LSTM Time Series Example - Stock price prediction

In [1]:

```
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
```

In [2]:

```
tr_data = pd.read_csv('AAPL_data.csv')
```

In [3]:

```
tr_data_proc = tr_data.iloc[:, 1:2].values
```

In [4]:

```
data_dates = tr_data.iloc[:, 0].values
```

Preprocess data

In [5]:

```
from sklearn.preprocessing import MinMaxScaler
scaler = MinMaxScaler(feature_range = (0, 1))

tr_data_scaled = scaler.fit_transform(tr_data_proc)
tr_data_scaled.shape
```

Out[5]:

```
(1280, 1)
```

In [6]:

```
features_set = []
labels = []
for i in range(60, 1270):
    features_set.append(tr_data_scaled[i-60:i, 0])
    labels.append(tr_data_scaled[i, 0])
```

In [7]:

```
features_set, labels = np.array(features_set), np.array(labels)
```

In [8]:

```
features_set = np.reshape(features_set, (features_set.shape[0], features_set.sha
pe[1], 1))
```

In [9]:

```
features_set.shape
```

Out[9]:

```
(1210, 60, 1)
```

LSTM Training

In [10]:

```
from keras.models import Sequential
from keras.layers import Dense
from keras.layers import LSTM
from keras.layers import Dropout
```

```
Using TensorFlow backend.
```

In [11]:

```
model = Sequential()
model.add(LSTM(units=50, return_sequences=True, input_shape=(features_set.shape[
1], 1)))
model.add(Dropout(0.2))
model.add(LSTM(units=50, return_sequences=True))
model.add(Dropout(0.2))
model.add(LSTM(units=50, return_sequences=True))
model.add(Dropout(0.2))
model.add(LSTM(units=50))
model.add(Dropout(0.2))
model.add(Dense(units = 1))
model.compile(optimizer = 'adam', loss = 'mean_squared_error')
model.fit(features_set, labels, epochs = 100, batch_size = 32)
```

```
Epoch 1/100
1210/1210 [==============================] - 8s 7ms/step - loss: 0.0
460
Epoch 2/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
047
Epoch 3/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
047
Epoch 4/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
040
```

```
Epoch 5/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
037
Epoch 6/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
036
Epoch 7/100
1210/1210 [==============================] - 7s 5ms/step - loss: 0.0
036
Epoch 8/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
036
Epoch 9/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
034
Epoch 10/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
033
Epoch 11/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
032
Epoch 12/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
031
Epoch 13/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
030
Epoch 14/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
026
Epoch 15/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
030
Epoch 16/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
026
Epoch 17/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
026
Epoch 18/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
026
Epoch 19/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
026
Epoch 20/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
028
Epoch 21/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
025
Epoch 22/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
```

```
022
Epoch 23/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
025
Epoch 24/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
025
Epoch 25/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
023
Epoch 26/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
022
Epoch 27/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
023
Epoch 28/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
023
Epoch 29/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
028
Epoch 30/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
024
Epoch 31/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
021
Epoch 32/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
025
Epoch 33/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
022
Epoch 34/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
020
Epoch 35/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
018
Epoch 36/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
019
Epoch 37/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
019
Epoch 38/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
018
Epoch 39/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
019
Epoch 40/100
```

```
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
018
Epoch 41/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
019
Epoch 42/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
018
Epoch 43/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
017
Epoch 44/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
019
Epoch 45/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
017
Epoch 46/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
019
Epoch 47/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
016
Epoch 48/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
019
Epoch 49/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
017
Epoch 50/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
016
Epoch 51/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
016
Epoch 52/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
017
Epoch 53/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
017
Epoch 54/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
015
Epoch 55/100
1210/1210 [==============================] - 7s 6ms/step - loss: 0.0
016
Epoch 56/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
015
Epoch 57/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
014
```

```
Epoch 58/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
017
Epoch 59/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
015
Epoch 60/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
015
Epoch 61/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
014
Epoch 62/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
015
Epoch 63/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
015
Epoch 64/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
015
Epoch 65/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
015
Epoch 66/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
015
Epoch 67/100
1210/1210 [==============================] - 7s 6ms/step - loss: 0.0
016
Epoch 68/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
013
Epoch 69/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
016
Epoch 70/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
015
Epoch 71/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
013
Epoch 72/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
014
Epoch 73/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
013
Epoch 74/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
013
Epoch 75/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
```

```
013
Epoch 76/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
014
Epoch 77/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
014
Epoch 78/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
013
Epoch 79/100
1210/1210 [==============================] - 7s 6ms/step - loss: 0.0
011
Epoch 80/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
013
Epoch 81/100
1210/1210 [==============================] - 7s 6ms/step - loss: 0.0
012
Epoch 82/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
012
Epoch 83/100
1210/1210 [==============================] - 7s 5ms/step - loss: 0.0
012
Epoch 84/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
013
Epoch 85/100
1210/1210 [==============================] - 7s 5ms/step - loss: 0.0
013
Epoch 86/100
1210/1210 [==============================] - 7s 5ms/step - loss: 0.0
011
Epoch 87/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
012
Epoch 88/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
012
Epoch 89/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
011
Epoch 90/100
1210/1210 [==============================] - 7s 5ms/step - loss: 0.0
013
Epoch 91/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
012
Epoch 92/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
012
Epoch 93/100
```

```
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
011
Epoch 94/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
012
Epoch 95/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
011
Epoch 96/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
012
Epoch 97/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
013
Epoch 98/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
010
Epoch 99/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
011
Epoch 100/100
1210/1210 [==============================] - 6s 5ms/step - loss: 0.0
010
```

