# Lets take a run ot our model and see how it performs. We will set a indicator for the daily returns for SPY between 7.2% and 11%, which is rear but does happen in the mist of economic crisis. This is a perfect time to look that the 08 crash as well as the current COViD-19 epidemic

In [ ]:

# Libraries

In [1]:
```
import pandas as pd
import numpy as np
from pandas_datareader import data as web
import matplotlib.pyplot as plt
import seaborn as sns
```

# import data

# We will be looking at the adjustable close for both the S&P and VIX

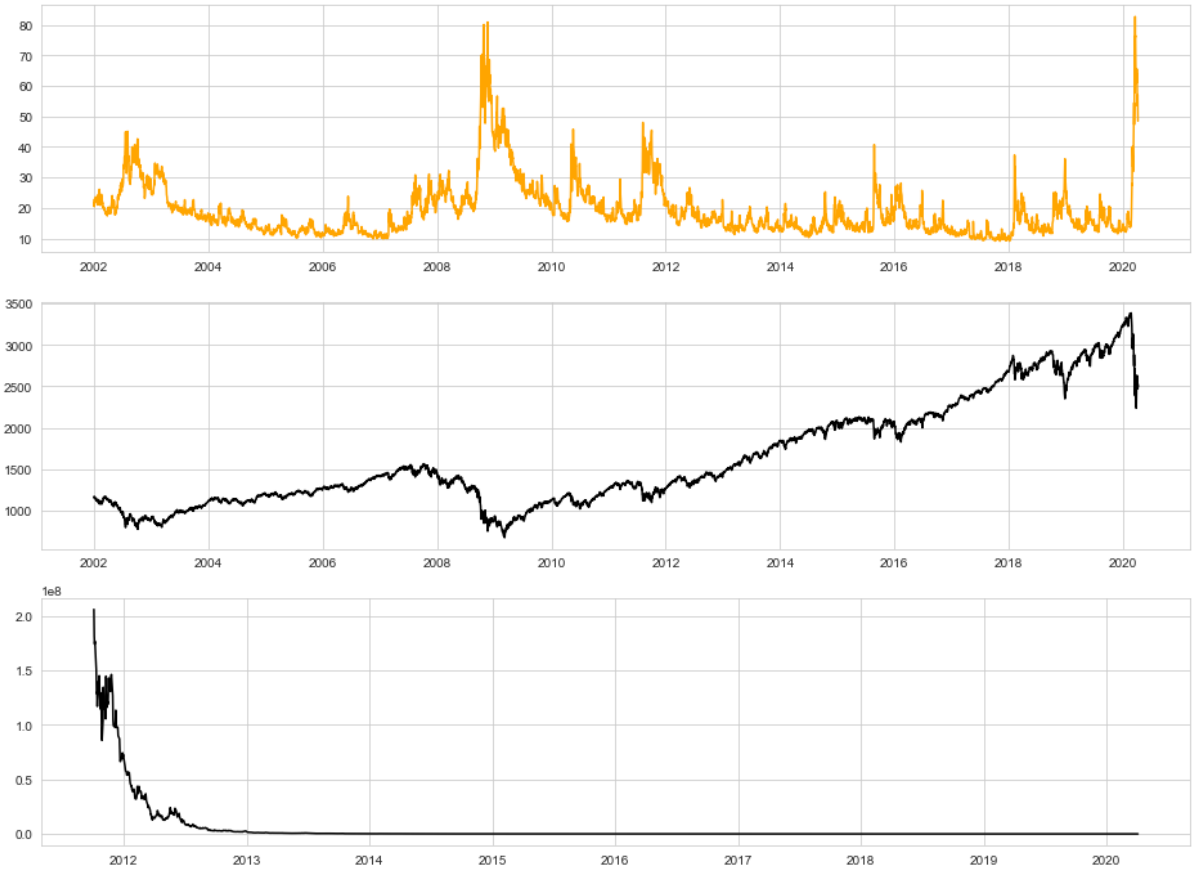
In [192]:
```
tickers = ["^VIX", "^GSPC","UVXY"]
data = pd.DataFrame()
for t in tickers:
    data[t] = web.DataReader(t, data_source="yahoo", start = "2002-1-1")
["Adj Close"]
```

In [ ]:

### plotting visual movement for both VIX and SPY .As expected the plots show an inverse correlation

In [193]:
```
fig, axes = plt.subplots(3,1,figsize = (16,12))
axes[0].plot(data["^VIX"], c = "orange")
axes[1].plot(data["^GSPC"], c = "black")
axes[2].plot(data["UVXY"], c = "black")
```

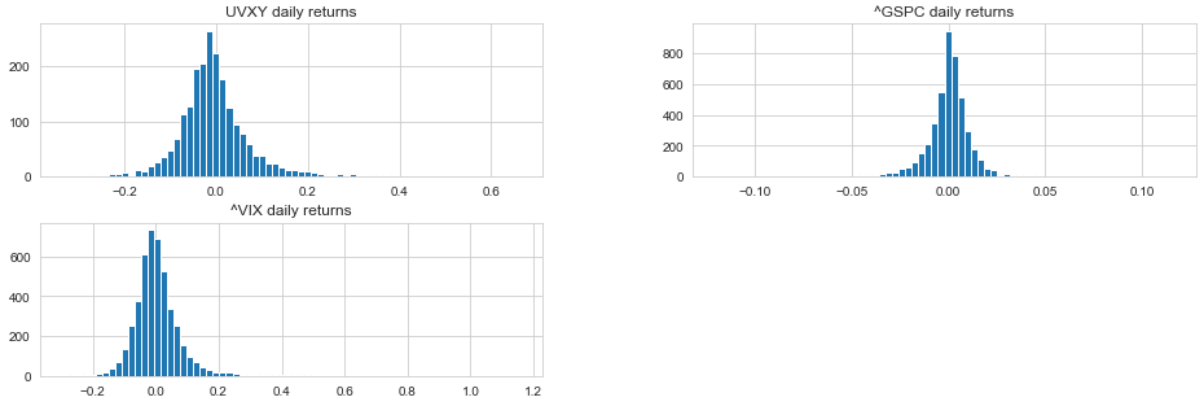
Out[193]:
```
[<matplotlib.lines.Line2D at 0x1a2bc99bd0>]
```




## Tracking thre daily returns for each security. We will look at the volitility of the daily returns on a histogram below. what we see is most of the daily returns of SPY between -0.05, and 0.05, where VIX is between -0.2, and .2 with a few outlyers

In [194]:
```
for t in tickers:
    data[f"{t} daily returns"] = data[f"{t}"].pct_change()
```

In [195]:
```
sns.set_style("whitegrid")
data[["^VIX daily returns","^GSPC daily returns", "UVXY daily returns"]]
.hist(figsize = (16,5), bins = 70);
```




**The reason for this analysis is the test the theory that as the daily returns of SPY is between 7% and 11% we can see a sharp increase in VIX. We will test this below but first we will creat a hypithetical portfolio containing both SPY and VIX . We will weigh the portfolio 40% SPY and 60% VIX with a position of 150K in the portfolio. Our other assumption is that we are getting in the market on the first date of 1-3-2006**

# Normal Returns

In [196]:
```
for s in tickers:
    data[f"{s} normal returns"] = data[s]/data[s].iloc[0]
```

