TITLE : Technical Analysis Using Python

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Covers:

1. MACD
2. BB & ATR
3. RSI
4. ADX
5. OBV
6. Slope- OLS
7. Renko
8. Spare me the math: TA-LIB

In [42]:

```
# import necessary libraries
import matplotlib.pyplot as plt
import pandas_datareader.data as pdr
import datetime
import numpy as np
import warnings
warnings.filterwarnings('ignore')
plt.style.use('ggplot')
```

In [43]:

```
#Set-up Historical Data for required stocks
ticker = 'MSFT'
#get_data_yahoo(ticker, start, end) We use 5 years date in this case
ohlc = pdr.get_data_yahoo(ticker,datetime.date.today() - datetime.timedelta(1825), datetime
#MACD SET-UP (12,26)
df = ohlc.copy()
```

1. Moving Average Convergence Divergence (MACD)

MACD – Moving Average Convergence Divergence

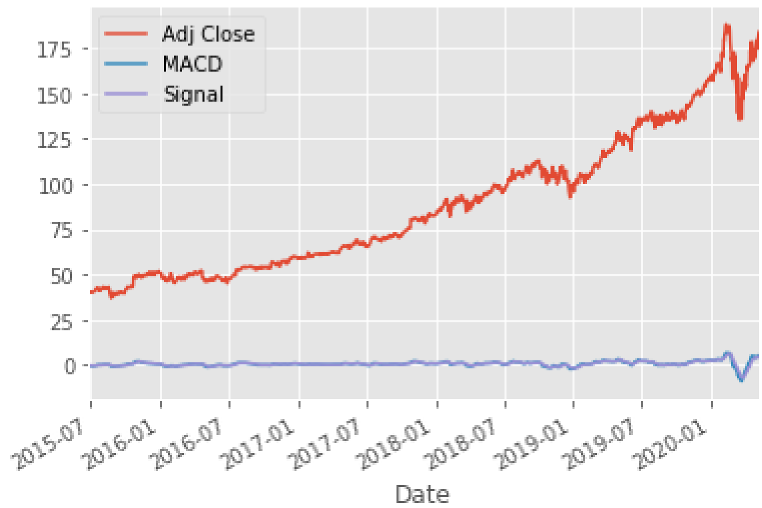
- It is a trend following momentum indicator which is calculated by taking the difference of two moving averages of an asset price (typically 12 period MA and 26 period MA).
- A signal line is also calculated which is again a moving average (typically 9 period) of the MACD line calculated as per the above step.
- The MACD line cutting the signal line from below signals bullish period and the former cutting the latter from above signals bearish period. This is called crossover strategy.
- Many false positives – especially during sideways market
- Suggested that this indicator be used in conjunction with other indicators
- Lagging indicator – Trails behind the actual price action

In [3]:

```
def MACD(DF,a,b,c):
    df =DF.copy()
        # Calculation to get MACD and Signal
    df['MA_Fast'] = df['Adj Close'].ewm(span =a, min_periods=a).mean()
    df['MA_Slow'] = df['Adj Close'].ewm(span = b, min_periods =b).mean()
    df['MACD'] = df['MA_Fast'] - df['MA_Slow']

    # Calculation to get Signal
    df['Signal'] = df['MACD'].ewm(span=c, min_periods =c).mean()

    # Clean up NaN Values
    df.dropna(inplace = True)

    return df



df_MACD = MACD(ohlc, 12,26,9)
#Data visualisation
# 5 =  Adj Close, 8 = MACD, 9 = Signal
df_MACD.iloc[:, [5,8,9]].plot()
```

