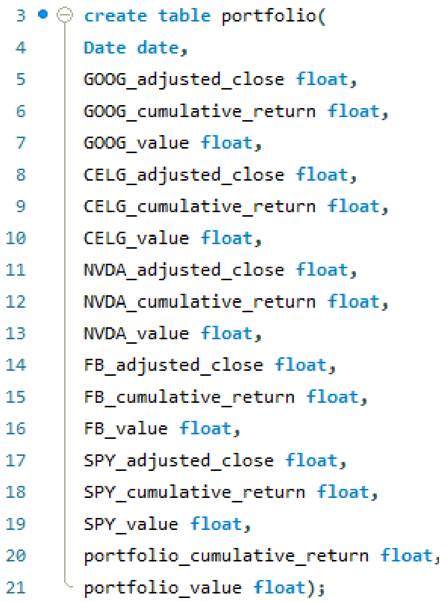
Lab #5 – Problem Solving with Data Analysis

Course: CS-3860
Author: Nigel Nelson
Date: 10/18/21

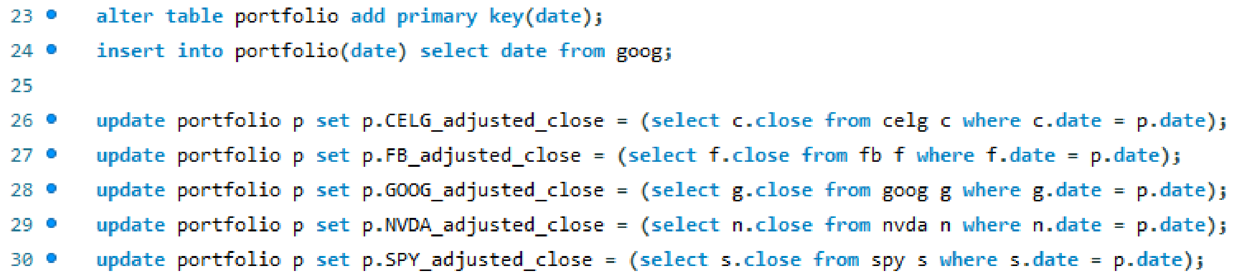
Part 1: Creating Portfolio Database

- Creating Portfolio table in the data_analytics_2020 database:



```sql
create table portfolio(
Date date,
GOOG_adjusted_close float,
GOOG_cumulative_return float,
GOOG_value float,
CELG_adjusted_close float,
CELG_cumulative_return float,
CELG_value float,
NVDA_adjusted_close float,
NVDA_cumulative_return float,
NVDA_value float,
FB_adjusted_close float,
FB_cumulative_return float,
FB_value float,
SPY_adjusted_close float,
SPY_cumulative_return float,
SPY_value float,
portfolio_cumulative_return float,
portfolio_value float);
```

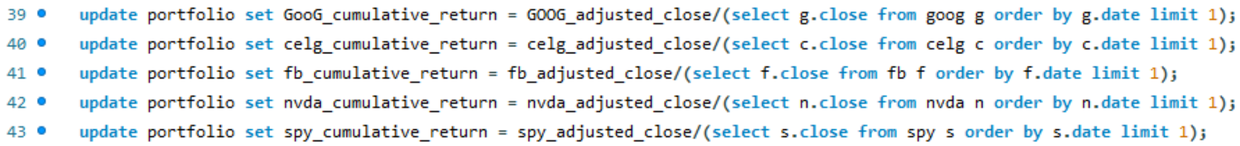
- Updating Portfolio's primary key date attribute based on dates from GOOG table, then updating all stock close values based on aligning dates between the queried tables:



```sql
alter table portfolio add primary key(date);
insert into portfolio(date) select date from goog;

update portfolio p set p.CELG_adjusted_close = (select c.close from celg c where c.date = p.date);
update portfolio p set p.FB_adjusted_close = (select f.close from fb f where f.date = p.date);
update portfolio p set p.GOOG_adjusted_close = (select g.close from goog g where g.date = p.date);
update portfolio p set p.NVDA_adjusted_close = (select n.close from nvda n where n.date = p.date);
update portfolio p set p.SPY_adjusted_close = (select s.close from spy s where s.date = p.date);
```