In [197]:
```
data.head()
```

Out[197]:

| Date | ^VIX | ^GSPC | UVXY | ^VIX daily returns | ^GSPC daily returns | UVXY daily returns | ^VIX normal returns | ^GSPC normal returns | UVXY normal returns |
|---|---|---|---|---|---|---|---|---|---|
| 2002-01-02 | 22.709999 | 1154.670044 | NaN | NaN | NaN | NaN | 1.000000 | 1.000000 | NaN |
| 2002-01-03 | 21.340000 | 1165.270020 | NaN | -0.060326 | 0.009180 | NaN | 0.939674 | 1.009180 | NaN |
| 2002-01-04 | 20.450001 | 1172.510010 | NaN | -0.041706 | 0.006213 | NaN | 0.900484 | 1.015450 | NaN |
| 2002-01-07 | 21.940001 | 1164.890015 | NaN | 0.072861 | -0.006499 | NaN | 0.966094 | 1.008851 | NaN |
| 2002-01-08 | 21.830000 | 1160.709961 | NaN | -0.005014 | -0.003588 | NaN | 0.961251 | 1.005231 | NaN |

# Allocations

In [198]:
```
weights = [0.3, 0.5, 0.2]
for s,w in zip(tickers, weights):
    data[f"{s} allocation"] = data[f"{s} normal returns"] * w
```

In [199]:
```
data.head()
```

Out[199]:

| Date | ^VIX | ^GSPC | UVXY | ^VIX daily returns | ^GSPC daily returns | UVXY daily returns | ^VIX normal returns | ^GSPC normal returns | UVXY normal returns |
|---|---|---|---|---|---|---|---|---|---|
| 2002-01-02 | 22.709999 | 1154.670044 | NaN | NaN | NaN | NaN | 1.000000 | 1.000000 | NaN |
| 2002-01-03 | 21.340000 | 1165.270020 | NaN | -0.060326 | 0.009180 | NaN | 0.939674 | 1.009180 | NaN |
| 2002-01-04 | 20.450001 | 1172.510010 | NaN | -0.041706 | 0.006213 | NaN | 0.900484 | 1.015450 | NaN |
| 2002-01-07 | 21.940001 | 1164.890015 | NaN | 0.072861 | -0.006499 | NaN | 0.966094 | 1.008851 | NaN |
| 2002-01-08 | 21.830000 | 1160.709961 | NaN | -0.005014 | -0.003588 | NaN | 0.961251 | 1.005231 | NaN |

# Position -> 150K

In [200]:
```
for x in tickers:
    data[f"{x} position"] = data[f"{x} allocation"] * 150000
```

In [201]:
```
data.head()
```

Out[201]:

| Date | ^VIX | ^GSPC | UVXY | ^VIX daily returns | ^GSPC daily returns | UVXY daily returns | ^VIX normal returns | ^GSPC normal returns | UVXY normal returns |
|---|---|---|---|---|---|---|---|---|---|
| 2002-01-02 | 22.709999 | 1154.670044 | NaN | NaN | NaN | NaN | 1.000000 | 1.000000 | NaN |
| 2002-01-03 | 21.340000 | 1165.270020 | NaN | -0.060326 | 0.009180 | NaN | 0.939674 | 1.009180 | NaN |
| 2002-01-04 | 20.450001 | 1172.510010 | NaN | -0.041706 | 0.006213 | NaN | 0.900484 | 1.015450 | NaN |
| 2002-01-07 | 21.940001 | 1164.890015 | NaN | 0.072861 | -0.006499 | NaN | 0.966094 | 1.008851 | NaN |
| 2002-01-08 | 21.830000 | 1160.709961 | NaN | -0.005014 | -0.003588 | NaN | 0.961251 | 1.005231 | NaN |

## Lets take a run ot our model and see how it performs. We will set a indicator for the daily returns for SPY and 7.2%, which is rear but does happen in the mist of economic crisis. THis is a perfect time to look that the 08 crash as well as the curren COViD-19 epidemic

### We can see there are 4 dates that this occurred and we just missed 2. in 2020

In [202]:
```
data.columns
```

Out[202]:
```
Index(['^VIX', '^GSPC', 'UVXY', '^VIX daily returns', '^GSPC daily retu
rns',
       'UVXY daily returns', '^VIX normal returns', '^GSPC normal retur
ns',
       'UVXY normal returns', '^VIX allocation', '^GSPC allocation',
       'UVXY allocation', '^VIX position', '^GSPC position', 'UVXY posi
tion'],
      dtype='object')
```

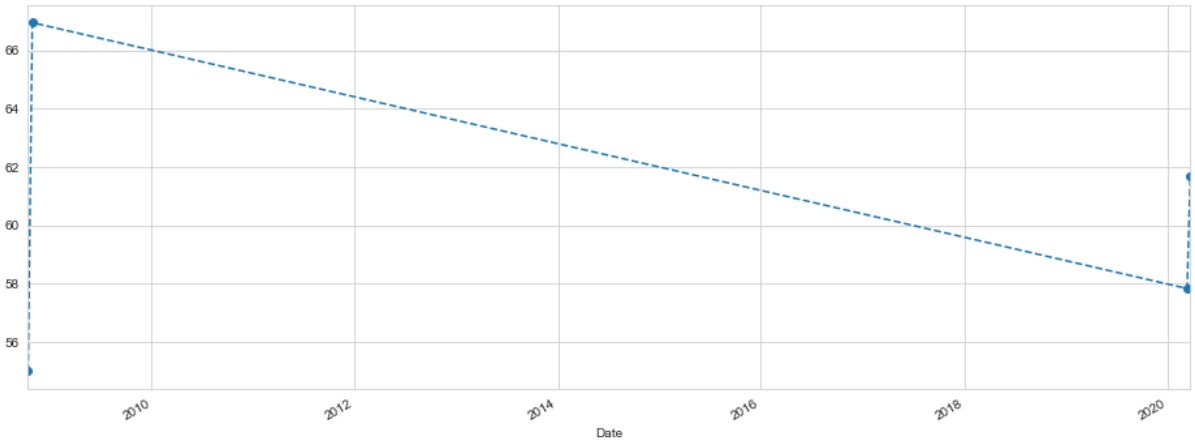
In [203]:
```
data[data["^GSPC daily returns"] * 100 > 7.2][["^VIX","^GSPC", '^GSPC daily returns']]
```

Out[203]:

| Date | ^VIX | ^GSPC | ^GSPC daily returns |
|---|---|---|---|
| 2008-10-13 | 54.990002 | 1003.349976 | 0.115800 |
| 2008-10-28 | 66.959999 | 940.510010 | 0.107890 |
| 2020-03-13 | 57.830002 | 2711.020020 | 0.092871 |
| 2020-03-24 | 61.669998 | 2447.330078 | 0.093828 |

In [204]:
```
data[(data["^GSPC daily returns"] * 100 > 7.2)]["^VIX"].plot(figsize = (16,6), marker = "o", ls = "--")
```

Out[204]: <matplotlib.axes._subplots.AxesSubplot at 0x1a2c924350>



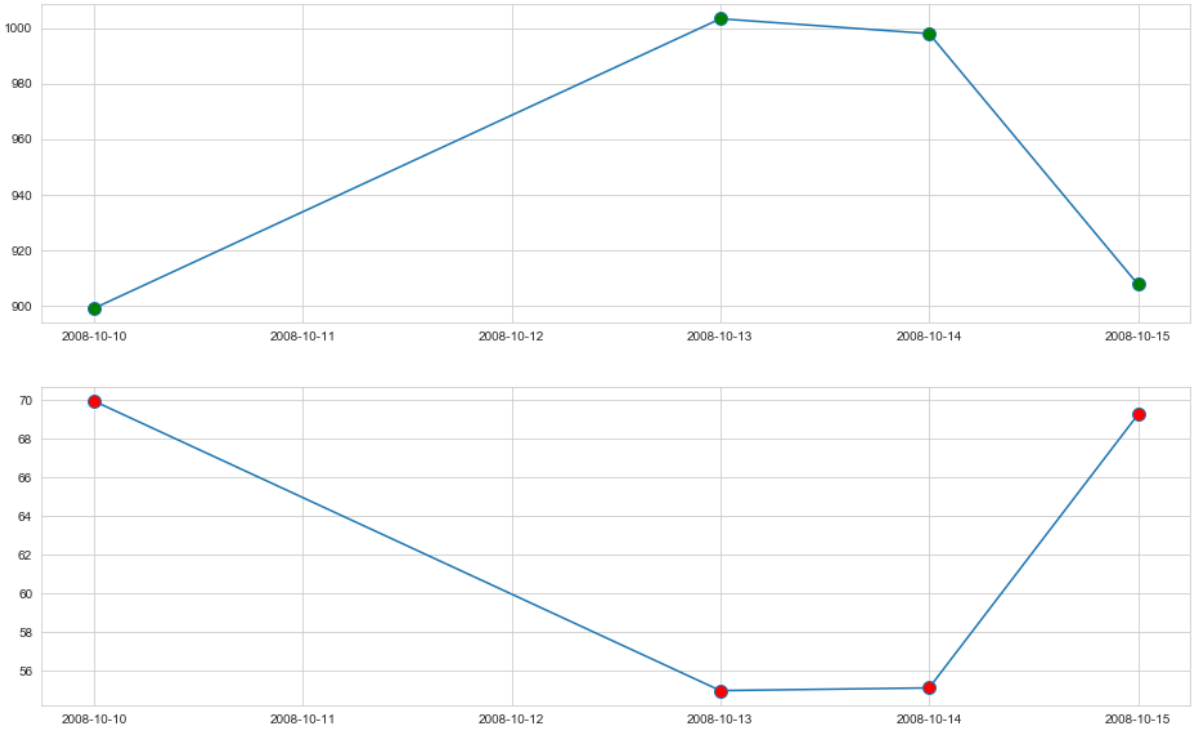

# lets take a look at each date where SpY was 7.2 or above. To get a better look at this we will take a few days before and after the set date

# 2008-10-13

## SPY daily returns up 11.5 %

In [205]:
```
fig, axes = plt.subplots(2,1, figsize = (16,10))
axes[0].plot(data.loc["2008-10-10":"2008-10-15"]["^GSPC"], marker = "o",
mfc = "g", ms = 10)
axes[1].plot(data.loc["2008-10-10":"2008-10-15"]["^VIX"], marker = "o",
mfc = "r", ms = 10)
```

Out[205]:
```
[<matplotlib.lines.Line2D at 0x1a2ffcfe90>]
```

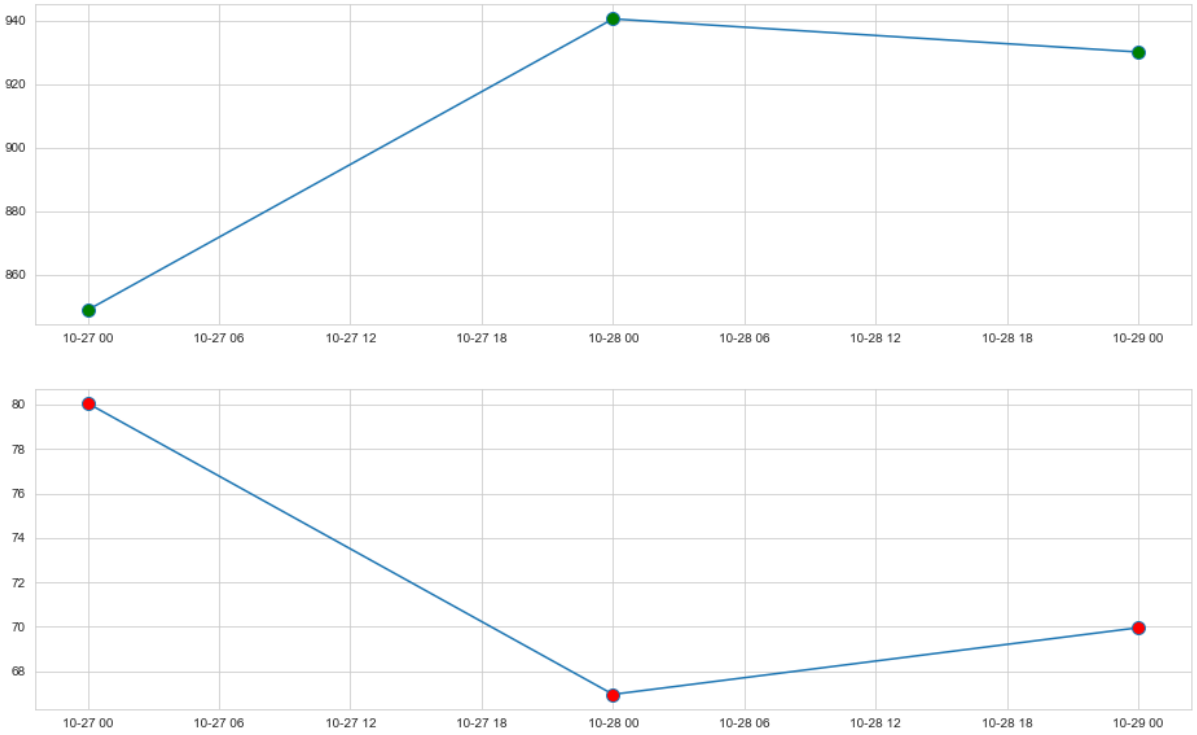



## 2008-10-28

## SpY daily returns spike 10.5%

In [206]:
```
fig, axes = plt.subplots(2,1, figsize = (16,10));
axes[0].plot(data.loc["2008-10-25":"2008-10-29"]["^GSPC"], marker = "o",
mfc = "g", ms = 10)
axes[1].plot(data.loc["2008-10-25":"2008-10-29"]["^VIX"], marker = "o",
mfc = "r", ms = 10)
```

Out[206]:
```
[<matplotlib.lines.Line2D at 0x1a300f13d0>]
```

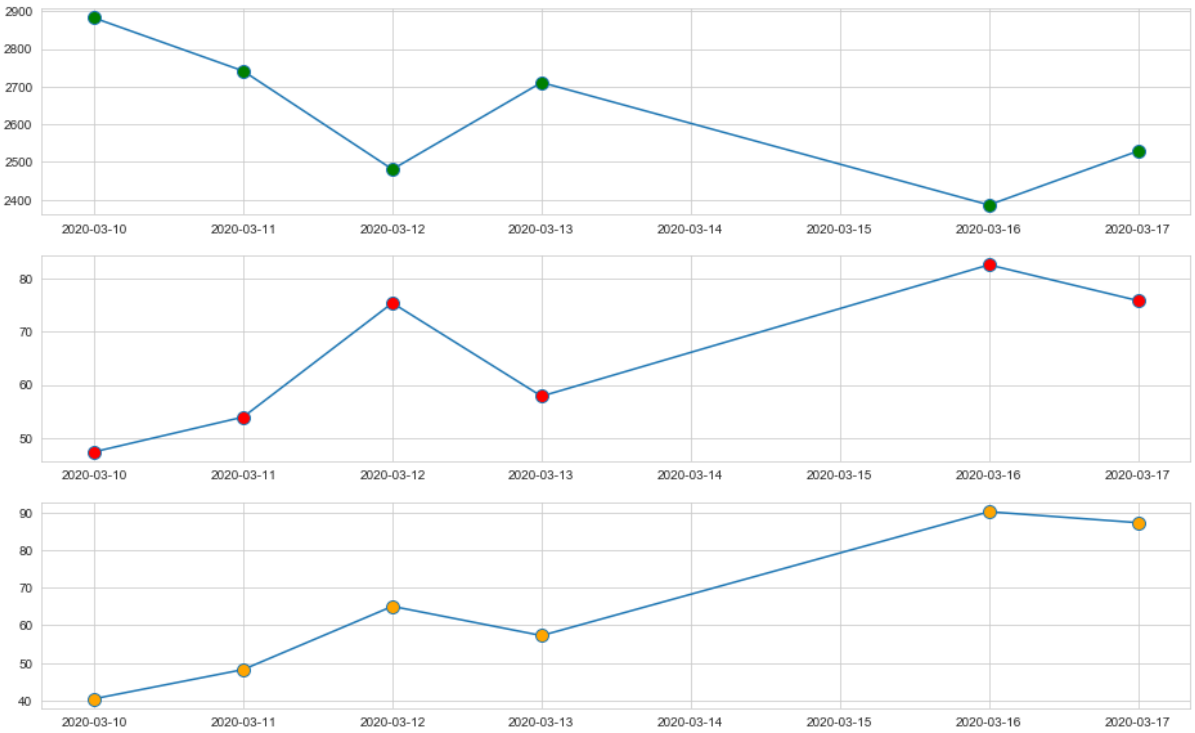



# 2020-03-13

## SPY Daily returns up 9.3%

In [207]:
```
fig, axes = plt.subplots(3,1, figsize = (16,10));
axes[0].plot(data.loc["2020-03-10":"2020-03-17"]["^GSPC"], marker = "o",
mfc = "g", ms = 10)
axes[1].plot(data.loc["2020-03-10":"2020-03-17"]["^VIX"], marker = "o",
mfc = "r", ms = 10)
axes[2].plot(data.loc["2020-03-10":"2020-03-17"]["UVXY"], marker = "o",
mfc = "orange", ms = 10)
```

Out[207]:
```
[<matplotlib.lines.Line2D at 0x1a30436cd0>]
```

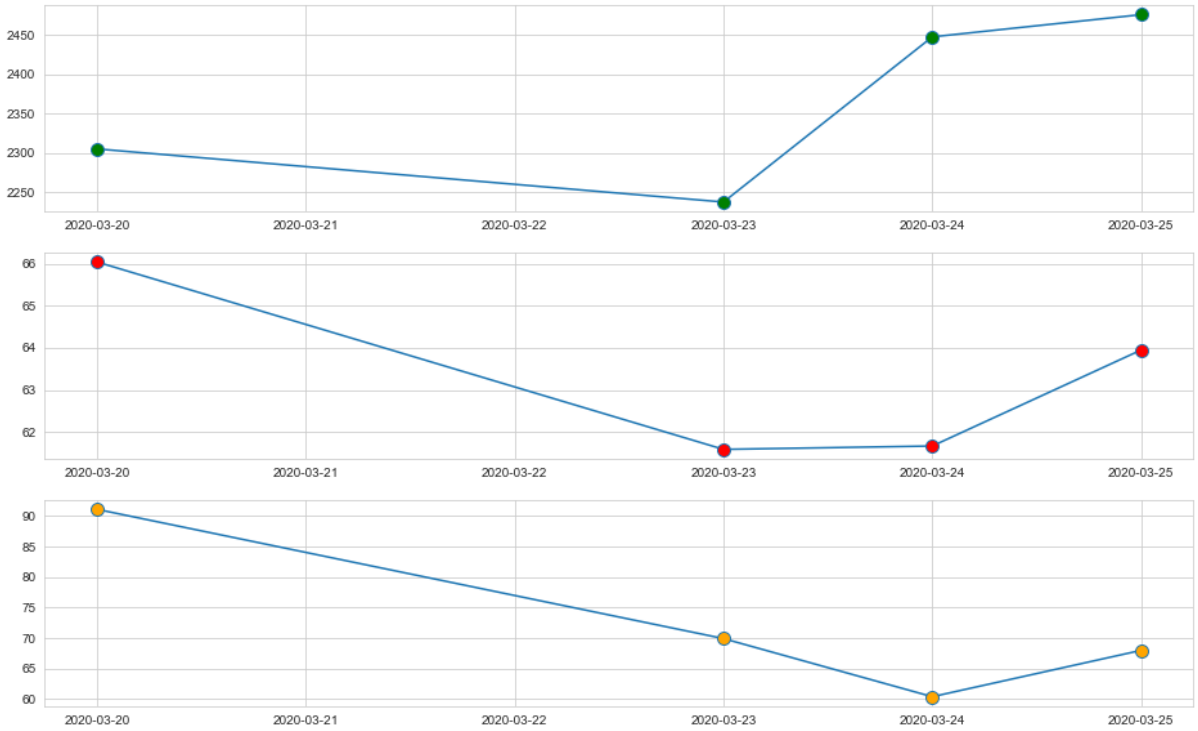



## 2020-03-24

## SPY Daily return up 9.4%

In [208]:
```
fig, axes = plt.subplots(3,1, figsize = (16,10));
axes[0].plot(data.loc["2020-03-20":"2020-03-25"]["^GSPC"], marker = "o",
mfc = "g", ms = 10)
axes[1].plot(data.loc["2020-03-20":"2020-03-25"]["^VIX"], marker = "o",
mfc = "r", ms = 10)
axes[2].plot(data.loc["2020-03-20":"2020-03-25"]["UVXY"], marker = "o",
mfc = "orange", ms = 10)
```

Out[208]:
```
[<matplotlib.lines.Line2D at 0x1a31094e10>]
```

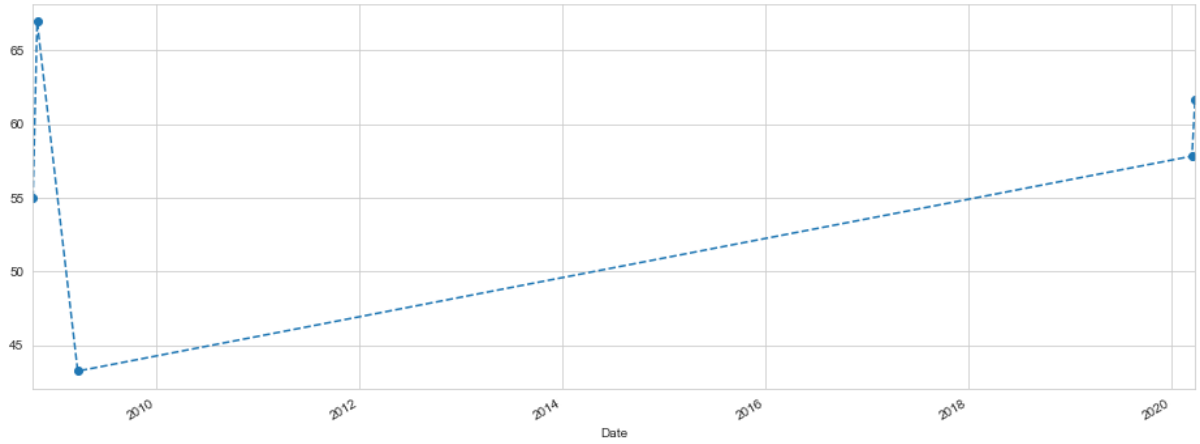



## in summary ad SPY daily returns is in the range of 7.2 and 11 it is almost certain that VIX will have a significant gain. We cna see this clearly in 2020 on the days of 3/13 and 3 /24

## lets take a look at tthe inverse. Since SPY is less likely to jump 7% regularly lets investigate VIX daily returns in relation to S&P

In [209]:
```
data[(data["^GSPC daily returns"] * 100 > 7)]["^VIX"].plot(figsize = (16
,6), marker = "o", ls = "--")
```

