In [9]:

```
!pip install cloudmesh-common
```

```
Requirement already satisfied: cloudmesh-common in /usr/local/lib/python3.7/dist-packages (4.3.66)
Requirement already satisfied: oyaml in /usr/local/lib/python3.7/dist-packages (from cloudmesh-common) (1.0)
Requirement already satisfied: psutil in /usr/local/lib/python3.7/dist-packages (from cloudmesh-common) (5.4.8)
Requirement already satisfied: simplejson in /usr/local/lib/python3.7/dist-packages (from cloudmesh-common) (3.
17.2)
Requirement already satisfied: requests in /usr/local/lib/python3.7/dist-packages (from cloudmesh-common) (2.2
3.0)
Requirement already satisfied: pyfiglet in /usr/local/lib/python3.7/dist-packages (from cloudmesh-common) (0.8.
post1)
Requirement already satisfied: pytz in /usr/local/lib/python3.7/dist-packages (from cloudmesh-common) (2018.9)
Requirement already satisfied: humanize in /usr/local/lib/python3.7/dist-packages (from cloudmesh-common) (0.5.
1)
Requirement already satisfied: colorama in /usr/local/lib/python3.7/dist-packages (from cloudmesh-common) (0.4.
4)
Requirement already satisfied: pathlib in /usr/local/lib/python3.7/dist-packages (from cloudmesh-common) (1.0.
1)
Requirement already satisfied: tabulate in /usr/local/lib/python3.7/dist-packages (from cloudmesh-common) (0.8.
9)
Requirement already satisfied: tqdm in /usr/local/lib/python3.7/dist-packages (from cloudmesh-common) (4.41.1)
Requirement already satisfied: python-hostlist in /usr/local/lib/python3.7/dist-packages (from cloudmesh-commo
n) (1.21)
Requirement already satisfied: python-dateutil in /usr/local/lib/python3.7/dist-packages (from cloudmesh-commo
n) (2.8.1)
Requirement already satisfied: pyyaml in /usr/local/lib/python3.7/dist-packages (from oyaml->cloudmesh-common)
(3.13)
Requirement already satisfied: chardet<4,>=3.0.2 in /usr/local/lib/python3.7/dist-packages (from requests->clou
dmesh-common) (3.0.4)
Requirement already satisfied: urllib3!=1.25.0,!=1.25.1,<1.26,>=1.21.1 in /usr/local/lib/python3.7/dist-package
s (from requests->cloudmesh-common) (1.24.3)
Requirement already satisfied: idna<3,>=2.5 in /usr/local/lib/python3.7/dist-packages (from requests->cloudmesh
-common) (2.10)
Requirement already satisfied: certifi>=2017.4.17 in /usr/local/lib/python3.7/dist-packages (from requests->clo
udmesh-common) (2020.12.5)
Requirement already satisfied: six>=1.5 in /usr/local/lib/python3.7/dist-packages (from python-dateutil->cloudm
esh-common) (1.15.0)
```

In [10]:

```
# Importing Libraries
import numpy as np
import matplotlib.pyplot as plt
import pandas as pd
from cloudmesh.common.StopWatch import StopWatch
```

In [11]:

```
from sklearn.preprocessing import MinMaxScaler
from keras.models import Sequential, load_model
from keras.layers import Dense
from keras.layers import LSTM
from keras.layers import Dropout
```

In [12]:

```
StopWatch.start("Loading Data")

dataset = pd.read_csv('https://raw.githubusercontent.com/cybertraining-dsc/sp21-599-353/main/project/code/AMZN_

training_ratio = 0.8
training_num = int(len(dataset)*training_ratio)
training_data = dataset[:training_num]
testing_data = dataset[training_num:]

training_set_open = training_data.iloc[:,1:2].values
training_set_vol = training_data.iloc[:,6:7].values # Getting Volume
#training_set = np.column_stack(training_set_open, training_set_vol)
training_set = training_set_open

testing_set_open = testing_data.iloc[:,1:2].values
testing_set_vol = testing_data.iloc[:,6:7].values # Getting Volume
#testing_set = np.column_stack(testing_set_open, testing_set_vol)
testing_set = testing_set_open

print(training_set.shape, testing_set.shape)

StopWatch.stop("Loading Data")
```

```
(4826, 1) (1207, 1)
```