Out[3]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1d735d6b488>
```



2. Bolinger Bands and Average True Range (ATR)

Bollinger Bands & ATR (Average True Range)

- Both Bollinger bands and ATR are volatility based indicators
- Bollinger band comprises of two lines plotted *n* (*n* is typically 2) standard deviations from a *m* period simple moving average line (*m* is typically 20); The bands widen during periods of increased volatility and shrink during period of reduced volatility.
- The ATR takes in account the market movement each day in either direction and averaging them out. It focuses on total price movement and conveys how wildly the market is swinging as it moves
- Traders typically use them in conjunction as they approach volatility differently and are complimentary.

Bolinger Bands

In [4]:

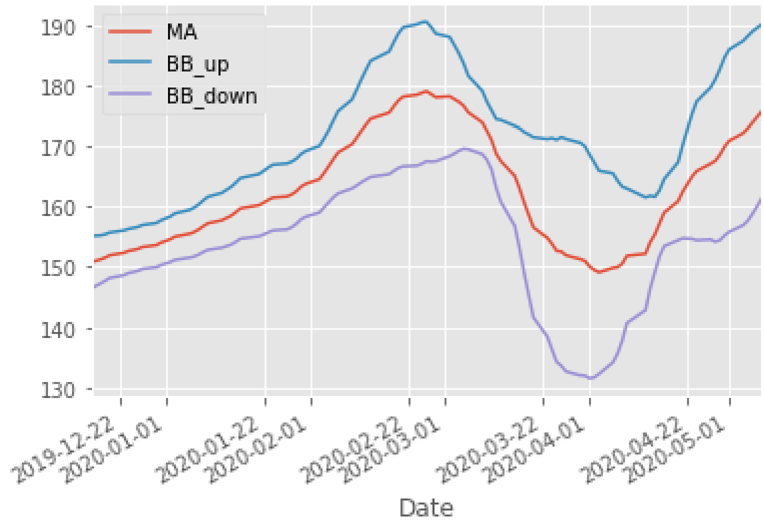
```
def BollBnd(DF,n):
    #Function to calculate BB
    df = DF.copy()
    df['MA'] = df['Adj Close'].rolling(n).mean()
    df['BB_up']  = df['MA'] + 2*df['MA'].rolling(n).std()
    df['BB_down'] = df['MA'] - 2*df['MA'].rolling(n).std()
    df['BB_range'] = df['BB_up'] - df['BB_down']
    df.dropna(inplace =True)
    return df
```

In [5]:

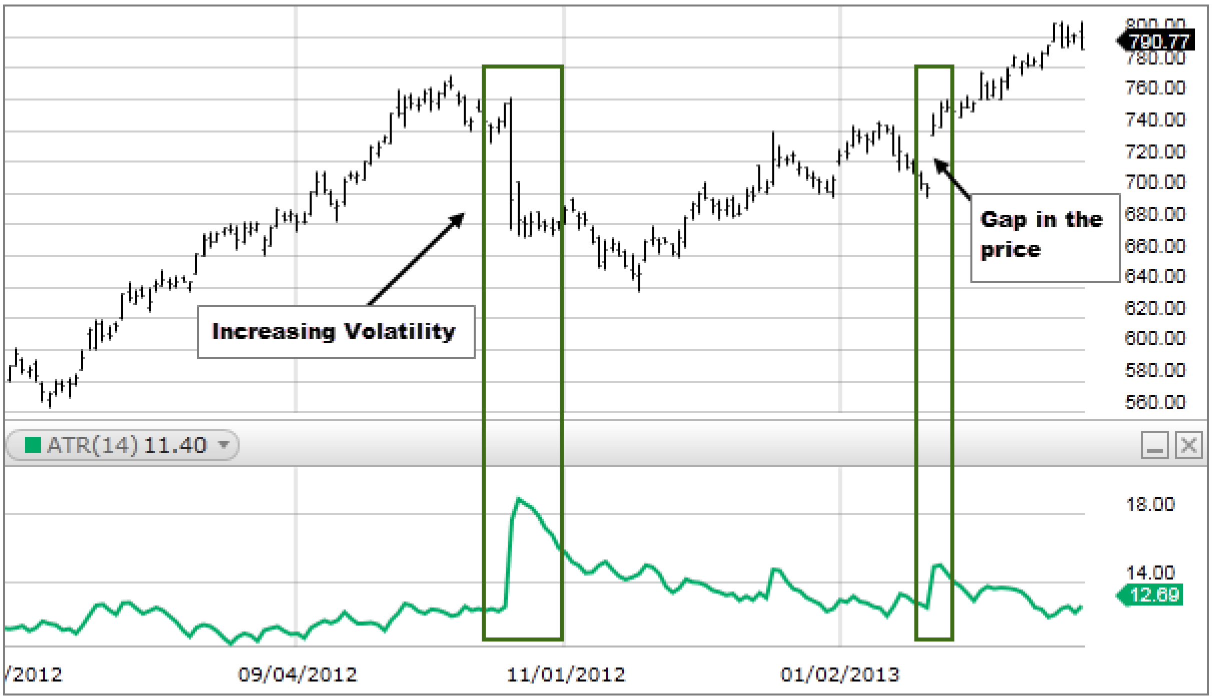
```
#-4 = MA , -3 = BB_up, -2 = BB_down
BollBnd(ohlc, 20).iloc[-100:,[-4,-3,-2]].plot()
```

Out[5]:

<matplotlib.axes._subplots.AxesSubplot at 0x1d735b56048>



Average True Range (ATR)



In [6]:

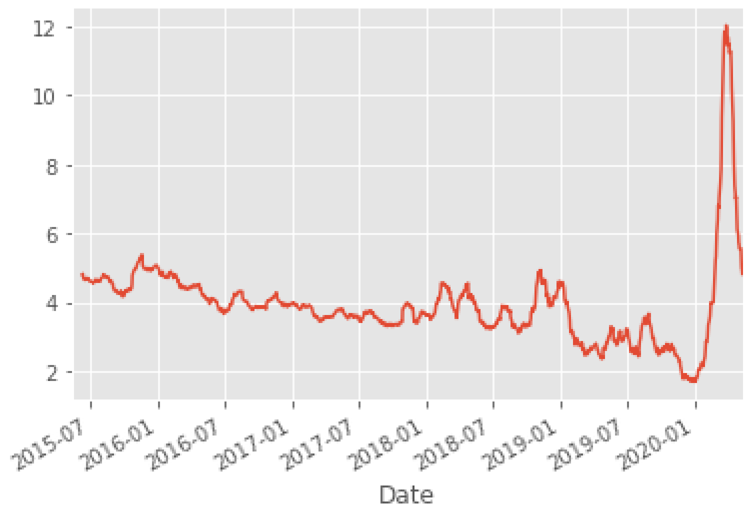
```
#We will be taking in the TSLA ticker dataframe as declared above