- Calculating cumulative return for each stock and updating the Portfolio table:



```sql
update portfolio set GooG_cumulative_return = GOOG_adjusted_close/(select g.close from goog g order by g.date limit 1);
update portfolio set celg_cumulative_return = celg_adjusted_close/(select c.close from celg c order by c.date limit 1);
update portfolio set fb_cumulative_return = fb_adjusted_close/(select f.close from fb f order by f.date limit 1);
update portfolio set nvda_cumulative_return = nvda_adjusted_close/(select n.close from nvda n order by n.date limit 1);
update portfolio set spy_cumulative_return = spy_adjusted_close/(select s.close from spy s order by s.date limit 1);
```

- Resulting Portfolio table in the data_analytics_2020 database:

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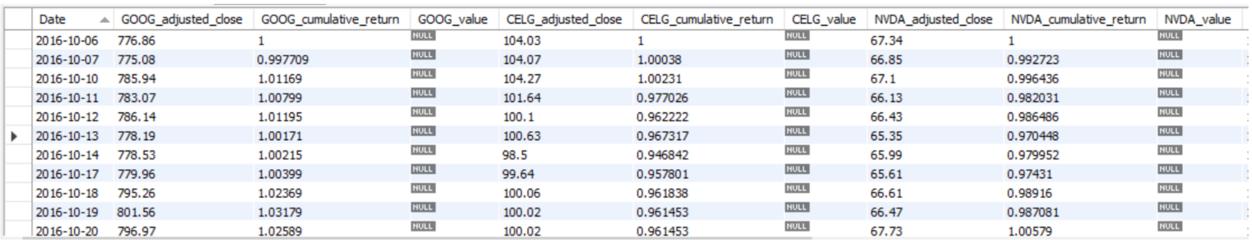
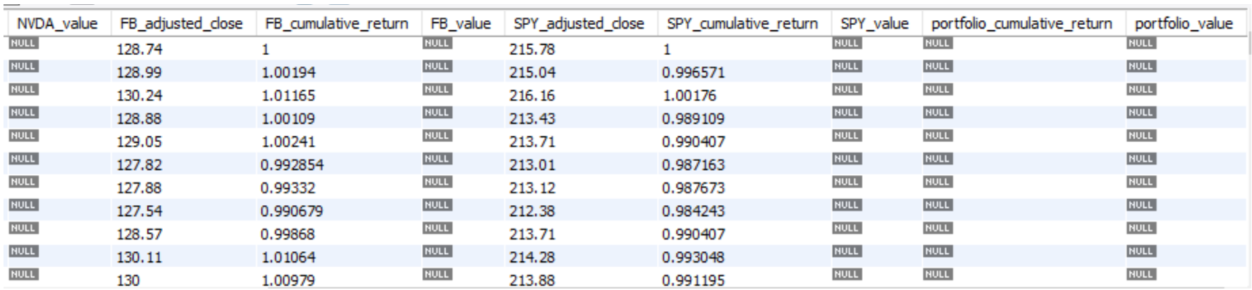


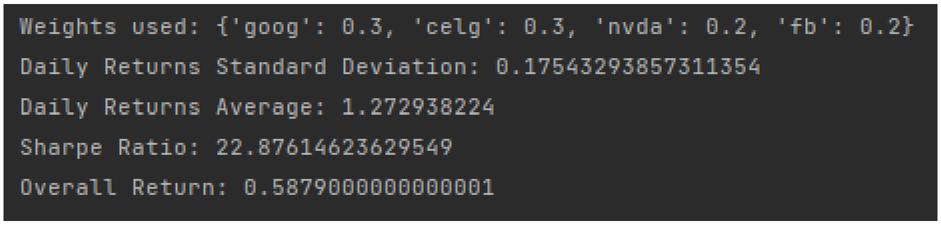
Date	GOOG_adjusted_close	GOOG_cumulative_return	GOOG_value	CELG_adjusted_close	CELG_cumulative_return	CELG_value	NVDA_adjusted_close	NVDA_cumulative_return	NVDA_value
2016-10-06	776.86	1	NULL	104.03	1	NULL	67.34	1	NULL
2016-10-07	775.08	0.997709	NULL	104.07	1.00038	NULL	66.85	0.992723	NULL
2016-10-10	785.94	1.01169	NULL	104.27	1.00231	NULL	67.1	0.996436	NULL
2016-10-11	783.07	1.00799	NULL	101.64	0.977026	NULL	66.13	0.982031	NULL
2016-10-12	786.14	1.01195	NULL	100.1	0.962222	NULL	66.43	0.986486	NULL
2016-10-13	778.19	1.00171	NULL	100.63	0.967317	NULL	65.35	0.970448	NULL
2016-10-14	778.53	1.00215	NULL	98.5	0.946842	NULL	65.99	0.979952	NULL
2016-10-17	779.96	1.00399	NULL	99.64	0.957801	NULL	65.61	0.97431	NULL
2016-10-18	795.26	1.02369	NULL	100.06	0.961838	NULL	66.61	0.98916	NULL
2016-10-19	801.56	1.03179	NULL	100.02	0.961453	NULL	66.47	0.987081	NULL
2016-10-20	796.97	1.02589	NULL	100.02	0.961453	NULL	67.73	1.00579	NULL



NVDA_value	FB_adjusted_close	FB_cumulative_return	FB_value	SPY_adjusted_close	SPY_cumulative_return	SPY_value	portfolio_cumulative_return	portfolio_value
NULL	128.74	1	NULL	215.78	1	NULL	NULL	NULL
NULL	128.99	1.00194	NULL	215.04	0.996571	NULL	NULL	NULL
NULL	130.24	1.01165	NULL	216.16	1.00176	NULL	NULL	NULL
NULL	128.88	1.00109	NULL	213.43	0.989109	NULL	NULL	NULL
NULL	129.05	1.00241	NULL	213.71	0.990407	NULL	NULL	NULL
NULL	127.82	0.992854	NULL	213.01	0.987163	NULL	NULL	NULL
NULL	127.88	0.99332	NULL	213.12	0.987673	NULL	NULL	NULL
NULL	127.54	0.990679	NULL	212.38	0.984243	NULL	NULL	NULL
NULL	128.57	0.99868	NULL	213.71	0.990407	NULL	NULL	NULL
NULL	130.11	1.01064	NULL	214.28	0.993048	NULL	NULL	NULL
NULL	130	1.00979	NULL	213.88	0.991195	NULL	NULL	NULL

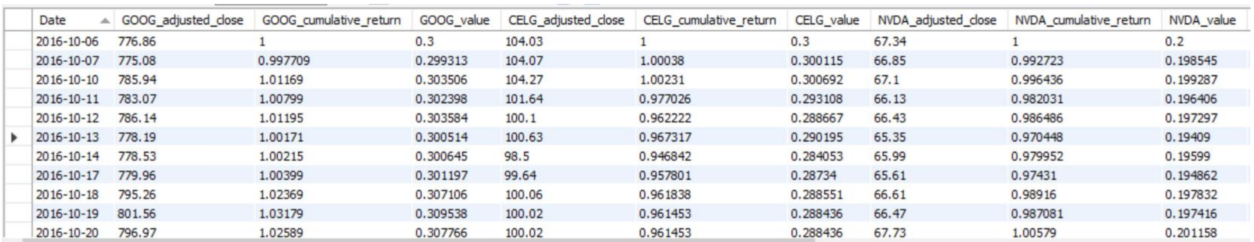
Part 2: Write Portfolio Simulation Function

- Running the created simulation function on the input specified below:

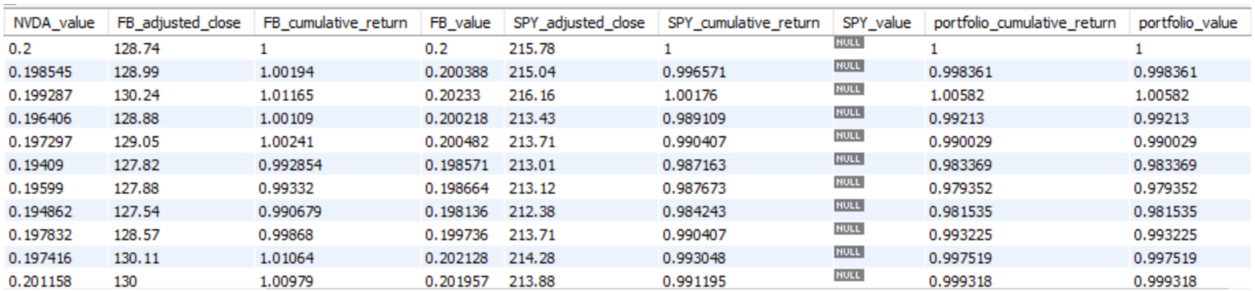


```
Weights used: {'goog': 0.3, 'celg': 0.3, 'nvda': 0.2, 'fb': 0.2}
Daily Returns Standard Deviation: 0.17543293857311354
Daily Returns Average: 1.272938224
Sharpe Ratio: 22.87614623629549
Overall Return: 0.5879000000000001
```

- The result of the simulation on the Portfolio table:



Date	GOOG_adjusted_close	GOOG_cumulative_return	GOOG_value	CELG_adjusted_close	CELG_cumulative_return	CELG_value	NVDA_adjusted_close	NVDA_cumulative_return	NVDA_value
2016-10-06	776.86	1	0.3	104.03	1	0.3	67.34	1	0.2
2016-10-07	775.08	0.997709	0.299313	104.07	1.00038	0.300115	66.85	0.992723	0.198545
2016-10-10	785.94	1.01169	0.303506	104.27	1.00231	0.300692	67.1	0.996436	0.199287
2016-10-11	783.07	1.00799	0.302398	101.64	0.977026	0.293108	66.13	0.982031	0.196406
2016-10-12	786.14	1.01195	0.303584	100.1	0.962222	0.288667	66.43	0.986486	0.197297
2016-10-13	778.19	1.00171	0.300514	100.63	0.967317	0.290195	65.35	0.970448	0.19409
2016-10-14	778.53	1.00215	0.300645	98.5	0.946842	0.284053	65.99	0.979952	0.19599
2016-10-17	779.96	1.00399	0.301197	99.64	0.957801	0.28734	65.61	0.97431	0.194862
2016-10-18	795.26	1.02369	0.307106	100.06	0.961838	0.288551	66.61	0.98916	0.197832
2016-10-19	801.56	1.03179	0.309538	100.02	0.961453	0.288436	66.47	0.987081	0.197416
2016-10-20	796.97	1.02589	0.307766	100.02	0.961453	0.288436	67.73	1.00579	0.201158



NVDA_value	FB_adjusted_close	FB_cumulative_return	FB_value	SPY_adjusted_close	SPY_cumulative_return	SPY_value	portfolio_cumulative_return	portfolio_value
0.2	128.74	1	0.2	215.78	1	NULL	1	1
0.198545	128.99	1.00194	0.200388	215.04	0.996571	NULL	0.998361	0.998361
0.199287	130.24	1.01165	0.20233	216.16	1.00176	NULL	1.00582	1.00582
0.196406	128.88	1.00109	0.200218	213.43	0.989109	NULL	0.99213	0.99213
0.197297	129.05	1.00241	0.200482	213.71	0.990407	NULL	0.990029	0.990029
0.19409	127.82	0.992854	0.198571	213.01	0.987163	NULL	0.983369	0.983369
0.19599	127.88	0.99332	0.198664	213.12	0.987673	NULL	0.979352	0.979352
0.194862	127.54	0.990679	0.198136	212.38	0.984243	NULL	0.981535	0.981535
0.197832	128.57	0.99868	0.199736	213.71	0.990407	NULL	0.993225	0.993225
0.197416	130.11	1.01064	0.202128	214.28	0.993048	NULL	0.997519	0.997519
0.201158	130	1.00979	0.201957	213.88	0.991195	NULL	0.999318	0.999318

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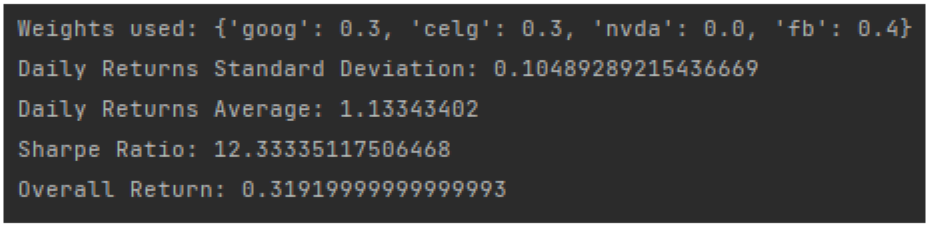
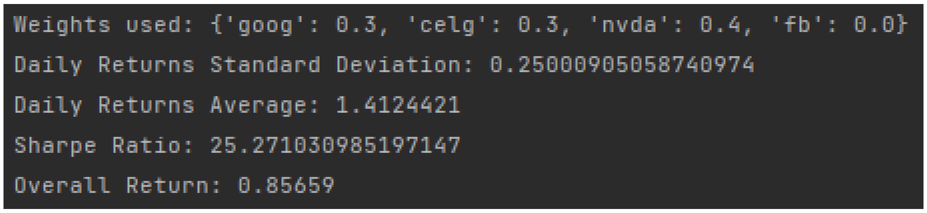
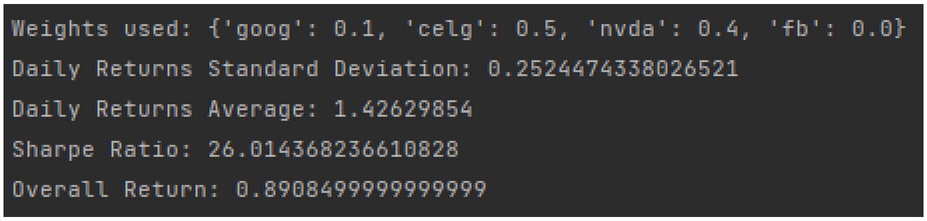
Manually adjusting stock weights to improve Sharpe Ratio:



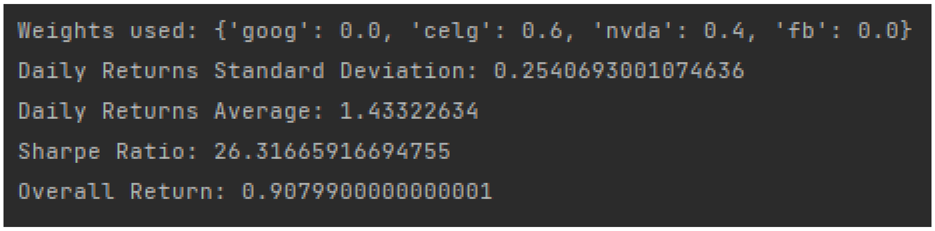
```
Weights used: {'goog': 0.3, 'celg': 0.3, 'nvda': 0.0, 'fb': 0.4}
Daily Returns Standard Deviation: 0.10489289215436669
Daily Returns Average: 1.13343402
Sharpe Ratio: 12.33335117506468
Overall Return: 0.31919999999999993
```



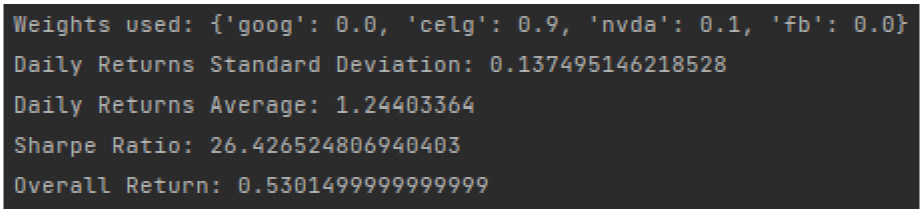
```
Weights used: {'goog': 0.3, 'celg': 0.3, 'nvda': 0.4, 'fb': 0.0}
Daily Returns Standard Deviation: 0.25000905058740974
Daily Returns Average: 1.4124421
Sharpe Ratio: 25.271030985197147
Overall Return: 0.85659
```



```
Weights used: {'goog': 0.1, 'celg': 0.5, 'nvda': 0.4, 'fb': 0.0}
Daily Returns Standard Deviation: 0.2524474338026521
Daily Returns Average: 1.42629854
Sharpe Ratio: 26.014368236610828
Overall Return: 0.8908499999999999
```



```
Weights used: {'goog': 0.0, 'celg': 0.6, 'nvda': 0.4, 'fb': 0.0}
Daily Returns Standard Deviation: 0.2540693001074636
Daily Returns Average: 1.43322634
Sharpe Ratio: 26.31665916694755
Overall Return: 0.9079900000000001
```



```
Weights used: {'goog': 0.0, 'celg': 0.9, 'nvda': 0.1, 'fb': 0.0}
Daily Returns Standard Deviation: 0.137495146218528
Daily Returns Average: 1.24403364
Sharpe Ratio: 26.426524806940403
Overall Return: 0.5301499999999999
```

Part 3: Write a portfolio optimization function:

- Output of optimization function that takes into account all possible combinations of stock weights, and returns the combination of weights used to achieve the highest Sharpe Ratio:

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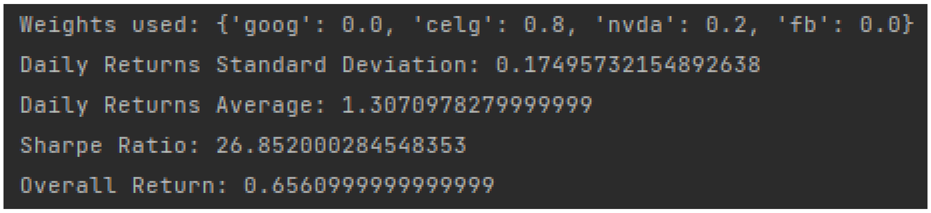
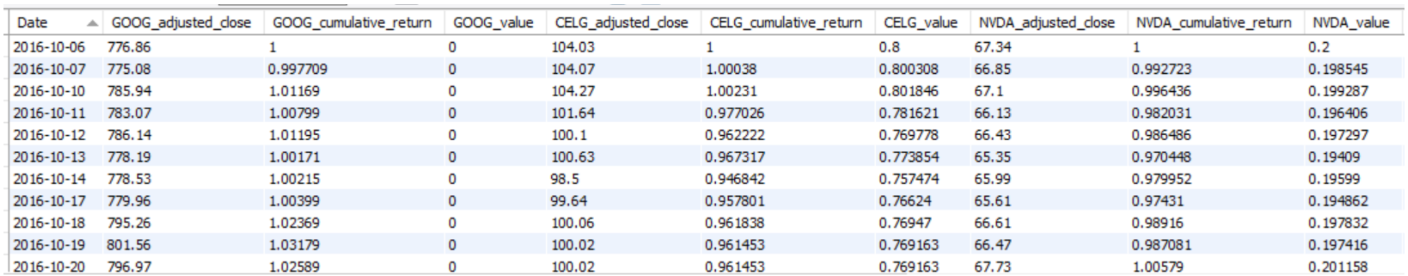
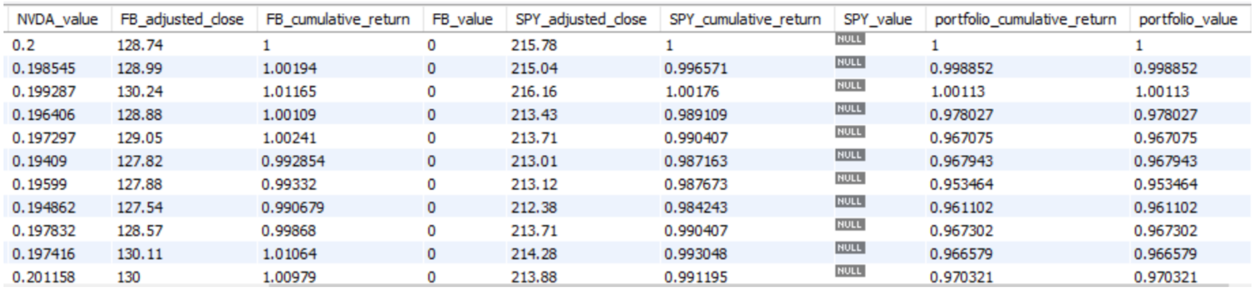


```
Weights used: {'goog': 0.0, 'celg': 0.8, 'nvda': 0.2, 'fb': 0.0}
Daily Returns Standard Deviation: 0.17495732154892638
Daily Returns Average: 1.3070978279999999
Sharpe Ratio: 26.852000284548353
Overall Return: 0.6560999999999999
```

- Resulting Portfolio table after running optimization function:



Date	GOOG_adjusted_close	GOOG_cumulative_return	GOOG_value	CELG_adjusted_close	CELG_cumulative_return	CELG_value	NVDA_adjusted_close	NVDA_cumulative_return	NVDA_value
2016-10-06	776.86	1	0	104.03	1	0.8	67.34	1	0.2
2016-10-07	775.08	0.997709	0	104.07	1.00038	0.800308	66.85	0.992723	0.198545
2016-10-10	785.94	1.01169	0	104.27	1.00231	0.801846	67.1	0.996436	0.199287
2016-10-11	783.07	1.00799	0	101.64	0.977026	0.781621	66.13	0.982031	0.196406
2016-10-12	786.14	1.01195	0	100.1	0.962222	0.769778	66.43	0.986486	0.197297
2016-10-13	778.19	1.00171	0	100.63	0.967317	0.773854	65.35	0.970448	0.19409
2016-10-14	778.53	1.00215	0	98.5	0.946842	0.757474	65.99	0.979952	0.19599
2016-10-17	779.96	1.00399	0	99.64	0.957801	0.76624	65.61	0.97431	0.194862
2016-10-18	795.26	1.02369	0	100.06	0.961838	0.76947	66.61	0.98916	0.197832
2016-10-19	801.56	1.03179	0	100.02	0.961453	0.769163	66.47	0.987081	0.197416
2016-10-20	796.97	1.02589	0	100.02	0.961453	0.769163	67.73	1.00579	0.201158



NVDA_value	FB_adjusted_close	FB_cumulative_return	FB_value	SPY_adjusted_close	SPY_cumulative_return	SPY_value	portfolio_cumulative_return	portfolio_value
0.2	128.74	1	0	215.78	1	NULL	1	1
0.198545	128.99	1.00194	0	215.04	0.996571	NULL	0.998852	0.998852
0.199287	130.24	1.01165	0	216.16	1.00176	NULL	1.00113	1.00113
0.196406	128.88	1.00109	0	213.43	0.989109	NULL	0.978027	0.978027
0.197297	129.05	1.00241	0	213.71	0.990407	NULL	0.967075	0.967075
0.19409	127.82	0.992854	0	213.01	0.987163	NULL	0.967943	0.967943
0.19599	127.88	0.99332	0	213.12	0.987673	NULL	0.953464	0.953464
0.194862	127.54	0.990679	0	212.38	0.984243	NULL	0.961102	0.961102
0.197832	128.57	0.99868	0	213.71	0.990407	NULL	0.967302	0.967302
0.197416	130.11	1.01064	0	214.28	0.993048	NULL	0.966579	0.966579
0.201158	130	1.00979	0	213.88	0.991195	NULL	0.970321	0.970321