In [13]:

```
sc = MinMaxScaler(feature_range = (0, 2))
training_set_scaled = sc.fit_transform(training_set)
```

In [14]:

```
x_train = []
y_train = []
for i in range(60,len(training_set)):
    x_train.append(training_set_scaled[i-60:i,0])
    y_train.append(training_set_scaled[i,0])
x_train, y_train = np.array(x_train), np.array(y_train)
X_train = np.reshape(x_train, (x_train.shape[0], x_train.shape[1], 1))
```

In [15]:

```
StopWatch.start("training")

model=Sequential()
model.add(LSTM(units=100,return_sequences=True,input_shape=(X_train.shape[1], 1)))
model.add(Dropout(0.2))
model.add(LSTM(units=100,return_sequences=True))
model.add(Dropout(0.2))
model.add(LSTM(units=100,return_sequences=True))
model.add(Dropout(0.2))
model.add(LSTM(units=100))
model.add(Dropout(0.2))
model.add(Dense(units=1))
model.compile(optimizer='adam',loss='mean_squared_error')
model.fit(X_train,y_train,epochs=100,batch_size=32)
model.save('my_model')

StopWatch.stop("training")
```

```
Epoch 1/100
149/149 [==============================] - 38s 14ms/step - loss: 0.0224
Epoch 2/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0041
Epoch 3/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0030
Epoch 4/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0028
Epoch 5/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0025
Epoch 6/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0027
Epoch 7/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0030
Epoch 8/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0029
Epoch 9/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0023
Epoch 10/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0022
Epoch 11/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0017
Epoch 12/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0018
Epoch 13/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0018
Epoch 14/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0018
Epoch 15/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0021
Epoch 16/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0017
Epoch 17/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0016
Epoch 18/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0016
Epoch 19/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0019
Epoch 20/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0015
Epoch 21/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0016
Epoch 22/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0015
Epoch 23/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0019
Epoch 24/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0021
Epoch 25/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0023
Epoch 26/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0019
Epoch 27/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0017
Epoch 28/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0017
Epoch 29/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0016
Epoch 30/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0016
Epoch 31/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0016
Epoch 32/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0016
Epoch 33/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0013
Epoch 34/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0014
Epoch 35/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0015
Epoch 36/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0023
Epoch 37/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0013
Epoch 38/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0012
Epoch 39/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0014
Epoch 40/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0015
Epoch 41/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0013
Epoch 42/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0012
Epoch 43/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0013
Epoch 44/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0015
Epoch 45/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0014
Epoch 46/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0013
Epoch 47/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0013
Epoch 48/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0016
Epoch 49/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0016
Epoch 50/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0012
Epoch 51/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0014
Epoch 52/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0012
Epoch 53/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0014
Epoch 54/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0016
Epoch 55/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0015
Epoch 56/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0011
Epoch 57/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0013
Epoch 58/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0012
Epoch 59/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0011
Epoch 60/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0012
Epoch 61/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0011
Epoch 62/100
149/149 [==============================] - 2s 13ms/step - loss: 9.7807e-04
Epoch 63/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0013
Epoch 64/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0011
Epoch 65/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0012
Epoch 66/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0011
Epoch 67/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0012
Epoch 68/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0010
Epoch 69/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0012
Epoch 70/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0012
Epoch 71/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0013
Epoch 72/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0011
Epoch 73/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0011
Epoch 74/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0012
Epoch 75/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0011
Epoch 76/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0014
Epoch 77/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0013
Epoch 78/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0011
Epoch 79/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0012
Epoch 80/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0014
Epoch 81/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0012
Epoch 82/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0012
Epoch 83/100
149/149 [==============================] - 2s 13ms/step - loss: 9.8255e-04
Epoch 84/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0011
Epoch 85/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0012
Epoch 86/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0011
Epoch 87/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0011
Epoch 88/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0011
Epoch 89/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0013
Epoch 90/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0011
Epoch 91/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0010
Epoch 92/100
149/149 [==============================] - 2s 13ms/step - loss: 9.3597e-04
Epoch 93/100
149/149 [==============================] - 2s 13ms/step - loss: 9.1482e-04
Epoch 94/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0013
Epoch 95/100
149/149 [==============================] - 2s 14ms/step - loss: 0.0013
Epoch 96/100
149/149 [==============================] - 2s 14ms/step - loss: 9.4496e-04
Epoch 97/100
149/149 [==============================] - 2s 14ms/step - loss: 9.8439e-04
Epoch 98/100
149/149 [==============================] - 2s 13ms/step - loss: 0.0012
Epoch 99/100
149/149 [==============================] - 2s 14ms/step - loss: 9.9185e-04
Epoch 100/100
149/149 [==============================] - 2s 14ms/step - loss: 9.3711e-04
WARNING:absl:Found untraced functions such as lstm_cell_layer_call_and_return_conditional_losses, lstm_cell_lay
er_call_fn, lstm_cell_1_layer_call_and_return_conditional_losses, lstm_cell_1_layer_call_fn, lstm_cell_2_layer_
call_and_return_conditional_losses while saving (showing 5 of 20). These functions will not be directly callabl
e after loading.
WARNING:absl:Found untraced functions such as lstm_cell_layer_call_and_return_conditional_losses, lstm_cell_lay
er_call_fn, lstm_cell_1_layer_call_and_return_conditional_losses, lstm_cell_1_layer_call_fn, lstm_cell_2_layer_
call_and_return_conditional_losses while saving (showing 5 of 20). These functions will not be directly callabl
e after loading.
INFO:tensorflow:Assets written to: my_model/assets
INFO:tensorflow:Assets written to: my_model/assets
```

In [16]:

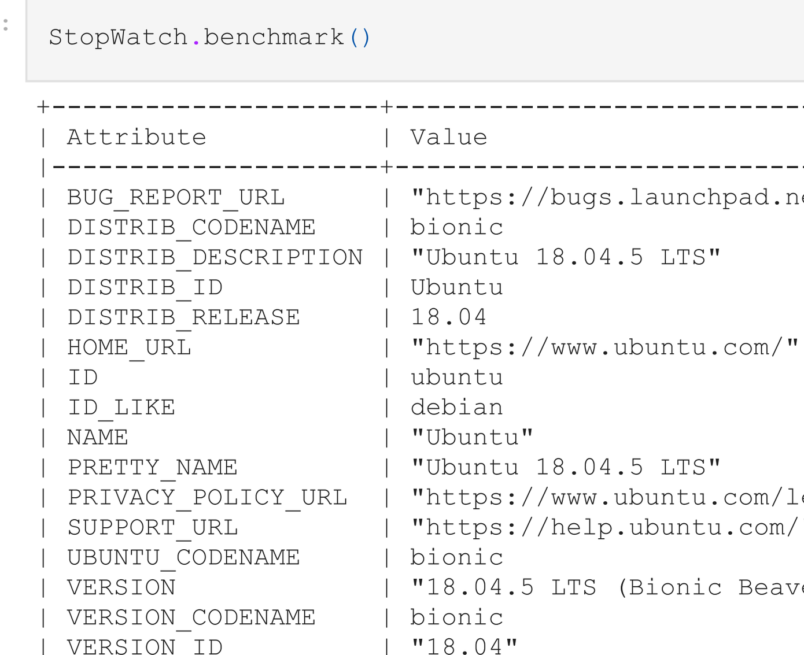
```
model = load_model('my_model')
```

In [17]:

```
StopWatch.start("Prediction")

all_data = dataset["Open"]
inputs = all_data[len(all_data) - len(testing_data) - 60:].values
inputs = inputs.reshape(-1,1)
inputs = sc.transform(inputs)

x_test = []
for i in range(60, len(testing_data)):
    x_test.append(inputs[i-60:i, 0])

x_test = np.array(x_test)
x_test = np.reshape(x_test, (x_test.shape[0], x_test.shape[1], 1))
predicted_stock_price = model.predict(x_test)
predicted_stock_price = sc.inverse_transform(predicted_stock_price)

StopWatch.stop("Prediction")
```

In [18]:

```
plt.plot(testing_set[:150], color = 'red', label = 'Real AMZN Stock Price')
plt.plot(predicted_stock_price[:150], color = 'blue', label = 'Predicted AMZN Stock Price')
plt.title('AMZN Stock Price Prediction')
plt.xlabel('Time')
plt.ylabel('AMZN Stock Price')
plt.legend()
plt.show()
plt.savefig("AMZN_stock_prediction_graph.png")
```




```
<Figure size 432x288 with 0 Axes>
```

In [20]:

```
StopWatch.benchmark()
```

```
+---------------------+------------------------------------------------------------------+
| Attribute           | Value                                                            |
|---------------------+------------------------------------------------------------------|
| BUG_REPORT_URL      | "https://bugs.launchpad.net/ubuntu/"                             |
| DISTRIB_CODENAME    | bionic                                                           |
| DISTRIB_DESCRIPTION | "Ubuntu 18.04.5 LTS"                                             |
| DISTRIB_ID          | Ubuntu                                                           |
| DISTRIB_RELEASE     | 18.04                                                            |
| HOME_URL            | "https://www.ubuntu.com/"                                        |
| ID                  | ubuntu                                                           |
| ID_LIKE             | debian                                                           |
| NAME                | "Ubuntu"                                                         |
| PRETTY_NAME         | "Ubuntu 18.04.5 LTS"                                             |
| PRIVACY_POLICY_URL  | "https://www.ubuntu.com/legal/terms-and-policies/privacy-policy" |
| SUPPORT_URL         | "https://help.ubuntu.com/"                                       |
| UBUNTU_CODENAME     | bionic                                                           |
| VERSION             | "18.04.5 LTS (Bionic Beaver)"                                    |
| VERSION_CODENAME    | bionic                                                           |
| VERSION_ID          | "18.04"                                                          |
| cpu_count           | 2                                                                |
| mem.active          | 2.4 GiB                                                          |
| mem.available       | 10.3 GiB                                                         |
| mem.free            | 4.6 GiB                                                          |
| mem.inactive        | 5.2 GiB                                                          |
| mem.percent         | 19.3 %                                                           |
| mem.total           | 12.7 GiB                                                         |
| mem.used            | 3.2 GiB                                                          |
| platform.version    | #1 SMP Thu Jul 23 08:00:38 PDT 2020                              |
| python              | 3.7.10 (default, Feb 20 2021, 21:17:23)                          |
|                     | [GCC 7.5.0]                                                      |
| python.pip          | 19.3.1                                                           |
| python.version      | 3.7.10                                                           |
| sys.platform        | linux                                                            |
| uname.machine       | x86_64                                                           |
| uname.node          | 933b2ca73d28                                                     |
| uname.processor     | x86_64                                                           |
| uname.release       | 4.19.112+                                                        |
| uname.system        | Linux                                                            |
| uname.version       | #1 SMP Thu Jul 23 08:00:38 PDT 2020                              |
| user                | collab                                                           |
+---------------------+------------------------------------------------------------------+

+--------------+----------+---------+---------+---------------------+-------+--------------+--------+-------+--
-----------------------------------+
| Name         | Status   |    Time |     Sum | Start               | tag   | Node         | User   | OS    | V
ersion                             |
|--------------+----------+---------+---------+---------------------+-------+--------------+--------+-------+--
-----------------------------------|
| Loading Data | ok       |   0.224 |   0.224 | 2021-05-07 16:51:29 |       | 933b2ca73d28 | collab | Linux | #
1 SMP Thu Jul 23 08:00:38 PDT 2020 |
| training     | ok       | 259.306 | 259.306 | 2021-05-07 16:51:30 |       | 933b2ca73d28 | collab | Linux | #
1 SMP Thu Jul 23 08:00:38 PDT 2020 |
| Prediction   | ok       |   1.361 |   1.361 | 2021-05-07 16:55:56 |       | 933b2ca73d28 | collab | Linux | #
1 SMP Thu Jul 23 08:00:38 PDT 2020 |
+--------------+----------+---------+---------+---------------------+-------+--------------+--------+-------+--
-----------------------------------+

# csv,timer,status,time,sum,start,tag,uname.node,user,uname.system,platform.version
# csv,Loading Data,ok,0.224,0.224,2021-05-07 16:51:29,,933b2ca73d28,collab,Linux,#1 SMP Thu Jul 23 08:00:38 PDT
2020
# csv,training,ok,259.306,259.306,2021-05-07 16:51:30,,933b2ca73d28,collab,Linux,#1 SMP Thu Jul 23 08:00:38 PDT
2020
# csv,Prediction,ok,1.361,1.361,2021-05-07 16:55:56,,933b2ca73d28,collab,Linux,#1 SMP Thu Jul 23 08:00:38 PDT 2
020
```