Out[11]:

```
<keras.callbacks.History at 0x127c58f28>
```

LSTM Testing

In [12]:

```
test_data = pd.read_csv('AAPL_testdata.csv')
test_data_proc = test_data.iloc[:, 1:2].values
test_data_dates = test_data.iloc[:, 0].values
```

Preprocess test data

In [13]:

```
data_all = pd.concat((tr_data['Open'], test_data['Open']), axis=0)
```

In [14]:

```
test_inputs = data_all[len(data_all) - len(test_data) - 60:].values
```

In [15]:

```
test_inputs = test_inputs.reshape(-1,1)
test_inputs = scaler.transform(test_inputs)
```

In [16]:

```
test_features = []
for i in range(60, 80):
    test_features.append(test_inputs[i-60:i, 0])
```

In [17]:

```
test_features = np.array(test_features)
test_features = np.reshape(test_features, (test_features.shape[0], test_features
.shape[1], 1))
```

In [18]:

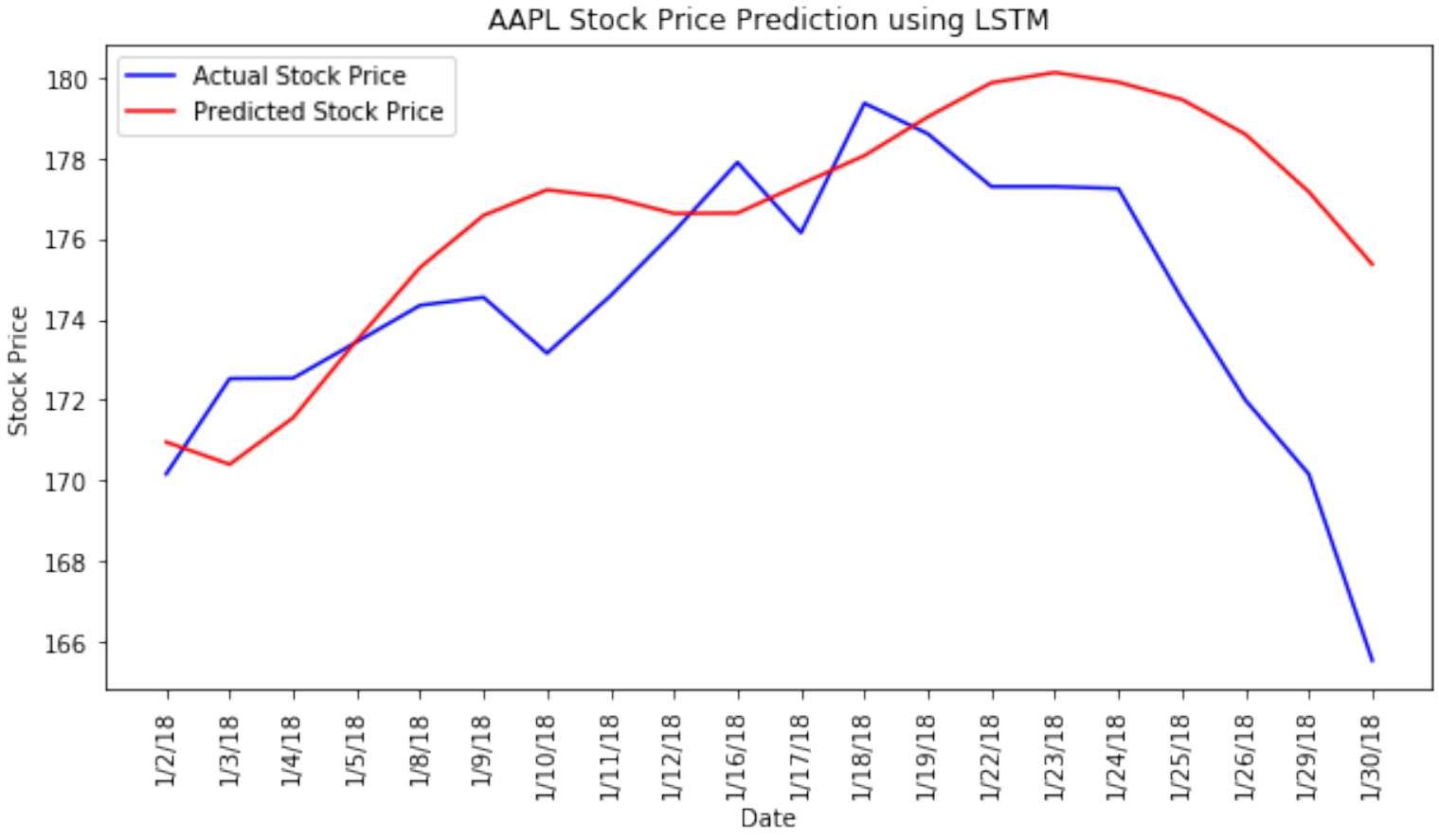
```
predictions = model.predict(test_features)
```

In [19]:

```
predictions = scaler.inverse_transform(predictions)
```

In [20]:

```
plt.figure(figsize=(10,5))
plt.plot(test_data_dates[0:20],test_data_proc[0:20], color='blue', label='Actual
Stock Price')
plt.plot(predictions , color='red', label='Predicted Stock Price')
plt.xticks(rotation=90, size=10)
plt.title('AAPL Stock Price Prediction using LSTM')
plt.xlabel('Date')
plt.ylabel('Stock Price')
plt.legend()
plt.show()
```


AAPL Stock Price Prediction using LSTM
Actual Stock Price
Predicted Stock Price
Stock Price
180
178
176
174
172
170
168
166
1/2/18
1/3/18
1/4/18
1/5/18
1/8/18
1/9/18
1/10/18
1/11/18
1/12/18
1/16/18
1/17/18
1/18/18
1/19/18
1/22/18
1/23/18
1/24/18
1/25/18
1/26/18
1/29/18
1/30/18
Date