Out[209]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x1a31144c90>
```




In [210]:
```
(data["^GSPC daily returns"] * 100).sort_values().head(10)
```

Out[210]:
```
Date
2020-03-16   -11.984055
2020-03-12    -9.511268
2008-10-15    -9.034978
2008-12-01    -8.929524
2008-09-29    -8.806776
2008-10-09    -7.616710
2020-03-09    -7.596970
2008-11-20    -6.712293
2011-08-08    -6.663446
2008-11-19    -6.115558
Name: ^GSPC daily returns, dtype: float64
```

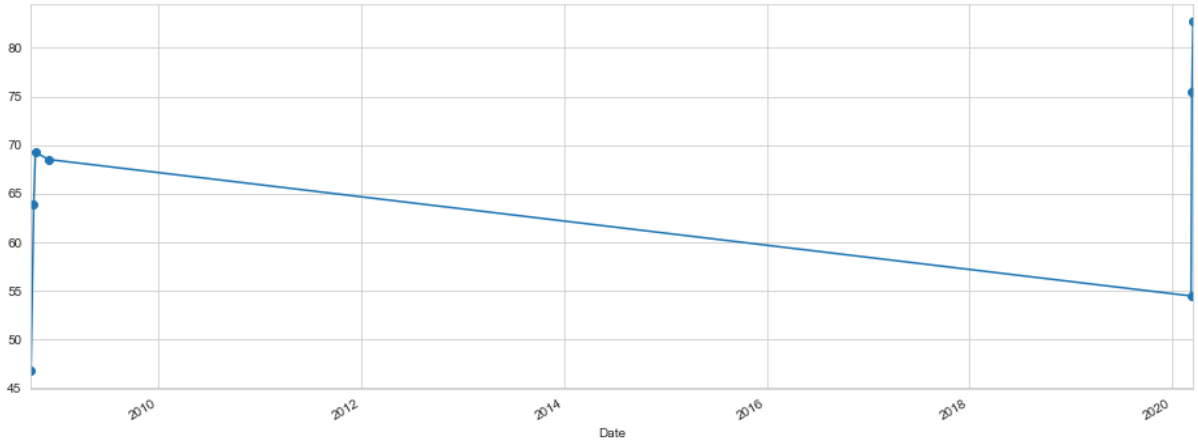
# Dates blow where SPY went under -7% daily return

In [211]:
```
data[data["^GSPC daily returns"] * 100 < -7]["^VIX"]
```

Out[211]:
```
Date
2008-09-29    46.720001
2008-10-09    63.919998
2008-10-15    69.250000
2008-12-01    68.510002
2020-03-09    54.459999
2020-03-12    75.470001
2020-03-16    82.690002
Name: ^VIX, dtype: float64
```

In [212]:
```
data[data["^GSPC daily returns"] * 100 < -7]["^VIX"].plot(figsize = (16, 6), marker = "o")
```

Out[212]: <matplotlib.axes._subplots.AxesSubplot at 0x1a313ab9d0>



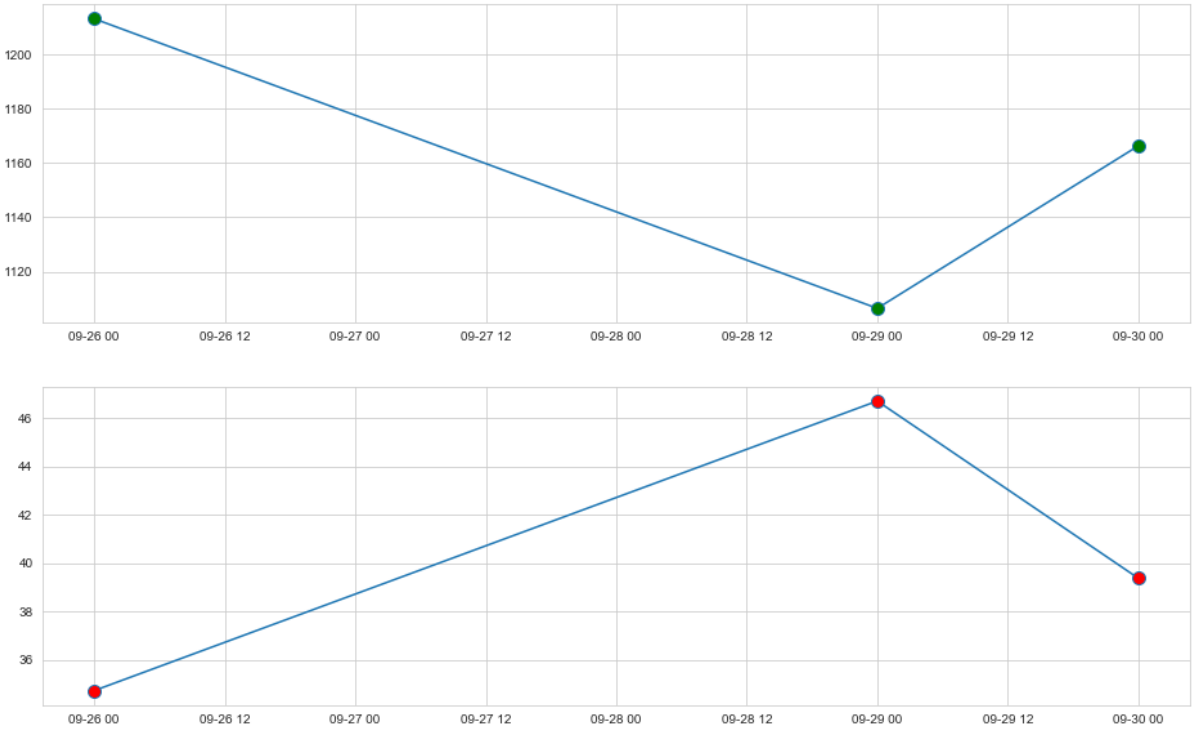

## GSPC daily under < -7

### 2008-09-29

## SPY at -8.8 % , with a 3% increase next day as vix drops 15%

In [213]:
```
fig, axes = plt.subplots(2,1, figsize = (16,10));
axes[0].plot(data.loc["2008-09-26":"2008-09-30"]["^GSPC"], marker = "o",
mfc = "g", ms = 10)
axes[1].plot(data.loc["2008-09-26":"2008-09-30"]["^VIX"], marker = "o",
mfc = "r", ms = 10)
```

Out[213]:
```
[<matplotlib.lines.Line2D at 0x1a31451890>]
```

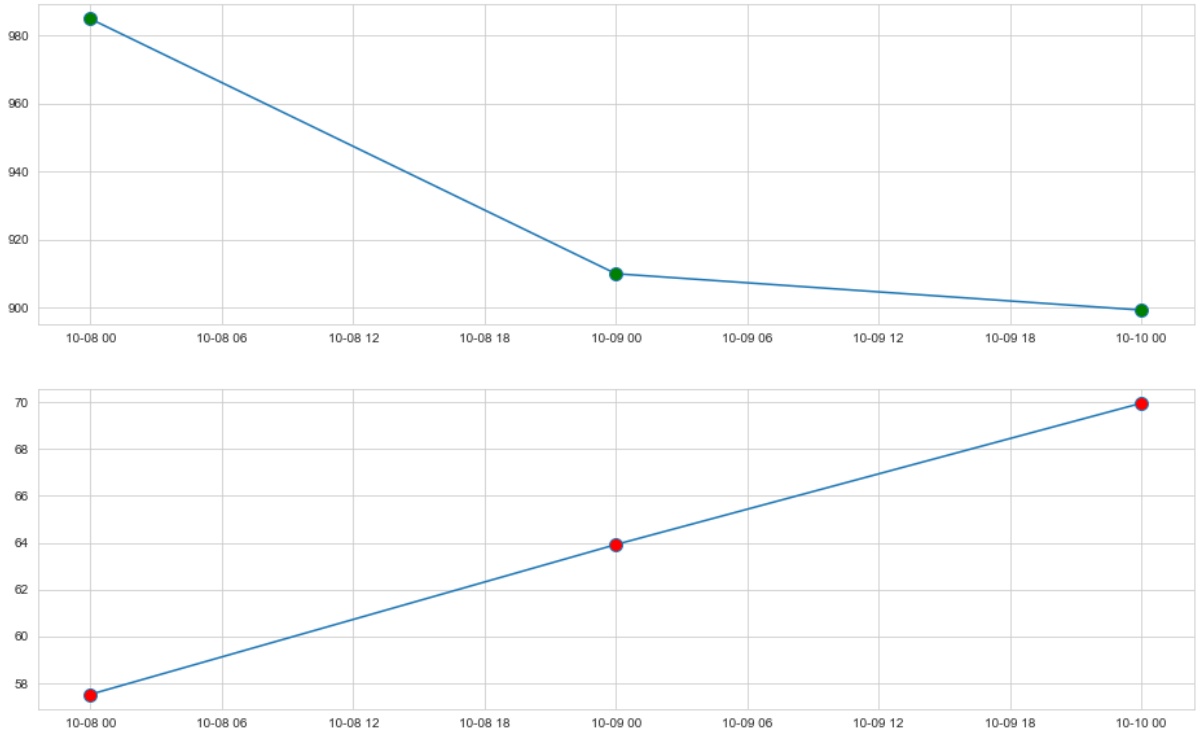



## 2008-10-09

# SPY down 7.6%, insufficient here

In [215]:
```
fig, axes = plt.subplots(2,1, figsize = (16,10));
axes[0].plot(data.loc["2008-10-8":"2008-10-11"]["^GSPC"], marker = "o",
mfc = "g", ms = 10)
axes[1].plot(data.loc["2008-10-8":"2008-10-11"]["^VIX"], marker = "o", m
fc = "r", ms = 10)
```

Out[215]:
```
[<matplotlib.lines.Line2D at 0x1a31861e10>]
```

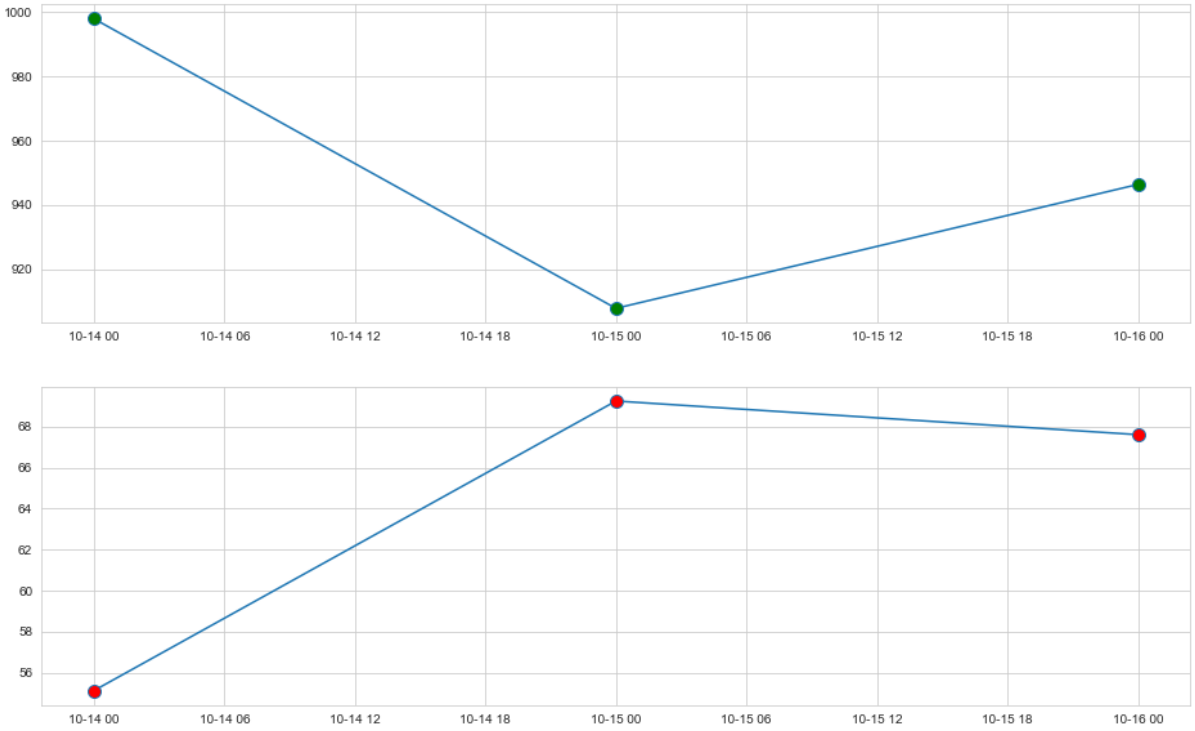



## 2008-10-15

# SPY down 9% -> 3.5 %increase in SPY next day with a 3.4 % drop in VIX

In [216]:
```
fig, axes = plt.subplots(2,1, figsize = (16,10));
axes[0].plot(data.loc["2008-10-14":"2008-10-16"]["^GSPC"], marker = "o",
mfc = "g", ms = 10)
axes[1].plot(data.loc["2008-10-14":"2008-10-16"]["^VIX"], marker = "o",
mfc = "r", ms = 10)
```

Out[216]:
```
[<matplotlib.lines.Line2D at 0x1a31b3c910>]
```

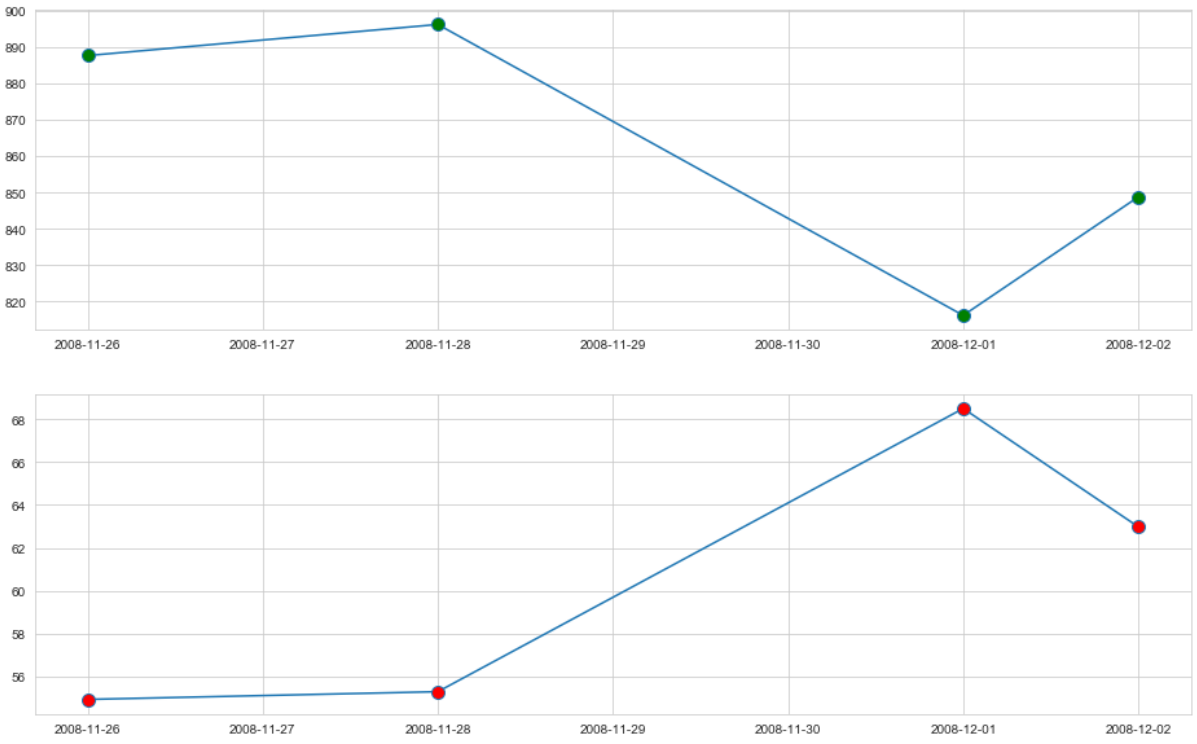



## 2008-12-01

## SPY down 8.9%- 4% jump in SPY and a 9.5% loss in VIX

In [217]:
```
fig, axes = plt.subplots(2,1, figsize = (16,10));
axes[0].plot(data.loc["2008-11-26":"2008-12-02"]["^GSPC"], marker = "o",
mfc = "g", ms = 10)
axes[1].plot(data.loc["2008-11-26":"2008-12-02"]["^VIX"], marker = "o",
mfc = "r", ms = 10)
```

Out[217]:
```
[<matplotlib.lines.Line2D at 0x1a2bd22650>]
```

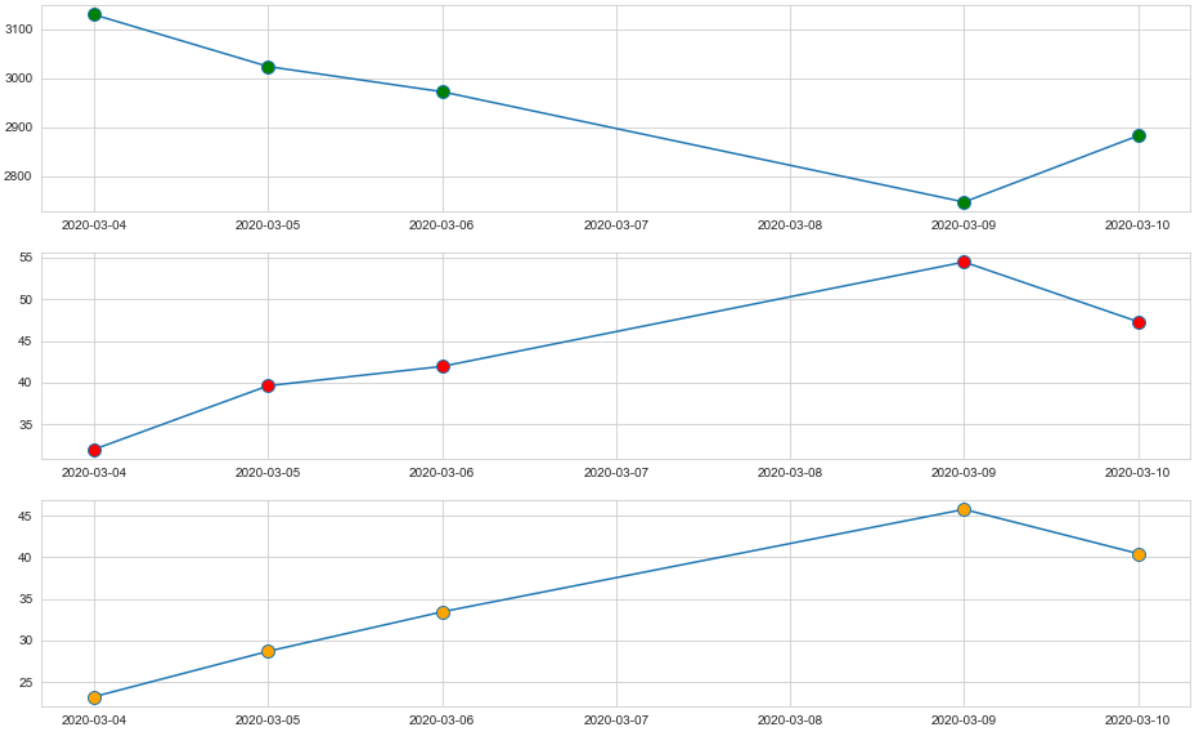



# 2020-03-09

# SPY down 7.6%

In [218]:
```
fig, axes = plt.subplots(3,1, figsize = (16,10));
axes[0].plot(data.loc["2020-03-04":"2020-03-10"]["^GSPC"], marker = "o",
mfc = "g", ms = 10)
axes[1].plot(data.loc["2020-03-04":"2020-03-10"]["^VIX"], marker = "o",
mfc = "r", ms = 10)
axes[2].plot(data.loc["2020-03-04":"2020-03-10"]["UVXY"], marker = "o",
mfc = "orange", ms = 10)
```

Out[218]:
```
[<matplotlib.lines.Line2D at 0x1a2c8c7050>]
```

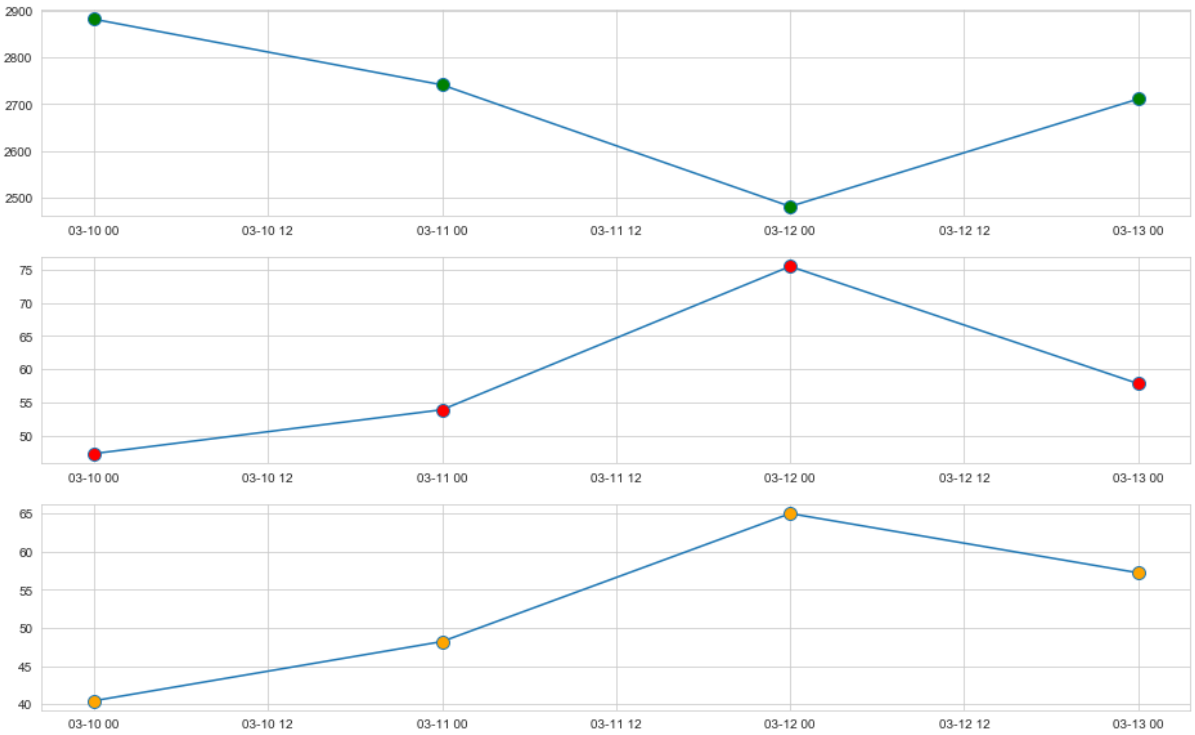



## 2020-03-12

# Spy down 9.5%

In [219]:
```
fig, axes = plt.subplots(3,1, figsize = (16,10));
axes[0].plot(data.loc["2020-03-10":"2020-03-14"]["^GSPC"], marker = "o",
mfc = "g", ms = 10)
axes[1].plot(data.loc["2020-03-10":"2020-03-14"]["^VIX"], marker = "o",
mfc = "r", ms = 10)
axes[2].plot(data.loc["2020-03-10":"2020-03-14"]["UVXY"], marker = "o",
mfc = "orange", ms = 10)
```

Out[219]:
```
[<matplotlib.lines.Line2D at 0x1a2e550950>]
```

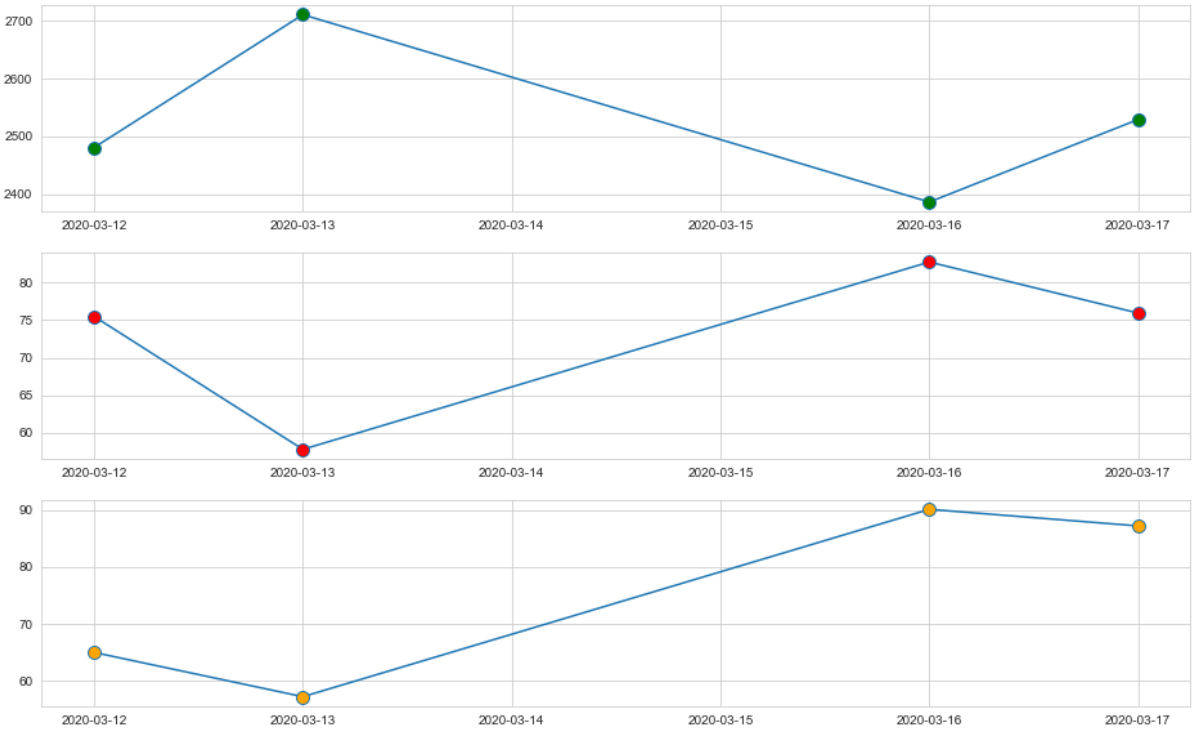



## 2020-03-16

## SPY down 11.9%

In [220]:
```
fig, axes = plt.subplots(3,1, figsize = (16,10));
axes[0].plot(data.loc["2020-03-12":"2020-03-17"]["^GSPC"], marker = "o",
mfc = "g", ms = 10)
axes[1].plot(data.loc["2020-03-12":"2020-03-17"]["^VIX"], marker = "o",
mfc = "r", ms = 10)
axes[2].plot(data.loc["2020-03-12":"2020-03-17"]["UVXY"], marker = "o",
mfc = "orange", ms = 10)
```

Out[220]:
```
[<matplotlib.lines.Line2D at 0x1a302eeed0>]
```




In [ ]:

In [ ]:

In [ ]:

In [ ]: