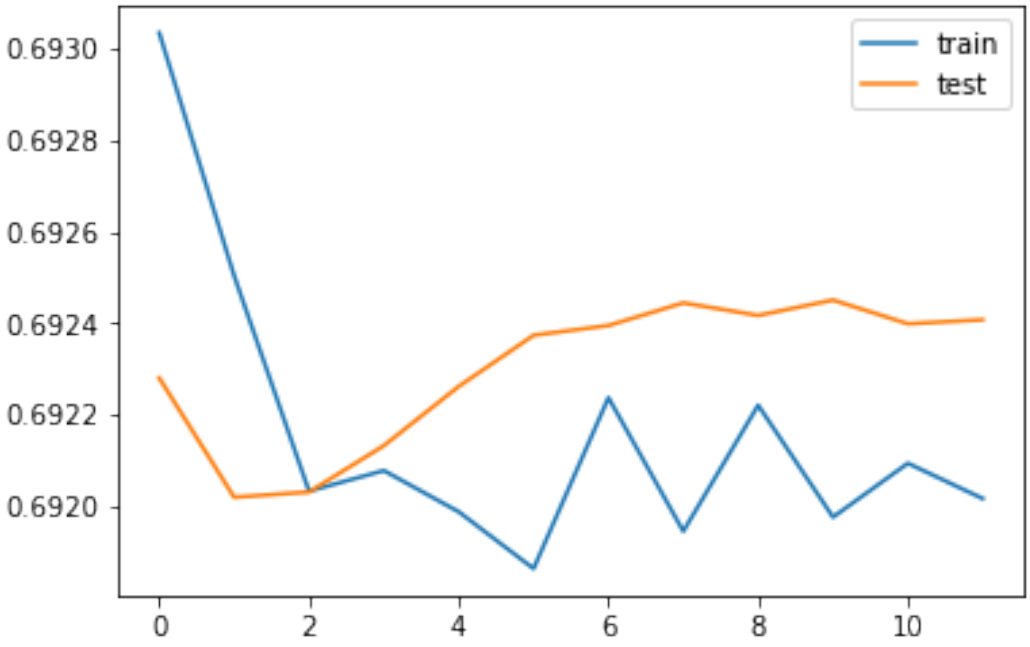
```
Train on 1606 samples, validate on 392 samples
Epoch 1/100
1606/1606 [==============================] - 2s 1ms/step - loss:
0.6930 - acc: 0.5019 - val_loss: 0.6923 - val_acc: 0.5281
Epoch 2/100
1606/1606 [==============================] - 0s 120us/step - loss:
0.6925 - acc: 0.5255 - val_loss: 0.6920 - val_acc: 0.5281
```

```
Epoch 3/100
1606/1606 [==============================] - 0s 119us/step - loss:
0.6920 - acc: 0.5255 - val_loss: 0.6920 - val_acc: 0.5281
Epoch 4/100
1606/1606 [==============================] - 0s 123us/step - loss:
0.6921 - acc: 0.5255 - val_loss: 0.6921 - val_acc: 0.5281
Epoch 5/100
1606/1606 [==============================] - 0s 111us/step - loss:
0.6920 - acc: 0.5255 - val_loss: 0.6923 - val_acc: 0.5281
Epoch 6/100
1606/1606 [==============================] - 0s 119us/step - loss:
0.6919 - acc: 0.5255 - val_loss: 0.6924 - val_acc: 0.5281
Epoch 7/100
1606/1606 [==============================] - 0s 114us/step - loss:
0.6922 - acc: 0.5255 - val_loss: 0.6924 - val_acc: 0.5281
Epoch 8/100
1606/1606 [==============================] - 0s 114us/step - loss:
0.6919 - acc: 0.5255 - val_loss: 0.6924 - val_acc: 0.5281
Epoch 9/100
1606/1606 [==============================] - 0s 112us/step - loss:
0.6922 - acc: 0.5255 - val_loss: 0.6924 - val_acc: 0.5281
Epoch 10/100
1606/1606 [==============================] - 0s 118us/step - loss:
0.6920 - acc: 0.5255 - val_loss: 0.6924 - val_acc: 0.5281
Epoch 11/100
1606/1606 [==============================] - 0s 123us/step - loss:
0.6921 - acc: 0.5255 - val_loss: 0.6924 - val_acc: 0.5281
Epoch 12/100
1606/1606 [==============================] - 0s 125us/step - loss:
0.6920 - acc: 0.5255 - val_loss: 0.6924 - val_acc: 0.5281
Epoch 00012: early stopping
```

```
# evaluate the model
_, train_acc = model_class.evaluate(X_train, y_train_class, verbose=1)
_, test_acc = model_class.evaluate(X_test, y_test_class, verbose=1)
print('Train: %.3f, Test: %.3f' % (train_acc, test_acc))
```

```
1606/1606 [==============================] - 0s 41us/step
392/392 [==============================] - 0s 56us/step
Train: 0.526, Test: 0.528
```

```
# plot training history
plt.plot(history_class.history['loss'], label='train')
plt.plot(history_class.history['val_loss'], label='test')
plt.legend()
plt.show()
```


train
test
0.6930
0.6928
0.6926
0.6924
0.6922
0.6920
0
2
4
6
8
10