In [1]:
```
import pandas as pd
import numpy as np
%matplotlib inline
import matplotlib.pyplot as plt
from sklearn.preprocessing import MinMaxScaler
from sklearn.metrics import r2_score
from keras.models import Sequential
from keras.layers import Dense
from keras.callbacks import EarlyStopping
from keras.optimizers import Adam
from keras.layers import LSTM
from keras.layers import GRU
import tensorflow as tf
import math
from keras.layers import Dense, LSTM, Dropout, GRU, Bidirectional
from sklearn.metrics import mean_squared_error
```

```
Using TensorFlow backend.
```

In [2]:
```
def plot_predictions(test,predicted):
    plt.figure(figsize = (10,6))
    plt.plot(test, color='red',label='Real Stock Price')
    plt.plot(predicted, color='blue',label='Predicted Stock Price')
    plt.title('Amazon Stock Price Prediction')
    plt.xlabel('Time')
    plt.ylabel('Amazon Stock Price')
    plt.legend()
    plt.show()
```

In [3]:
```
def return_rmse(test,predicted):
    rmse = math.sqrt(mean_squared_error(test, predicted))
    print("The root mean squared error is {}.".format(rmse))
```

In [44]:
```
dataset = pd.read_csv('goog1.csv', index_col='Date', parse_dates=['Date'])
dataset.tail()
```

Out[44]:

Date	Close	High	Low	Open	Adj Close	Volume
2019-04-26	1272.180054	1273.069946	1260.319946	1269.000000	1272.180054	1241400
2019-04-29	1287.579956	1289.270020	1266.295044	1274.000000	1287.579956	2499400
2019-04-30	1188.479980	1192.810059	1175.000000	1185.000000	1188.479980	6207000
2019-05-01	1168.079956	1188.050049	1167.180054	1188.050049	1168.079956	2639200
2019-05-02	1162.609985	1174.189941	1155.001953	1167.760010	1162.609985	1943700

In [45]:
```
dataset=dataset.drop(['Volume'],axis=1) # Original Data
```

In [46]:
```
dataset.head(2)
```

Out[46]:

Date	Close	High	Low	Open	Adj Close
2013-05-02	412.124542	414.578552	406.878632	407.400269	412.124542
2013-05-03	420.127472	420.663971	415.298889	415.775787	420.127472

Technical Analysis

In [47]:
```
    # Create 7 and 21 days Moving Average
    dataset['ma7'] = dataset['Close'].rolling(window=7).mean()
    dataset['ma21'] = dataset['Close'].rolling(window=21).mean()

    # Create MACD
    dataset['26ema'] = dataset['Close'].ewm(span=26).mean()
    dataset['12ema'] = dataset['Close'].ewm(span=12).mean()
    dataset['MACD'] = (dataset['12ema']-dataset['26ema'])

    # Create Bollinger Bands
    dataset['20sd'] = pd.stats.moments.rolling_std(dataset['Close'],20)
    dataset['upper_band'] = dataset['ma21'] + (dataset['20sd']*2)
    dataset['lower_band'] = dataset['ma21'] - (dataset['20sd']*2)



    # Create Exponential moving average
    dataset['ema'] = dataset['Close'].ewm(com=0.5).mean()

    # Create Momentum
    dataset['momentum'] = dataset['Close']-1
```

```
/Users/san/anaconda3/lib/python3.6/site-packages/ipykernel_launcher.py:15: Futu
reWarning: pd.rolling_std is deprecated for Series and will be removed in a fut
ure version, replace with
        Series.rolling(window=20,center=False).std()
  from ipykernel import kernelapp as app
```

In [48]:
```
def RSI(series, period):
 delta = series.diff().dropna() #daily positive differences, i.e. gains.
 u = delta * 0
 d = u.copy()                   #daily negative difference, i.e. losses

 u[delta > 0] = delta[delta > 0] #Average daily positive differences for the peri
 d[delta < 0] = -delta[delta < 0] #Average daily negative difference for the peri
 u[u.index[period-1]] = np.mean( u[:period] ) #first value is sum of avg gains
 u = u.drop(u.index[:(period-1)])
 d[d.index[period-1]] = np.mean( d[:period] ) #first value is sum of avg losses
 d = d.drop(d.index[:(period-1)])
 rs = pd.stats.moments.ewma(u, com=period-1, adjust=False) / \
 pd.stats.moments.ewma(d, com=period-1, adjust=False)
 return 100 - 100 / (1 + rs)
```

In [50]:
```
dataset['RSI'] = RSI(dataset['Close'], 14)
dataset.head()
```

```
/Users/san/anaconda3/lib/python3.6/site-packages/ipykernel_launcher.py:12: Futu
reWarning: pd.ewm_mean is deprecated for Series and will be removed in a future
version, replace with
        Series.ewm(com=13,min_periods=0,adjust=False,ignore_na=False).mean()
  if sys.path[0] == '':
/Users/san/anaconda3/lib/python3.6/site-packages/ipykernel_launcher.py:13: Futu
reWarning: pd.ewm_mean is deprecated for Series and will be removed in a future
version, replace with
        Series.ewm(com=13,min_periods=0,adjust=False,ignore_na=False).mean()
  del sys.path[0]
```

Out[50]:

	High	Low	Open	Adj Close	ma7	ma21	26ema	12ema	MACD	20sd	uppe
	414.578552	406.878632	407.400269	412.124542	NaN	NaN	412.124542	412.124542	0.000000	NaN	
	420.663971	415.298889	415.775787	420.127472	NaN	NaN	416.279910	416.459462	0.179553	NaN	
	428.140350	421.389282	421.389282	427.991333	NaN	NaN	420.487710	420.960354	0.472644	NaN	
	429.143829	422.586487	428.716614	425.845276	NaN	NaN	421.985452	422.502333	0.516882	NaN	
	434.116486	423.699249	425.731018	433.992310	NaN	NaN	424.769892	425.624119	0.854227	NaN	

In [51]:
```
print('Total dataset has {} samples, and {} features.'.format(dataset.shape[0], \
                                                              dataset.shape[1]))
```

```
Total dataset has 1511 samples, and 16 features.
```

In [52]:
```
dataset
```

05-02	412.124542	414.578552	406.878632	407.400269	412.124542	NaN	NaN	412.124
2013-05-03	420.127472	420.663971	415.298889	415.775787	420.127472	NaN	NaN	416.279
2013-05-06	427.991333	428.140350	421.389282	421.389282	427.991333	NaN	NaN	420.487
2013-05-07	425.845276	429.143829	422.586487	428.716614	425.845276	NaN	NaN	421.985
2013-05-08	433.992310	434.116486	423.699249	425.731018	433.992310	NaN	NaN	424.769
2013-05-09	432.924255	436.987823	431.309753	432.606323	432.924255	NaN	NaN	426.403
2013-05-10	437.270966	437.424957	433.262054	434.826874	437.270966	427.182308	NaN	428.335
2013-05-13	435.929688	438.383728	433.868103	436.605316	435.929688	430.583043	NaN	429.559

In [ ]:
```
```

In [53]:
```
dataset = dataset[~np.isnan(dataset).any(axis=1)]
```

In [55]:
```
dataset.head()
```

Out[55]:

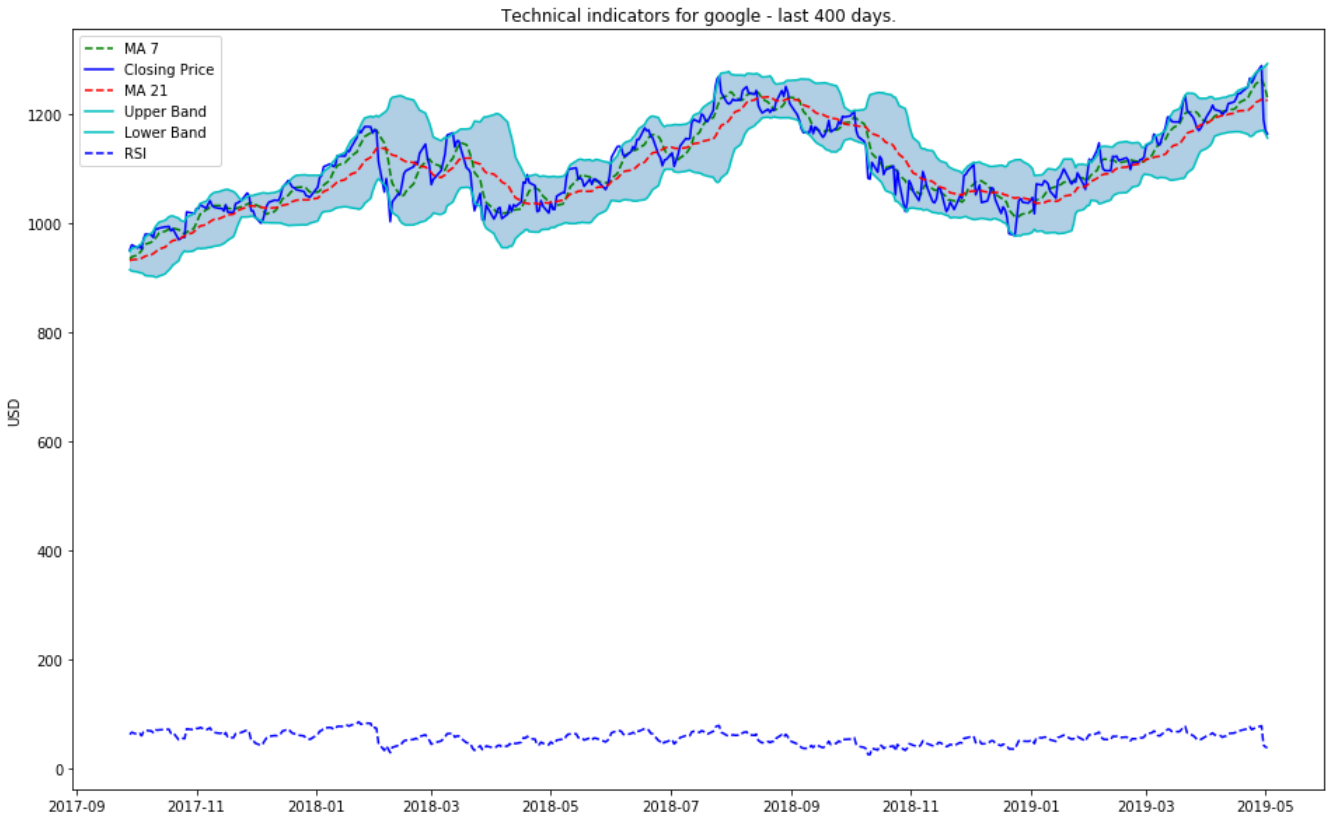
	Open	Adj Close	ma7	ma21	26ema	12ema	MACD	20sd	upper_ban
'031	431.255096	432.795074	435.530857	436.816309	437.923179	437.449146	-0.474034	9.419660	455.65562
'437	433.679321	431.011688	433.984488	437.715697	437.295820	436.433014	-0.862806	8.609199	454.93409
482	431.120972	426.774231	432.303279	438.032209	436.356455	434.914482	-1.441973	8.692001	455.41621
624	428.468231	427.072296	431.336709	437.988445	435.539982	433.685694	-1.854288	8.601584	455.19161
620	429.357452	429.526337	430.156525	438.163734	435.018361	433.035814	-1.982547	8.783423	455.73058

In [56]:
```
print('Total dataset has {} samples, and {} features.'.format(dataset.shape[0], \
                                                              dataset.shape[1]))
```

```
Total dataset has 1491 samples, and 16 features.
```

In [76]:
```
def plot_technical_indicators(dataset, last_days):
    plt.figure(figsize=(16, 10))
    shape_0 = dataset.shape[0]
    xmacd_ = shape_0-last_days

    dataset = dataset.iloc[-last_days:, :]
    x_ = range(3, dataset.shape[0])
    x_ =list(dataset.index)


    plt.plot(dataset['ma7'],label='MA 7', color='g',linestyle='--')
    plt.plot(dataset['Close'],label='Closing Price', color='b')
    plt.plot(dataset['ma21'],label='MA 21', color='r',linestyle='--')
    plt.plot(dataset['upper_band'],label='Upper Band', color='c')
    plt.plot(dataset['lower_band'],label='Lower Band', color='c')
    plt.plot(dataset['RSI'],label='RSI', color='b',linestyle='--')

    plt.fill_between(x_, dataset['lower_band'], dataset['upper_band'], alpha=.35)
    plt.title('Technical indicators for google - last {} days.'.format(last_days))
    plt.ylabel('USD')
    plt.legend()

    plt.legend()
    plt.show()
```

In [77]:
```
plot_technical_indicators(dataset, 400)
```



Feature Selection

In [62]:
```
def get_feature_importance_data(data_income):
    data = data_income.copy()
    y = data['Close']
    X = data.iloc[:, 1:]

    train_samples = int(X.shape[0] * 0.65)

    X_train = X.iloc[:train_samples]
    X_test = X.iloc[train_samples:]

    y_train = y.iloc[:train_samples]
    y_test = y.iloc[train_samples:]

    return (X_train, y_train), (X_test, y_test)
```

In [63]:
```
(X_train, y_train), (X_test, y_test) = get_feature_importance_data(dataset)
```

In [64]:
```
import xgboost as xgb

regressor = xgb.XGBRegressor(gamma=0.0,n_estimators=150,base_score=0.7,colsample_
```

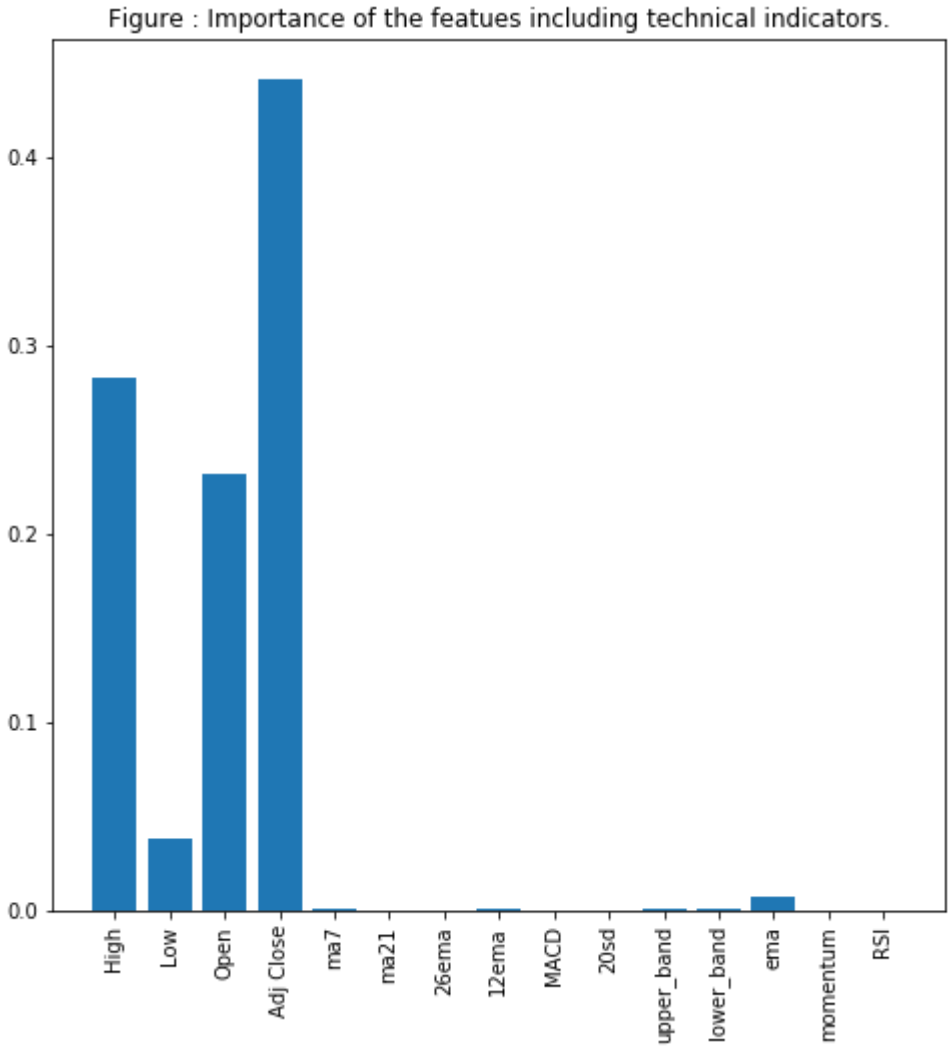
In [65]:
```
xgbModel = regressor.fit(X_train,y_train,eval_set = [(X_train, y_train), (X_test,
                         verbose=False)
```

In [66]:
```
eval_result = regressor.evals_result()
```

In [67]:
```
training_rounds = range(len(eval_result['validation_0']['rmse']))
```

In [68]:
```
plt.scatter(x=training_rounds,y=eval_result['validation_0']['rmse'],label='Traini
plt.scatter(x=training_rounds,y=eval_result['validation_1']['rmse'],label='Valida
plt.xlabel('Iterations')
plt.ylabel('RMSE')
plt.title('Training Vs Validation Error')
plt.legend()
plt.show()
```

In [69]:
```
fig = plt.figure(figsize=(8,8))
plt.xticks(rotation='vertical')
plt.bar([i for i in range(len(xgbModel.feature_importances_))], xgbModel.feature_
plt.title('Figure : Importance of the featues including technical indicators.')
plt.show()
```



In [ ]: