Example : HMM of Financial Time Series using hmmlearn

In [1]:

```
import matplotlib.pyplot as plt
from scipy import stats
import numpy as np
from hmmlearn import hmm
import math
import os
import urllib
import urllib.request as ur
import datetime
import warnings

from numpy.lib.stride_tricks import as_strided
import scipy
from scipy.io import wavfile
from sklearn.model_selection import StratifiedShuffleSplit
import mpl_finance
import itertools

from matplotlib import cm, pyplot as plt
from matplotlib.dates import YearLocator, MonthLocator

from mpl_finance import candlestick_ohlc
import pandas as pd
from sklearn.model_selection import train_test_split
from tqdm import tqdm
from hmmlearn import hmm

plt.style.use('ggplot')
```

In [2]:

```
test_size=0.33
n_latency_days=10
n_hidden_states=4
n_steps_frac_change=50
n_steps_frac_high=10
n_steps_frac_low=10
```

In [3]:

```
data = pd.read_csv('yahoofinance-INTC-19950101-20040412.csv')
```

In [4]:

```
train_data, test_data = train_test_split(data, test_size=test_size, shuffle=Fals
e)
```

In [5]:

```
def extract_features(data):
        open_price = np.array(data['Open'])
        close_price = np.array(data['Close'])
        high_price = np.array(data['High'])
        low_price = np.array(data['Low'])
        # Compute the fraction change in close, high and low prices which would
be used as features
        frac_change = (close_price - open_price) / open_price
        frac_high = (high_price - open_price) / open_price
        frac_low = (open_price - low_price) / open_price
        return np.column_stack((frac_change, frac_high, frac_low))
```

In [6]:

```
train_features = extract_features(train_data)
```

In [7]:

```
def compute_all_possible_outcomes(n_steps_frac_change,n_steps_frac_high, n_steps
_frac_low):
        frac_change_range = np.linspace(-0.1, 0.1, n_steps_frac_change)
        frac_high_range = np.linspace(0, 0.1, n_steps_frac_high)
        frac_low_range = np.linspace(0, 0.1, n_steps_frac_low)
        possible_outcomes = np.array(list(itertools.product(frac_change_range, f
rac_high_range, frac_low_range)))
        return possible_outcomes
```

In [8]:

```
def get_most_probable_outcome(day_index, possible_outcomes):
        previous_data_start_index = max(0, day_index - n_latency_days)
        previous_data_end_index = max(0, day_index - 1)
        previous_data = test_data.iloc[previous_data_end_index: previous_data_st
art_index]
        previous_data_features = extract_features(previous_data)
        outcome_score = []
        most_probable_outcome =[]
        for possible_outcome in possible_outcomes:
            total_data = np.row_stack((previous_data_features, possible_outcome)
)
            outcome_score.append(intc_hmm.score(total_data))
        maxscore_index = np.argmax(outcome_score)
        most_probable_outcome = possible_outcomes[maxscore_index]
        #print(most_probable_outcome,maxscore_index )
        return most_probable_outcome
```

In [9]:

```
def predict_close_price(day_index):
        open_price = test_data.iloc[day_index]['Open']
        predicted_frac_change= get_most_probable_outcome(day_index, possible_out
comes)
        #print(predicted_frac_change)
        close_price_predict = (open_price * (1 + predicted_frac_change))
        return close_price_predict
```

In [10]:

```
def predict_close_prices_for_days(test_data, possible_outcomes, days, with_plot=
True):
        predicted_close_prices = []
        for day_index in tqdm(range(days)):
            cpp = predict_close_price(day_index)
            #print(cpp)
            predicted_close_prices.append(predict_close_price(day_index))
            #print(day_index, predicted_close_prices)

        #if with_plot:
        test_data = test_data[0: days]
        days = np.array(test_data['Date'], dtype="datetime64[ms]")
        actual_close_prices = test_data['Close']

        #fig = plt.figure()
        fig, ax = plt.subplots(figsize=(10,5))
        #axes = fig.add_subplot(111)
        ax.plot(days, actual_close_prices, 'bo-', label="actual")
        ax.plot(days, predicted_close_prices, 'r+-', label="predicted")
        ax.set_title('INTC Stock Movement')

        fig.autofmt_xdate()

        plt.legend()
        plt.show()




        return predicted_close_prices
```

In [11]:

```
intc_hmm =  hmm.GaussianHMM(n_components=n_hidden_states)
```

In [12]:

```
intc_hmm.fit(train_features)
```

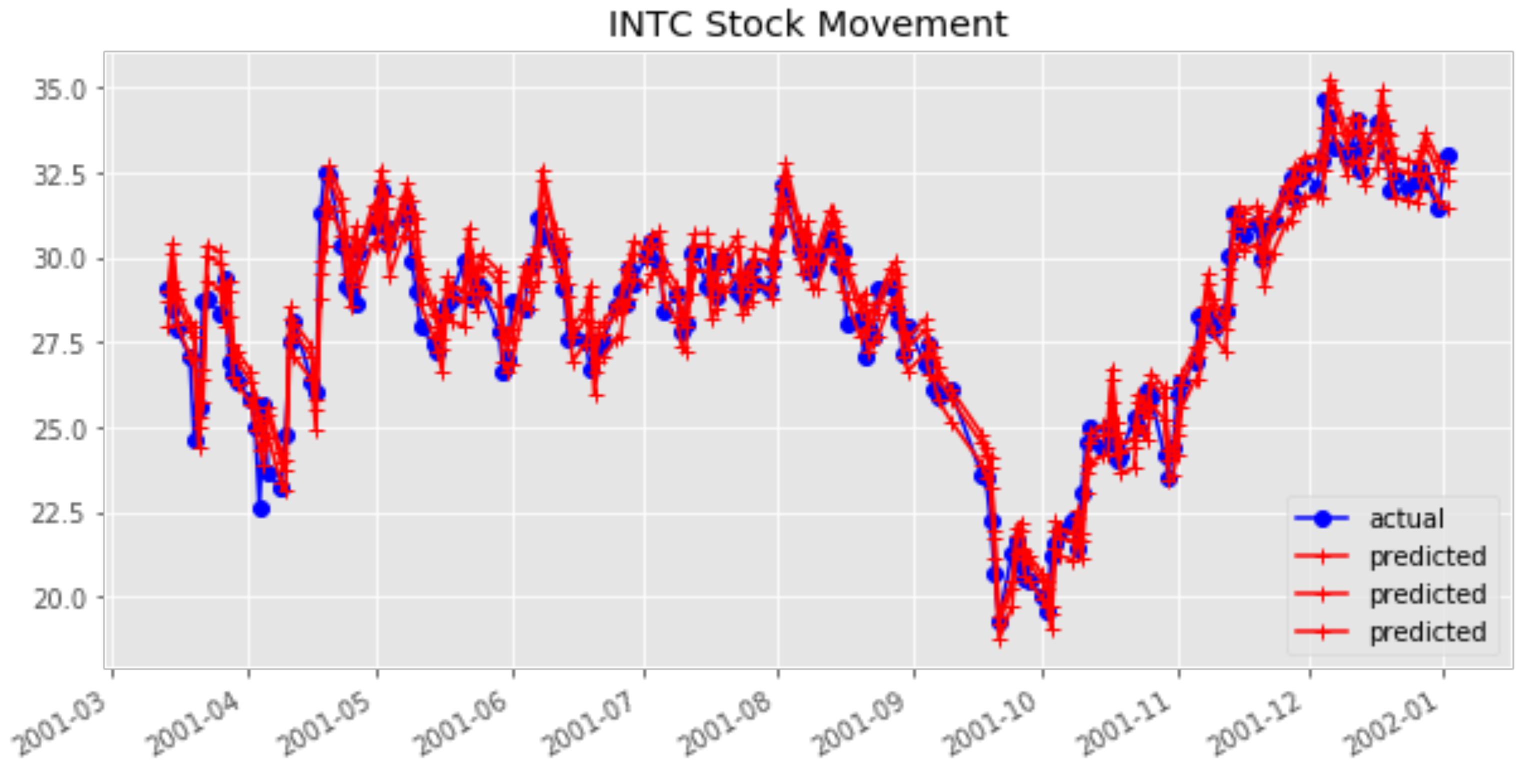
Out[12]:

```
GaussianHMM(algorithm='viterbi', covariance_type='diag', covars_prio
r=0.01,
      covars_weight=1, init_params='stmc', means_prior=0, means_weig
ht=0,
      min_covar=0.001, n_components=4, n_iter=10, params='stmc',
      random_state=None, startprob_prior=1.0, tol=0.01, transmat_pri
or=1.0,
      verbose=False)
```

In [13]:

```
possible_outcomes = compute_all_possible_outcomes(n_steps_frac_change,n_steps_frac_high, n_steps_frac_low)
predict_close_prices_for_days(test_data, possible_outcomes,200, with_plot=True)
```

```
100%|██████████| 200/200 [08:54<00:00,  2.06s/it]
```



Out[13]:

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In [ ]:

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