def ATR(DF,n):
    # function to calculate True Range and Average True Range
    df = DF.copy()
    df['H-L'] = abs(df['High']-df['Low']) #Present High - Present Low
    df['H-PC'] = abs(df['High']- df['Adj Close'].shift(1)) #Present High - Previous Close
    df['L-PC'] =abs(df['Low']- df['Adj Close'].shift(1)) #Present Low - Previous Close
    df['TR'] = df[['H-L','H-PC','L-PC']].max(axis=1,skipna = False)
    df['ATR'] = df['TR'].rolling(n).mean()
    #df['ATR'] = df['TR'].ewm(span= n, adjust =False, min_period=n).mean() #<- optional to
    df2 = df.drop(['H-L', 'H-PC', 'L-PC'], axis =1 )
    return df2
```

In [7]:

```
ATR(ohlc, 20)['ATR'].plot()
```

Out[7]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1d735c414c8>
```



3. Relative Strength Indicator (RSI)

RSI - Relative Strength Index

- RSI is a momentum oscillator which measures the speed and change of price movements.
- RSI value oscillates between 0 and100 with values above 70 indicating that the asset has now reached overbought territory. Values below 30 signify oversold territory.
- Assets can remain in overbought and oversold territories for long durations
- Calculation follows a two step method wherein the second step acts as a smoothening technique (similar to calculating exponential MA).

$$RSI\ (step\ one) = 100 - \left[\frac{100}{1 + \frac{Ave\ Gain}{Ave\ Loss}}\right]$$

$$RSI\ (step\ two) = 100 - \left[\frac{100}{1 + \frac{Previous\ Ave\ Gain\ x\ 13 + Current\ Gain}{Previous\ Ave\ Loss\ x\ 13 + Current\ Loss}}\right]$$

In [8]:

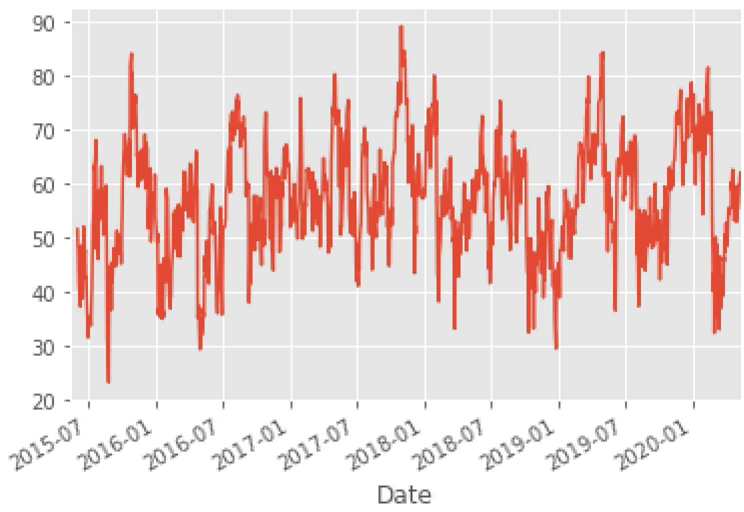
```
def RSI(DF,n):
    #function to calculate RSI
    df = DF.copy()

    #step 1. Find gain or loss before we can find average gain/loss!
    df['delta'] = df['Adj Close'] - df['Adj Close'].shift(1)
    df['gain'] = np.where(df['delta']>=0, df['delta'],0) # we will only store values to df[
    df['loss'] = np.where(df['delta']<0, abs(df['delta']) ,0) # same for df['loss']
    avg_gain = []
    avg_loss = []
    gain = df['gain'].tolist()
    loss = df['loss'].tolist()

    # refer to step 2 of formula for this portion
    for i in range(len(df)):
        if i < n :

            # we set to NaN as there is no value in getting the mean of values if it is les
            avg_gain.append(np.NaN)
            avg_loss.append(np.NaN)

        elif i == n:
            avg_gain.append(df['gain'].rolling(n).mean().tolist()[n])
            avg_loss.append(df['loss'].rolling(n).mean().tolist()[n])

        elif i > n:
            avg_gain.append(((n-1)*avg_gain[i-1] + gain[i])/n)
            avg_loss.append(((n-1)*avg_loss[i-1] + loss[i])/n)

    df['avg_gain'] = np.array(avg_gain)
    df['avg_loss'] = np.array(avg_loss)
    df['RS'] = df['avg_gain'] / df['avg_loss'] # relative strength in ratio +ve means more
    df['RSI'] = 100 - (100/(1+df['RS']))

    return df['RSI']
```

In [9]:

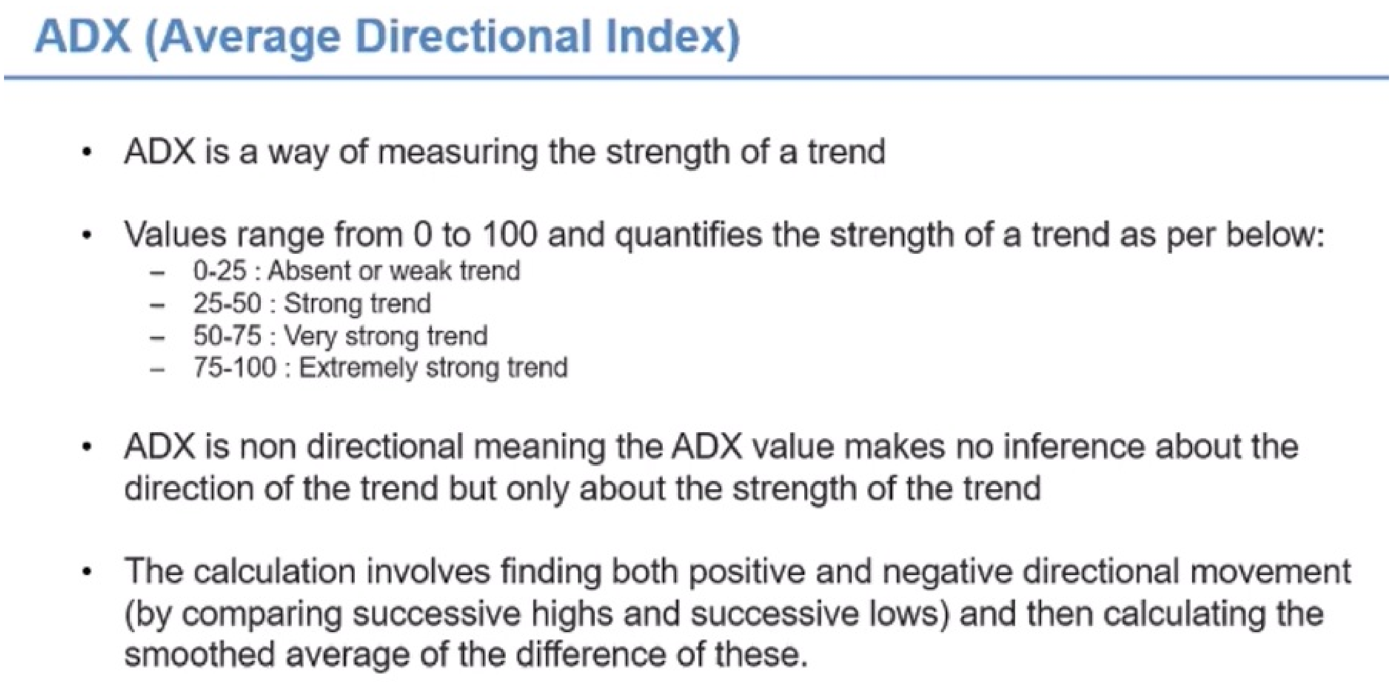
```
RSI(ohlc, 14).plot()
```

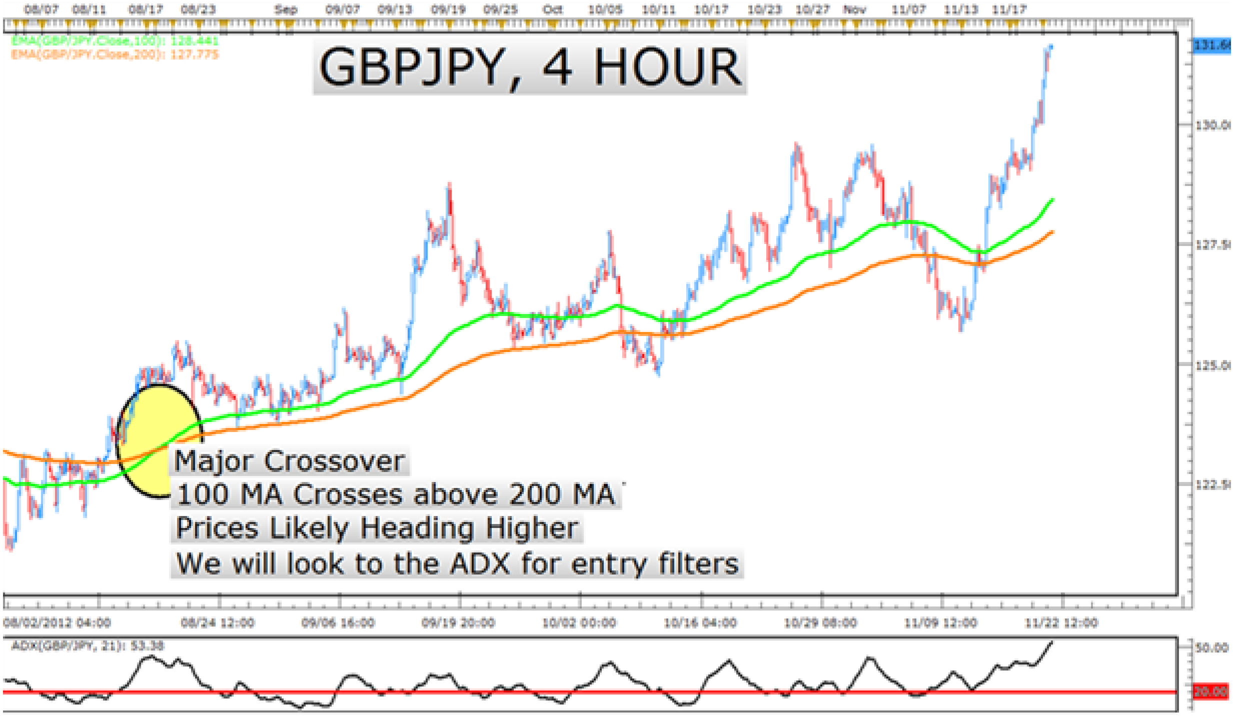
Out[9]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1d735ccc2c8>
```



4. Average Directional Index (ADX)




GBPJPY, 4 HOUR
Major Crossover
100 MA Crosses above 200 MA
Prices Likely Heading Higher
We will look to the ADX for entry filters

In [11]:

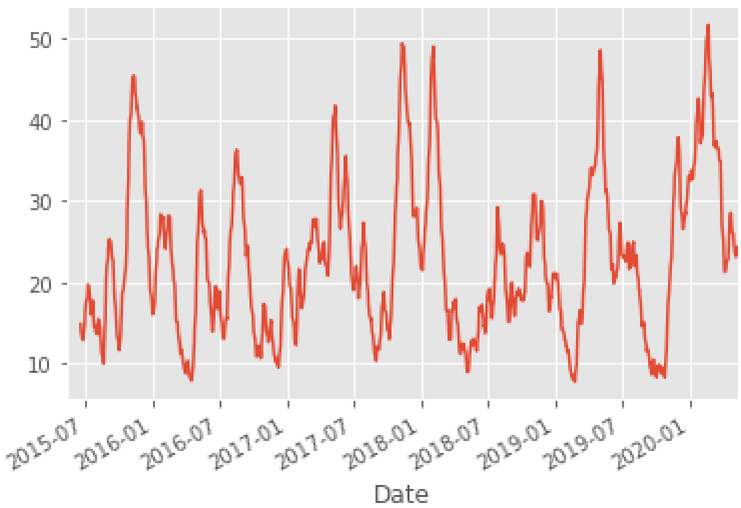
```
# WE WILL NEED THE ATR FUNCTION AS DEFINED ABOVE IN OUR CALCULATION FOR ADX
# REMEMBER ADX IS A DIRECTIONAL INDICATOR BUT A STRENGTH OF THE CURRENT DIRECTION THE INSTR

def ADX(DF,n):
    # function to calculate ADX
    df2 = DF.copy()
    df2['TR'] = ATR(df2,n)['TR'] #the period parameter of ATR function does not matter beca
    #DMplus = upside
    df2['DMplus']=np.where((df2['High']-df2['High'].shift(1))>(df2['Low'].shift(1)-df2['Low
    df2['DMplus']=np.where(df2['DMplus']<0,0,df2['DMplus'])
    #DMminus = downside
    df2['DMminus']=np.where((df2['Low'].shift(1)-df2['Low'])>(df2['High']-df2['High'].shift
    df2['DMminus']=np.where(df2['DMminus']<0,0,df2['DMminus'])
    TRn = []
    DMplusN = []
    DMminusN = []

    TR = df2['TR'].tolist()
    DMplus = df2['DMplus'].tolist()
    DMminus = df2['DMminus'].tolist()


    for i in range(len(df2)):
        if i < n:
            TRn.append(np.NaN)
            DMplusN.append(np.NaN)
            DMminusN.append(np.NaN)
        elif i == n:
            TRn.append(df2['TR'].rolling(n).sum().tolist()[n])
            DMplusN.append(df2['DMplus'].rolling(n).sum().tolist()[n])
            DMminusN.append(df2['DMminus'].rolling(n).sum().tolist()[n])
        elif i > n:
            TRn.append(TRn[i-1] - (TRn[i-1]/n) + TR[i])
            DMplusN.append(DMplusN[i-1] - (DMplusN[i-1]/n) + DMplus[i])
            DMminusN.append(DMminusN[i-1] - (DMminusN[i-1]/n) + DMminus[i])

    df2['TRn'] = np.array(TRn)
    df2['DMplusN'] = np.array(DMplusN)
    df2['DMminusN'] = np.array(DMminusN)
    df2['DIplusN']=100*(df2['DMplusN']/df2['TRn']) #Directional Indicator +
    df2['DIminusN']=100*(df2['DMminusN']/df2['TRn']) #Directional Indicator -
    df2['DIdiff']=abs(df2['DIplusN']-df2['DIminusN'])
    df2['DIsum']=df2['DIplusN']+df2['DIminusN']
    df2['DX']=100*(df2['DIdiff']/df2['DIsum'])

    ADX = []
    DX = df2['DX'].tolist()
    for j in range(len(df2)):
        if j < 2*n-1:
            ADX.append(np.NaN)
        elif j == 2*n-1:
            ADX.append(df2['DX'][j-n+1:j+1].mean())
        elif j > 2*n-1:
            ADX.append(((n-1)*ADX[j-1] + DX[j])/n)
    df2['ADX']=np.array(ADX)
    return df2['ADX']
```

In [13]:

```
ADX(ohlc ,14).plot()
```

Out[13]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1d736fb8f08>
```



5. On Balance Volume (OBV)

OBV (On Balance Volume)

- OBV is a momentum indicator which uses changes in trading volume as an indicator of future asset price moves.
- OBV formulation is based on the theory that volume precedes price movement. A rising OBV reflects positive volume pressure that can lead to higher prices and falling OBV predicts decline in prices.
- Leading market indicator but prone to making false signals. Typically used in conjunction with lagging indicators such as MACD
- The calculation of OBV is fairly straightforward and it is simply the cumulative sum of volume traded adjusted for the direction of the corresponding asset price move

$$OBV = OBV_{prev} + \begin{cases} volume, & if close > close_{prev} \\ 0, & if close = close_{prev} \\ -volume, & if close < close_{prev} \end{cases}$$

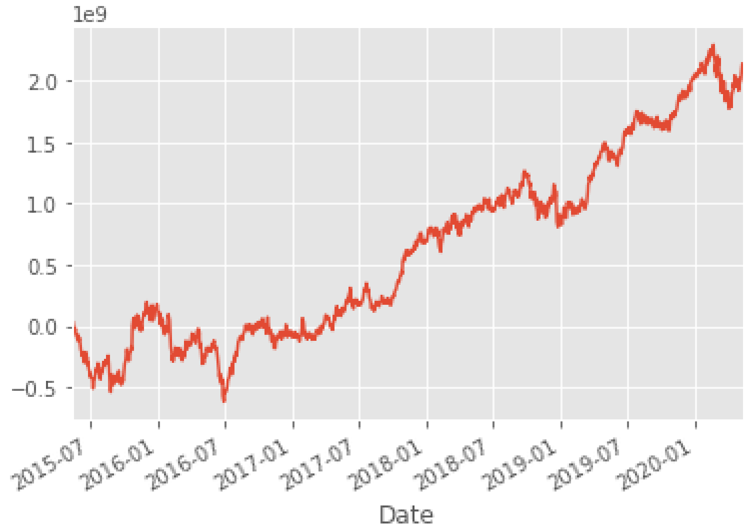
It will be important to note here that while OBV is a leading indicator, it is alos prone to generating false signals. It is usually used with other frequent indicators above rather than stand-alone. OBV's emphasis is on volume and price direction rather than price alone.

In [44]:

```
def OBV(DF):
    #function to calculate On Balance Volume (OBV)
    df = DF.copy()
    df['daily_ret'] = df['Adj Close'].pct_change()
    df['direction']  = np.where(df['daily_ret']>=0, 1, -1)
    df['direction'][0] = 0
    df['vol_adj'] =  df['Volume'] * df['direction']
    df['obv'] = df['vol_adj'].cumsum()
    return df['obv']
```

In [46]:

```
OBV(ohlc).plot();
```



6. Slope in a chart (Degree of Linear Regression)

In [17]:

```
import statsmodels.api as sm
```

In [19]:

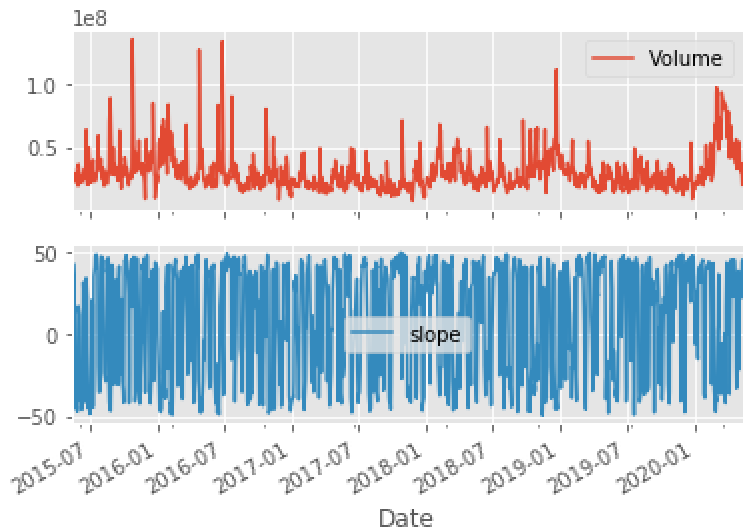
```
ser = ohlc['Adj Close']
n = 5  # n here refers to the number of consecutive data points
def slope(ser,n):
    # function to caculate the slope of n consecutive points on a plot
    slopes = [i*0 for i in range(n-1)]
    for i in range(n, len(ser)+1):
        y = ser[i-n:i] # first 5 values etc...
        x = np.array(range(n))

        # Gradient
        y_scaled = (y-y.min())/(y.max()-y.min())
        x_scaled = (x - x.min())/(x.max()-x.min())

        # c , y = mx +c , if without (y = mx)
        x_scaled = sm.add_constant(x_scaled)

        #fit to OLS
        model = sm.OLS(y_scaled, x_scaled)

        # Linear Regression
        results = model.fit()
        #results.summary()
        slopes.append(results.params[-1])
    slope_angle =(np.rad2deg(np.arctan(np.array(slopes))))
    return np.array(slope_angle)
```

In [26]:

```
df['slope'] = slope2(ser, n)
```

In [27]:

```
df.iloc[:,[4,6]].plot(subplots= True, layout = (2,1));
```



7. Renko Chart

Renko Chart

- Renko chart is built using price movement and not price against standardized time intervals – This filters out the noise and lets you visualize the true trend
- Price movements (fixed) are represented as bricks stacked at 45 degrees to each other. A new brick is added to the chart only when the price moves by a pre determined amount in either direction.
- Renko charts have a time axis, but the time scale is not fixed. Some bricks may take longer to form than others, depending on how long it takes the price to move the required box size.
- Renko charts typically use only the closing price based on the chart time frame chosen.

In [36]:

```
#pip install stocktrends
#to implement renko
from stocktrends import Renko
```

In [39]:

```
def renko_DF(DF):
    #function to convert ohlc data into renko bricks
    df = DF.copy()
    # We will need to convert the columns list to what the Renko Library requires
    df.reset_index(inplace=True)
    df = df.iloc[:,[0,1,2,3,5,6]]
    df.rename(columns = {"Date" : "date", "High" : "high","Low" : "low", "Open" : "open","A

    df2 = Renko(df)
    df2.brick_size = round(ATR(DF,120)["ATR"][-1],0)
    #renko_df = df2.get_bricks() #if get_bricks() does not work try using get_ohlc_data() i
    renko_df = df2.get_ohlc_data()
    return renko_df
```

In [41]:

```
renko_DF(ohlc).head()
```

Out[41]:

	date	open	high	low	close	uptrend
0	2015-05-11	35.0	40.0	35.0	40.0	True
1	2015-10-23	40.0	45.0	40.0	45.0	True
2	2015-11-06	45.0	50.0	45.0	50.0	True
3	2016-10-21	50.0	55.0	50.0	55.0	True
4	2016-12-19	55.0	60.0	55.0	60.0	True

Wow...................... that's a lot of code and math.... is there any library to give me an immediate answer?

8. CHECK OUT TALIB

TA-LIB Python Wrapper Github Page: https://mrjbq7.github.io/ta-lib/ (https://mrjbq7.github.io/ta-lib/)
Discussion on installation problems : https://github.com/mrjbq7/ta-lib/issues/127 (https://github.com/mrjbq7/ta-lib/issues/127)
Command to install TA-lib for newer versions of Python : pip install -i https://pypi.anaconda.org/masdeseiscaracteres/simple (https://pypi.anaconda.org/masdeseiscaracteres/simple) ta-lib
Good website on chart patterns: http://thepatternsite.com (http://thepatternsite.com) *<- PLEASE READ! ITS LIKE A FENGSHUI MASTER*

Momentum Indicators

```
ADX                   Average Directional Movement Index
ADXR                  Average Directional Movement Index Rating
APO                   Absolute Price Oscillator
AROON                 Aroon
AROONOSC              Aroon Oscillator
BOP                   Balance Of Power
CCI                   Commodity Channel Index
CMO                   Chande Momentum Oscillator
DX                    Directional Movement Index
MACD                  Moving Average Convergence/Divergence
MACDEXT               MACD with controllable MA type
MACDFIX               Moving Average Convergence/Divergence Fix 12/26
MFI                   Money Flow Index
MINUS_DI              Minus Directional Indicator
MINUS_DM              Minus Directional Movement
MOM                   Momentum
PLUS_DI               Plus Directional Indicator
PLUS_DM               Plus Directional Movement
PPO                   Percentage Price Oscillator
ROC                   Rate of change : ((price/prevPrice)-1)*100
ROCP                  Rate of change Percentage: (price-prevPrice)/prevPrice
ROCR                  Rate of change ratio: (price/prevPrice)
ROCR100               Rate of change ratio 100 scale: (price/prevPrice)*100
RSI                   Relative Strength Index
STOCH                 Stochastic
STOCHF                Stochastic Fast
STOCHRSI              Stochastic Relative Strength Index
TRIX                  1-day Rate-Of-Change (ROC) of a Triple Smooth EMA
ULTOSC                Ultimate Oscillator
WILLR                 Williams' %R
```

Even patterns..

Pattern Recognition

```
CDL2CROWS            Two Crows
CDL3BLACKCROWS       Three Black Crows
CDL3INSIDE           Three Inside Up/Down
CDL3LINESTRIKE       Three-Line Strike
CDL3OUTSIDE          Three Outside Up/Down
CDL3STARSINSOUTH     Three Stars In The South
CDL3WHITESOLDIERS    Three Advancing White Soldiers
CDLABANDONEDBABY     Abandoned Baby
CDLADVANCEBLOCK      Advance Block
CDLBELTHOLD          Belt-hold
CDLBREAKAWAY         Breakaway
CDLCLOSINGMARUBOZU   Closing Marubozu
CDLCONCEALBABYSWALL  Concealing Baby Swallow
CDLCOUNTERATTACK     Counterattack
CDLDARKCLOUDCOVER    Dark Cloud Cover
CDLDOJI              Doji
CDLDOJISTAR          Doji Star
CDLDRAGONFLYDOJI     Dragonfly Doji
CDLENGULFING         Engulfing Pattern
CDLEVENINGDOJISTAR   Evening Doji Star
CDLEVENINGSTAR       Evening Star
CDLGAPSIDESIDEWHITE  Up/Down-gap side-by-side white lines
CDLGRAVESTONEDOJI    Gravestone Doji
CDLHAMMER            Hammer
CDLHANGINGMAN        Hanging Man
CDLHARAMI            Harami Pattern
CDLHARAMICROSS       Harami Cross Pattern
CDLHIGHWAVE          High-Wave Candle
CDLHIKKAKE           Hikkake Pattern
CDLHIKKAKEMOD        Modified Hikkake Pattern
CDLHOMINGPIGEON      Homing Pigeon
CDLIDENTICAL3CROWS   Identical Three Crows
CDLINNECK            In-Neck Pattern
CDLINVERTEDHAMMER    Inverted Hammer
```

In [54]:

```
import talib
import copy
from alpha_vantage.timeseries import TimeSeries

tickers = ['MSFT','AAPL', 'FB', 'AMZN']
ohlc_tech = {}
YOUR_API_KEY = "C:\\Users\\Gigabyte\\Desktop\\quant-trading-python-bot\\AlphaVantage_API.tx
ts = TimeSeries(key = open(YOUR_API_KEY, 'r').read(), output_format = 'pandas')

attempt = 0 # initialising passthrough variable (to bypass alpha_v limit call)
drop = [] # initialise list to store tickers whose close price was successfully extracted

while len(tickers)!= 0 and attempt <= 100: #This is setup to bypass api limit calls for AV
    tickers = [j for j in tickers if j not in drop]
    for i in range(len(tickers)):
        try:
            ohlc_tech[tickers[i]] = ts.get_daily(symbol=tickers[i], outputsize = 'full')[0]
            ohlc_tech[tickers[i]].columns = ['Open', 'High', 'Low', 'Adj Close', 'Volume']
            drop.append(tickers[i])
        except:
            print(tickers[i], ":failed to fetch data.. retrying")
            continue
    attempt +=1

tickers = ohlc_tech.keys()
ohlc_dict = copy.deepcopy(ohlc_tech) #copy setup to reduce chances of us ruining the datase
```

In [56]:

```
#PATTERN RECOGNITION
# E.G CDL3INSIDE - THREE Inside Up/Down    CDL3INSIDE(open, high, low, close) <= must be in

for ticker in tickers:
    ohlc_dict[ticker]['3I'] = talib.CDL3INSIDE(ohlc_dict[ticker]['Open'],
                                              ohlc_dict[ticker]['High'],
                                              ohlc_dict[ticker]['Low'],
                                              ohlc_dict[ticker]['Adj Close'])
```

In [63]:

```
ohlc_dict['AAPL'][ohlc_dict['AAPL']['3I']> 0]
# THESE ARE THE DATA POINTS WHERE CDL3INSIDE detected a pattern. It will be important to hi
# Patterns are still subsceptible to false positives
```

Out[63]:

date	Open	High	Low	Adj Close	Volume	3I
2019-11-27	265.580	267.98	265.31	267.84	16386122.0	100
2019-08-13	201.020	212.14	200.83	208.97	47539786.0	100
2018-10-25	217.710	221.38	216.75	219.80	29855768.0	100
2016-09-15	113.860	115.73	113.49	115.57	90613177.0	100
2011-12-09	392.850	394.04	391.03	393.62	10606900.0	100
2011-11-08	402.210	408.00	401.56	406.23	14301500.0	100
2011-02-16	360.800	364.90	360.50	363.13	17184200.0	100
2010-10-26	306.870	309.74	305.65	308.05	14033200.0	100
2008-01-22	148.060	159.98	146.00	155.64	86955500.0	100
2007-12-13	190.190	192.12	187.82	191.83	30879200.0	100
2005-09-12	51.100	51.63	50.58	51.40	16171300.0	100
2005-05-26	40.025	40.94	38.80	40.74	18768600.0	100
2002-05-08	23.200	24.52	23.04	24.37	7797900.0	100
2002-01-17	21.970	22.74	21.87	22.48	11796000.0	100
2001-02-15	19.690	20.56	19.69	20.06	5561000.0	100