D_LSTM_HousingData

January 22, 2021

[1]:
```python
import numpy as np
import math
import matplotlib.pyplot as plt
import matplotlib.dates as mdates

import copy
import pandas as pd
import time
import datetime

from keras.models import Sequential, load_model
from keras.layers import Dense
from keras.layers import LSTM
from sklearn.preprocessing import MinMaxScaler
from sklearn.metrics import mean_squared_error
np.random.seed(7)
```

```
Using TensorFlow backend.
```

1 Data Preprocessing

[2]:
```python
Dataset = r'15minute_data_newyork/15minute_data_newyork.csv'
fulldata = pd.read_csv(Dataset)
```

[3]:
```python
data=fulldata[['dataid','local_15min','grid']]
```

[4]:
```python
sorteddata=data.sort_values(by = ['dataid', 'local_15min'])
```

[5]:
```python
ids=sorteddata['dataid'].unique().tolist()
```

[6]:
```python
housing_data = []
def convertDate(d):
    d = pd.to_datetime(d[:-3])
    return d

for i in range(len(ids)):
    housing_data.append(sorteddata.loc[sorteddata.dataid==ids[i]])
```

```
    housing_data[i] = housing_data[i].reset_index().drop(columns=['index'])
    housing_data[i]['local_15min'] = housing_data[i]['local_15min'].
 ↪apply(convertDate)
    #Convert datetimes to ints for faster ploting
    housing_data[i]['15min_ints'] =  housing_data[i]['local_15min'].map(mdates.
 ↪date2num)
```

[7]:
```
def create_dataset(dataset, look_back=1, look_ahead=None):
        "function for creating dataset for model, X being the known data, and Y␣
 ↪being target data"
        if look_ahead is None:
                look_ahead = look_back
        dataX, dataY = [], []
        for i in range(len(dataset)-2*look_back):
                dataX.append(dataset[i:(i+look_back), 0])
                if look_ahead == 0:
                        dataY.append(dataset[i + look_back, 0])
                else:
                        dataY.append(dataset[(i+look_back):
 ↪(i+look_back+look_ahead), 0])

        return np.array(dataX), np.array(dataY)
```

[8]:
```
#set up
dataframe = housing_data[0]['grid']
dataset = np.matrix(dataframe.values).transpose()
dataset = dataset.astype('float32')
```

[9]:
```
# normalize the dataset
scaler = MinMaxScaler(feature_range=(0, 1))
dataset = scaler.fit_transform(dataset)
```

[10]:
```
# split into train and test sets
train_size = int(len(dataset) * 0.67)
test_size = len(dataset) - train_size
train, test = dataset[0:train_size,:], dataset[train_size:,:]
```

[11]:
```
# reshape into X=t and Y=t+look_back
look_back = 104
trainX, trainY = create_dataset(train, look_back)
testX, testY = create_dataset(test, look_back)
```

[12]:
```
# reshape input to be [samples, time steps, features]
trainX = np.reshape(trainX, (trainX.shape[0], trainX.shape[1], 1))
testX = np.reshape(testX, (testX.shape[0], testX.shape[1], 1))
```

[13]:
```
print(trainX.shape)
print(trainY.shape)
```

```
(11626, 104, 1)
```

```
(11626, 104)
```

[14]:
```
print(testX.shape)
print(testY.shape)
```

```
(5621, 104, 1)
(5621, 104)
```

2 LSTM

https://machinelearningmastery.com/time-series-prediction-lstm-recurrent-neural-networks-python-keras/

[15]:
```
# create and fit the LSTM network
# opm = 'adam'
# model = Sequential()
# model.add(LSTM(4, input_shape=(look_back, 1)))
# model.add(Dense(104))
# model.compile(loss='mean_squared_error', optimizer=opm)
# model.fit(trainX, trainY, epochs=60, batch_size=1, verbose=2,␣
 ↪use_multiprocessing=True)
```

[16]:
```
#load
model = load_model('models/D_0house_model_2_34_Adadelta.h5')
```

```
WARNING:tensorflow:From /home/nathan/anaconda3/envs/tf/lib/python3.7/site-
packages/keras/backend/tensorflow_backend.py:422: The name tf.global_variables
is deprecated. Please use tf.compat.v1.global_variables instead.
```

[17]:
```
# make predictions
trainPredict = model.predict(trainX)
testPredict = model.predict(testX)
```

[18]:
```
# invert predictions
trainPredict = scaler.inverse_transform(trainPredict)
trainY = scaler.inverse_transform(trainY)
testPredict = scaler.inverse_transform(testPredict)
testY = scaler.inverse_transform(testY)
```

[19]:
```
# calculate root mean squared error on 1st sample
trainScore = math.sqrt(mean_squared_error(trainY[0], trainPredict[0]))
print('Train Score: %.2f RMSE' % (trainScore))
testScore = math.sqrt(mean_squared_error(testY[0], testPredict[0]))
print('Test Score: %.2f RMSE' % (testScore))
```

```
Train Score: 0.85 RMSE
Test Score: 2.24 RMSE
```

[20]:
```
# calculate root mean squared error on total data
trainScore = math.sqrt(mean_squared_error(trainY, trainPredict))
print('Train Score: %.2f RMSE' % (trainScore))
testScore = math.sqrt(mean_squared_error(testY, testPredict))
print('Test Score: %.2f RMSE' % (testScore))
```

```
Train Score: 1.94 RMSE
Test Score: 2.34 RMSE
```

[21]:
```
#save
# testscore = ('%.2f' % (testScore)).replace('.', '_')
# model.save(f'models/D_Ohouse_model_{testscore}_{opm}.h5')
```

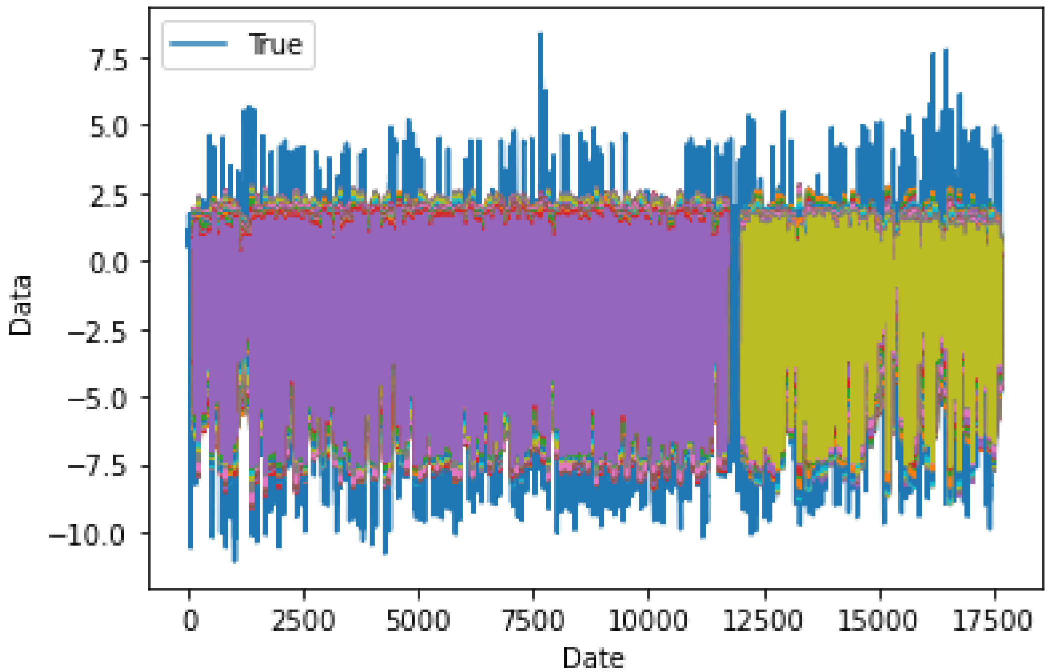
[22]:
```
# shift train predictions for plotting
trainPredictPlot = np.empty([dataset.shape[0], trainPredict.shape[1]])
trainPredictPlot[:, :] = np.nan
trainPredictPlot[look_back:len(trainPredict)+look_back, :] = trainPredict
```

[23]:
```
# shift test predictions for plotting
testPredictPlot = np.empty([dataset.shape[0], testPredict.shape[1]])
# testPredictPlot = np.empty_like(dataset)
testPredictPlot[:, :] = np.nan
testPredictPlot[len(trainPredict)+(look_back*4):len(dataset), :] = testPredict
```

[ ]:
```

```

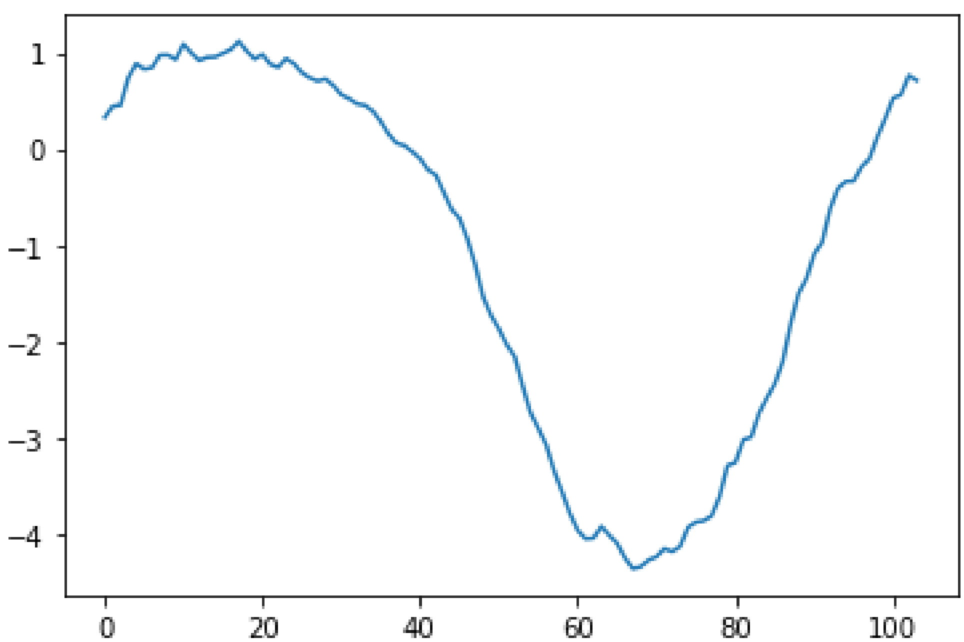
[24]:
```
# plot baseline and predictions
plt.plot(scaler.inverse_transform(dataset), label= 'True' )
plt.plot(trainPredictPlot )
plt.plot(testPredictPlot )
plt.xlabel('Date')
plt.ylabel('Data')
plt.legend()
plt.show()
```



3 Continous test

```
[25]: plt.plot(testPredictPlot[13043], label= 'test Predict')
```

```
[25]: [<matplotlib.lines.Line2D at 0x7f0eecae1290>]
```



[26]:
```
def predicted_Dp1(D,model,scaler):
    "Assumed input isn't scaled"
    sample = D.reshape(1, D.shape[0]) #shape for scaling
    sample_scaled = scaler.fit_transform(sample)
    sample_scaled = sample_scaled.reshape(1,D.shape[0],1) #shape for
    sample_scaled_predicted = model.predict(sample_scaled)
    sample_scaled_predicted = sample_scaled_predicted.reshape(1,D.shape[0])
    sample_predicted = scaler.inverse_transform(sample_scaled_predicted)
    Dp1 = sample_predicted.reshape(D.shape[0],)   #reshape for ploting
    return Dp1
```

[27]:
```
Dp1 = predicted_Dp1(testPredictPlot[13043],model,scaler)
Dp2 = predicted_Dp1(Dp1,model,scaler)
```

[ ]:
```
```

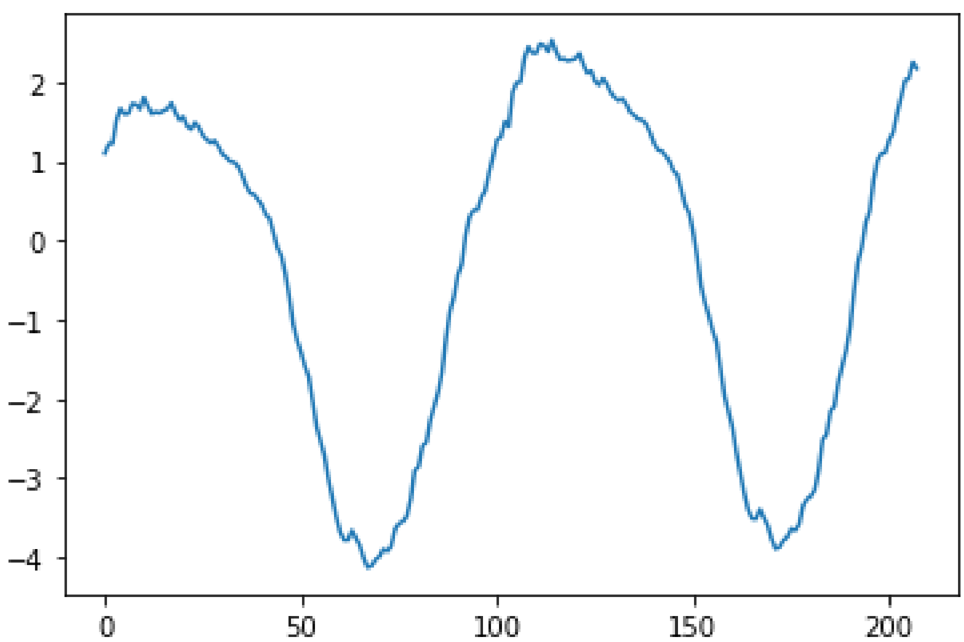
[28]:
```
math.sqrt(mean_squared_error(Dp1, Dp2)) #check that it's not the same
```

[28]:
```
0.5546417486100589
```

[29]:
```
D2 = np.concatenate((Dp1, Dp2))
```

[30]:
```
plt.plot(D2, label= '2D')
```

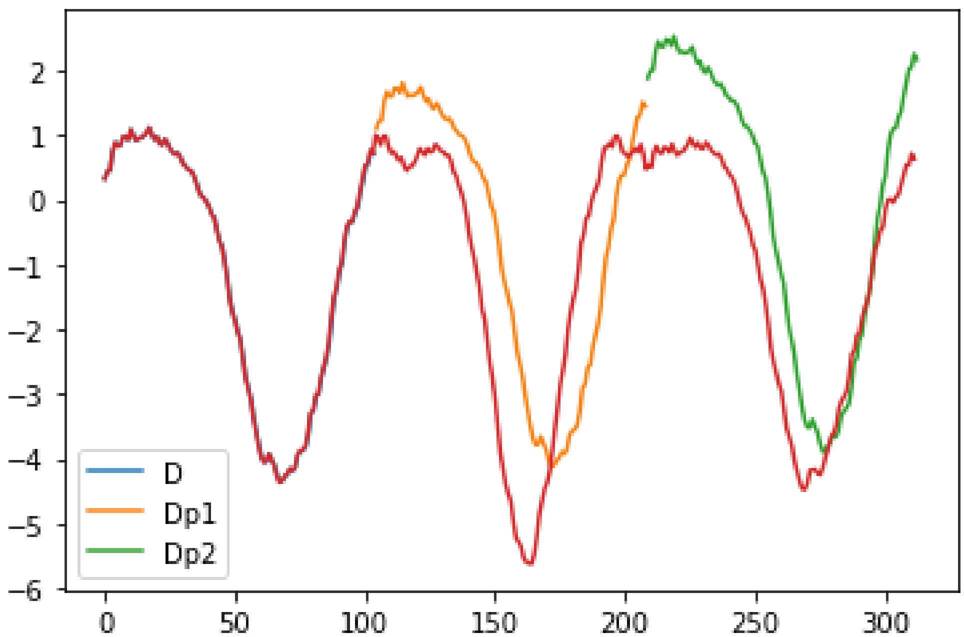
[30]:
```
[<matplotlib.lines.Line2D at 0x7f0eeca59190>]
```



[31]:
```
D3 = np.concatenate((testPredictPlot[13043], Dp1, Dp2))
x = np.linspace(0, D3.shape[0], D3.shape[0])
```

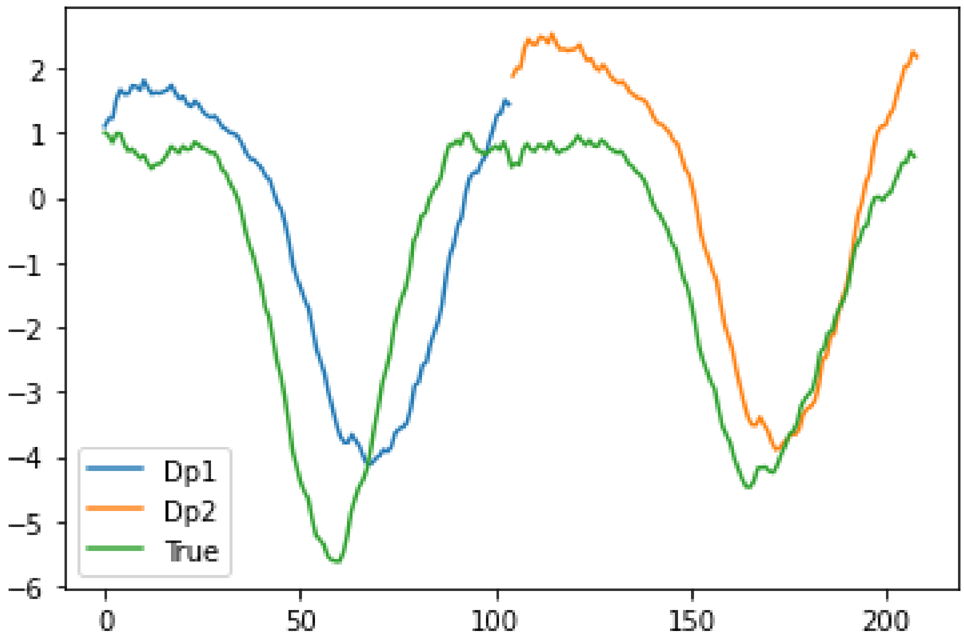
[32]:
```
plt.plot(x[:104],testPredictPlot[13043] , label= 'D')
plt.plot(x[104:2*104],Dp1 ,label= 'Dp1')
plt.plot(x[2*104:],Dp2 ,label= 'Dp2')
plt.plot(np.concatenate((testPredictPlot[13043], testPredictPlot[13043+104],␣
↪testPredictPlot[13043+2*104] )))
plt.legend()
```

[32]: <matplotlib.legend.Legend at 0x7f0eeca18090>



[33]:
```
# plt.plot(x[:104],testPredictPlot[13043] , label= 'D')
plt.plot(x[:104],Dp1 ,label= 'Dp1')
plt.plot(x[104:104*2],Dp2 ,label= 'Dp2')
plt.plot(np.concatenate((testPredictPlot[13043+104],␣
↪testPredictPlot[13043+2*104])), label= 'True')
plt.legend()
```

[33]: <matplotlib.legend.Legend at 0x7f0eec935fd0>



[34]:
```
m1 = np.concatenate((Dp1, Dp2))
m2 = np.concatenate((testPredictPlot[13043+104], testPredictPlot[13043+2*104]))
math.sqrt(mean_squared_error(m1, m2))
```

[34]: 1.4082733146558404

4 Experiments

4.1 Performace on another House

[35]:
```
#set up using house 1
dataframe1 = housing_data[1]['grid']
dataset1 = np.matrix(dataframe1.values).transpose()
dataset1 = dataset1.astype('float32')
dataset1 = scaler.fit_transform(dataset1)
```

[36]:
```
#predict on new housing data
house1X, house1Y = create_dataset(dataset1, look_back)
house1X = house1X.reshape(house1X.shape[0], house1X.shape[1],1)
house1Predict = model.predict(house1X)

house1Predict = scaler.inverse_transform(house1Predict)
house1Y = scaler.inverse_transform(house1Y)
```

[37]:
```
#score, closest to 0 the better
train1Score = math.sqrt(mean_squared_error(house1Y[0], house1Predict[0]))
print('Train Score: %.2f RMSE' % (train1Score))
```

```
Train Score: 0.89 RMSE
```

[38]:
```
ttrain1Score = math.sqrt(mean_squared_error(house1Y, house1Predict))
print('Train Score: %.2f RMSE' % (ttrain1Score))
```

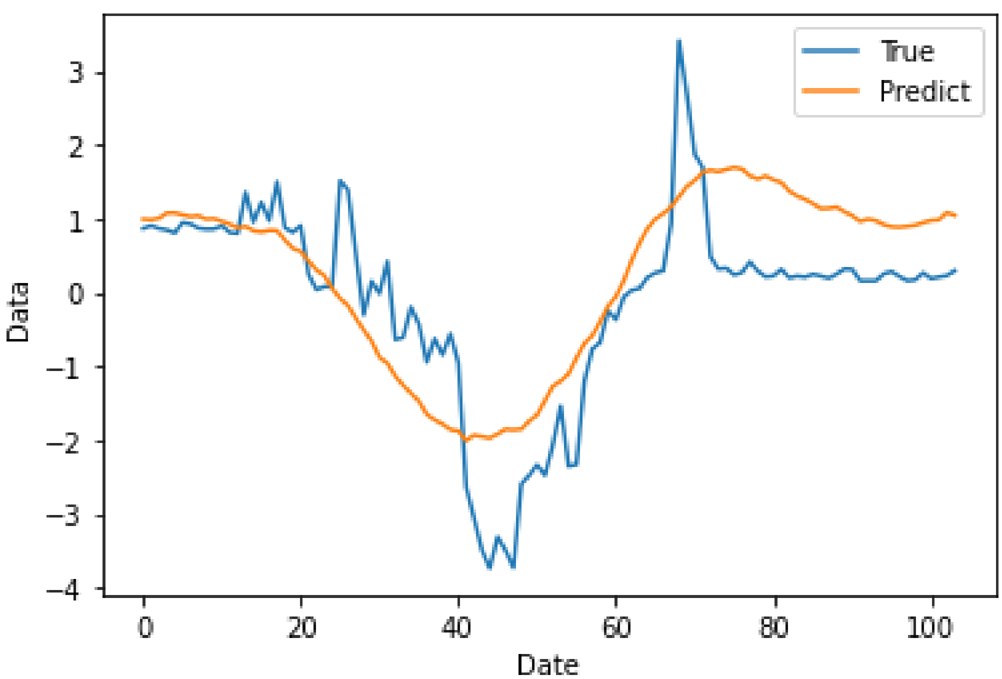
```
Train Score: 1.18 RMSE
```

[39]:
```
#plot set
house1PredictPlot = np.empty([dataset1.shape[0], house1Predict.shape[1]])
house1PredictPlot[:, :] = np.nan
house1PredictPlot[look_back:len(house1Predict)+look_back, :] = house1Predict
```

[ ]:

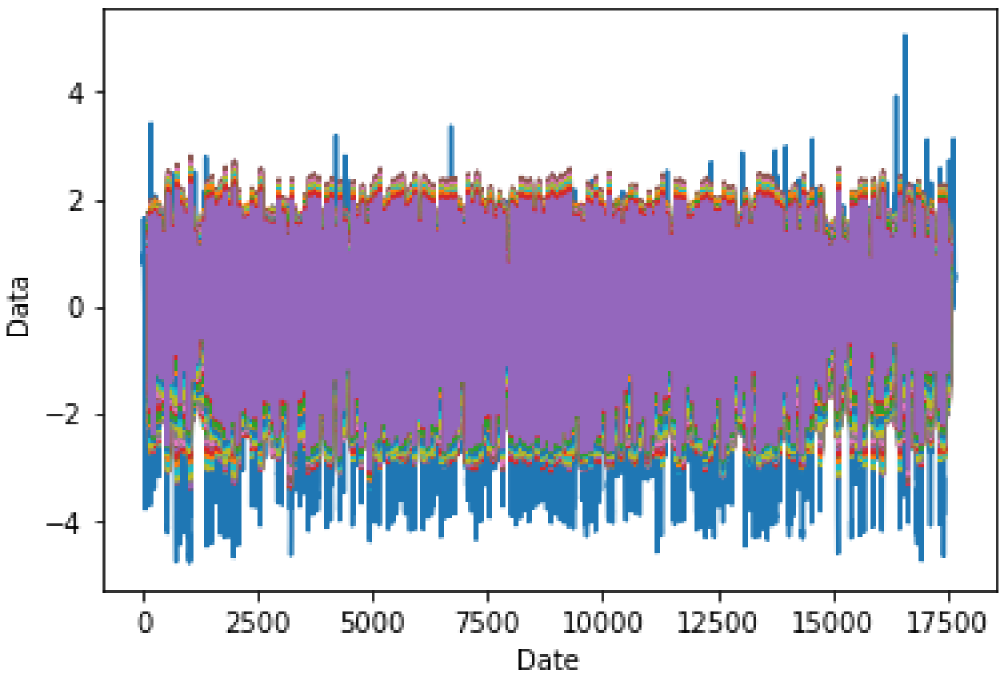
[ ]:

[40]:
```
# plot baseline and predictions
plt.plot(scaler.inverse_transform(dataset1)[104:2*104], label= 'True' )
plt.plot(house1PredictPlot[104], label= 'Predict')
plt.xlabel('Date')
plt.ylabel('Data')
plt.legend()
plt.show()
```



[41]:
```
# plot baseline and predictions
plt.plot(scaler.inverse_transform(dataset1), label= 'True' )
```

```
plt.plot(house1PredictPlot, label= 'Predict')
# plt.plot(testPredictPlot, label= 'test Predict')
plt.xlabel('Date')
plt.ylabel('Data')
# plt.legend()
plt.show()
```



[ ]: