

## 1) Introduction

In this assignment, we find ourselves in an odd situation where with the help of a friend we now have access to a bank deposit account from the past, specifically 01/01/1960 containing the amount of 1 dollar and through this account we can sell and buy stocks. As we are very greedy and we do not mind messing up the timeline we will use this to our advantage to get rich! We also have in our hands a dataset with 7195 stock files to use with each file named s.us.txt, s being the name of the respective stock. Some restrictions are in place aswell. Firstly we do not know if the highest or lowest price of a stock occurred first and thus this is not a trivial task anymore. The moves we can perform are buy-low, sell-high, buy-open, sell-open, buy-close, sell-close and during a day these happen in the following chronological order

{ buy-open , sell-open } >> { buy-low , sell-high } >> { buy-close , sell-close }.

As a further safety measure for the timeline, we can neither sell nor buy more than 10% of the volume of a stock on a certain day.

Our goal is to create one small and one big sequence of transactions with the stocks in order to create a high profit. All of this will be done with python and the code will be in a separate file called scripts in order to not make this report too lengthy and visually unappealing for the reader.

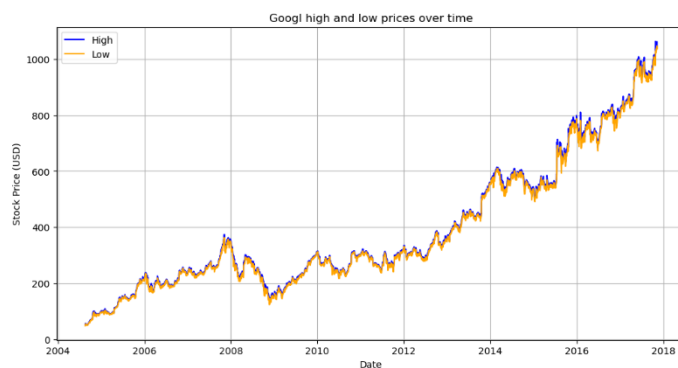
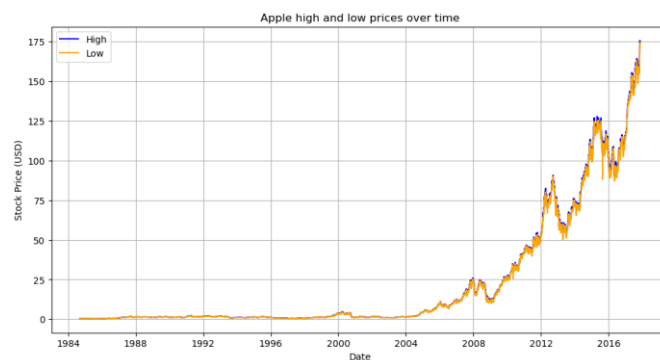
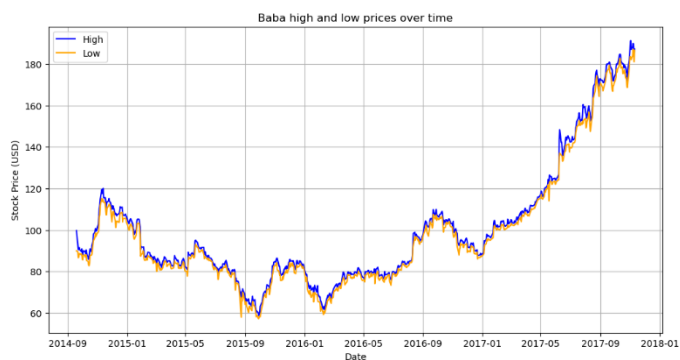
## 2) Data Analysis/Preprocessing

Before formulating our trading strategies, we analyze the dataset to identify and filter out erroneous data. Looking through our data we notice some stocks that have opening, closing, high or low prices with values being 0 or negative. These are obviously wrongly inputed data and must be removed. Moreover it is crucial to identify important and valuable stocks based on some criterion. That is why we introduce a scoring system based on the score being 'high vs low' price for each stock multiplies by its trading volume. This scoring approach puts emphasis both on the price dynamics but trading volume aswell which is very important since we need big amounts of stocks to trade and make big profit. After this, the resulting dataset is called big\_df\_sorted and is organizing in descending order based on the calculated scores. Moreover to get a feel for the most promising stocks, we extract the top 30 stocks from this dataset.

	Name	Start	End	Days Traded	MeanVolume	Score
2337	fb	2012-05-18	2017-11-10	1381	37707165.0	73785975.0
12	aapl	1984-09-07	2017-11-10	8363	106654380.0	55236558.1
2849	googl	2004-08-19	2017-11-10	3332	7954120.3	52380793.8
614	baba	2014-09-19	2017-11-10	794	16809356.5	50495340.6
913	brk-b	1996-05-09	2017-11-10	5415	27890478.0	42501121.8
...	...	...	...	...	...	...
1393	cndf	2016-06-16	2017-11-07	110	749.4	29.7
1409	cnsf	2016-05-31	2017-11-06	114	506.1	24.7
2273	evlmc	2016-04-01	2017-10-19	340	6130.9	14.5
2265	evgbc	2016-04-01	2017-10-19	340	5854.9	7.9
2283	evstc	2016-02-27	2017-10-19	367	6145.8	6.6

big\_df\_sorted

The 3 most valuable stocks are Facebook, Apple and Google. This aligns with our expectations since they are some of the most renowned companies in the world. We must also note that as expected from our scoring system, the companies placed at the top of our dataframe have very high trading volumes. We proceed to visualize time series data for our top stocks to observe their evolution over time. We observe a rise in the value of all these stocks as expected, with apple, google and facebook noting a smooth rise while Baba shows a few fluctuations before 2017. Apple seems to begin at a very low price which is important since our initial budget is 1 dollar. Finally we also examine the amazon stock which starts off at a very low price and increases with time to reach high prices of over 1000 dollar per stock (as does google although it begins from a much higher price)!



Before moving to our strategy, we create one more dataframe that we are gonna use called `final_df`(figure 1) the following way. We loop through all the stocks and if the current stock appears in our top 30 stocks we save it in the `final_df`. After that we remove duplicates of our dates and we keep only one stock per day, the one with the highest score.

	Date	Open	High	Low	Close	Volume	OpenInt	Name	Score
0	1972-01-07	0.01592	0.01592	0.01592	0.01592	3787746	0	intc	0.0
1	1972-01-14	0.00791	0.00791	0.00791	0.00791	7878523	0	intc	0.0
2	1972-01-21	0.00791	0.00791	0.00791	0.00791	1060564	0	intc	0.0
3	1972-01-24	0.00791	0.00791	0.00791	0.00791	6060405	0	intc	0.0
4	1972-01-25	0.00791	0.00791	0.00791	0.00791	1060564	0	intc	0.0

Figure 1: Final\_df.head()

### 3)Strategy

Our investment strategy revolves around a two-phase approach. We transition from intraday trading to investing in Amazon stock. This method capitalizes on the observation that Amazon's stock prices begin from a very low price of 1.98 per share and manage to surpass 1000\$ per share! However this begins in May 16 1997 so before that we engage in intraday trading to create a big enough budget so we can create big profit later on from the Amazon Stock. The intraday trading strategy is pretty straightforward. We systematically buy the maximum allowable quantity of the top performing stock, based on our final\_df, everyday being careful to not exceed the 10% of the stocks daily volume as requested by our predefined constraint. We then proceed to sell, deciding between buying at the opening price and selling at high or buying at low and selling at close price. This decision relies on which difference is bigger, 'High-Open' or 'Close-Low'.

To transition from intraday trading at the specified date in 1997, we edit the final\_df dataset to include data only until the day preceding this date. The following phase of our strategy involves a bulk investment in Amazon stock. The remaining capital from the intraday trading phase is allocated for the strategic purchase of Amazon stock.

Date	Open	High	Low	Close	Volume	OpenInt	
<b>0</b>	1997-05-16	1.97	1.98	1.71	1.73	14700000	0
<b>1</b>	1997-05-19	1.76	1.77	1.62	1.71	6106800	0
<b>2</b>	1997-05-20	1.73	1.75	1.64	1.64	5467200	0
<b>3</b>	1997-05-21	1.64	1.65	1.38	1.43	18853200	0
<b>4</b>	1997-05-22	1.44	1.45	1.31	1.40	11776800	0
...	...	...	...	...	...	...	...
<b>5148</b>	2017-11-06	1109.15	1125.41	1108.77	1120.66	3331738	0
<b>5149</b>	2017-11-07	1124.74	1130.60	1117.50	1123.17	2684443	0
<b>5150</b>	2017-11-08	1122.82	1135.54	1119.11	1132.88	2576010	0
<b>5151</b>	2017-11-09	1125.96	1129.62	1115.77	1129.13	3729978	0
<b>5152</b>	2017-11-10	1126.10	1131.75	1124.06	1125.35	2179181	0

Amazon Data

#### 4) Big Sequence

Starting with our big sequence of fewer than 1,000,000 transactions, we finally put the above strategy to the test. The results are very promising as our profits reach the astonishing amount of 143574114288, with only 13601 transactions used. That's less than 0.02 of the allowed transactions and yet the profit is extremely high. While we could go for another approach that utilizes many more transactions to secure even bigger profits, the simplicity of this algorithm, paired with our extreme profits, is enough to make it a desirable approach. It's essential to also note that, for instance, I chose to buy Amazon stock whenever

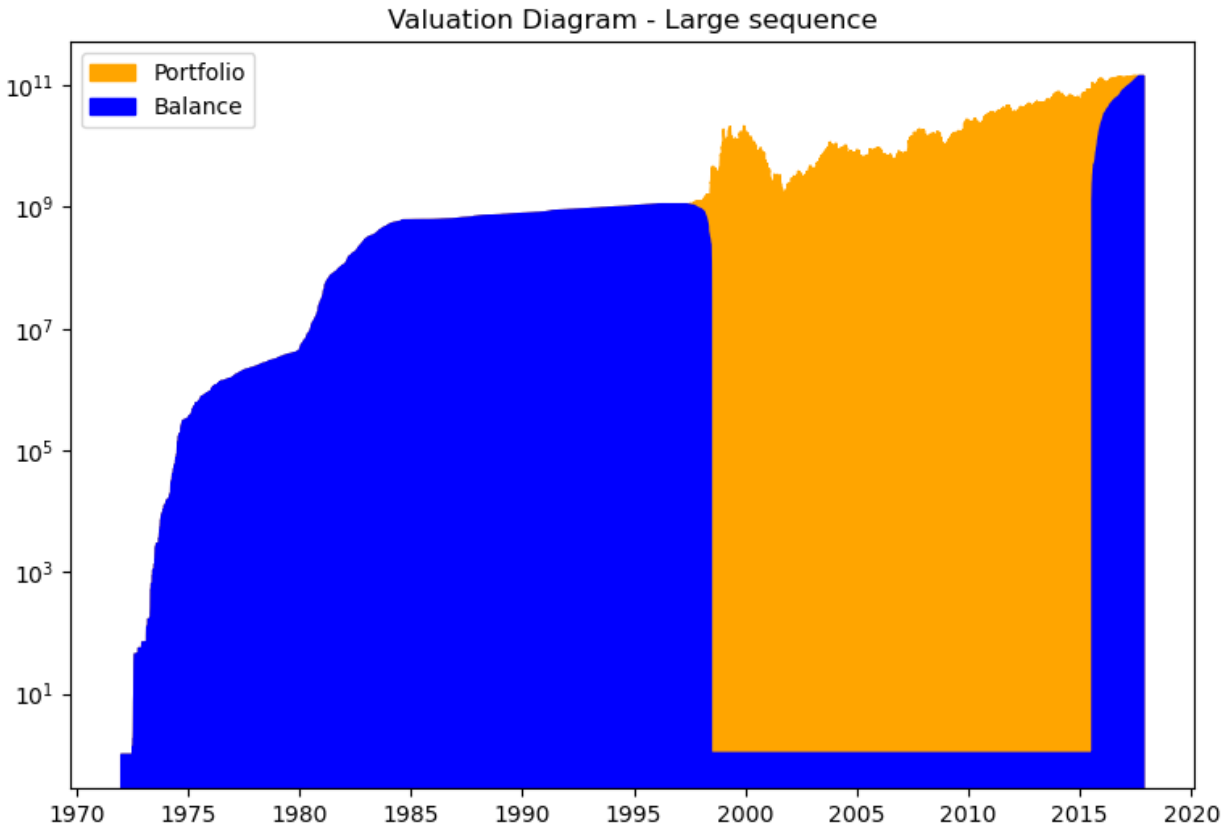
the low price was below 40 and sell whenever the high price was over 520. These numbers were chosen after trial and error in order to not end up with Amazon stocks that have not been sold before or during the final day.

```
1996-04-08 buy-low aapl 4708349
1996-04-08 sell-close aapl 4708349
1996-04-09 buy-low aapl 6555893
1996-04-09 sell-close aapl 6555893
1996-04-10 buy-open aapl 4873894
1996-04-10 sell-high aapl 4873894
1996-04-11 buy-low aapl 2740552
1996-04-11 sell-close aapl 2740552
1997-05-16 buy-low amzn 1470000
1997-05-19 buy-low amzn 610680
1997-05-20 buy-low amzn 546720
1997-05-21 buy-low amzn 1885320
1997-05-22 buy-low amzn 1177680
1997-05-23 buy-low amzn 1593720
1997-05-27 buy-low amzn 869760
1997-05-28 buy-low amzn 457440
1997-05-29 buy-low amzn 347280
1997-05-30 buy-low amzn 259440
1997-06-02 buy-low amzn 59160
```

## Success:

After 13601 transaction(s), your profit is 143574114288.46756 dollars.

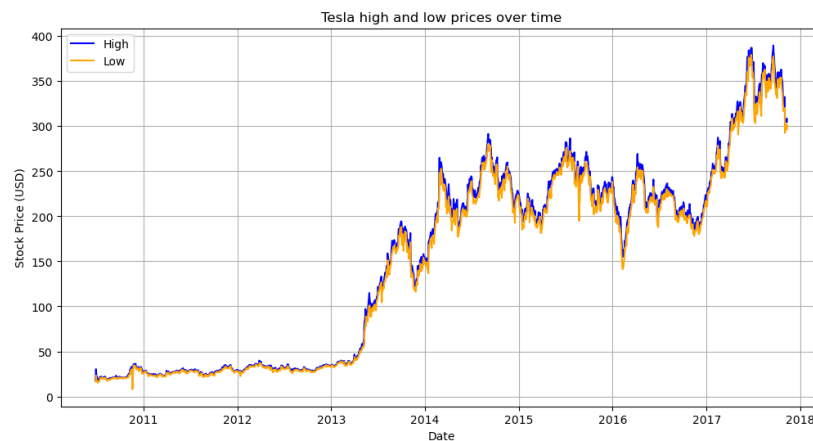
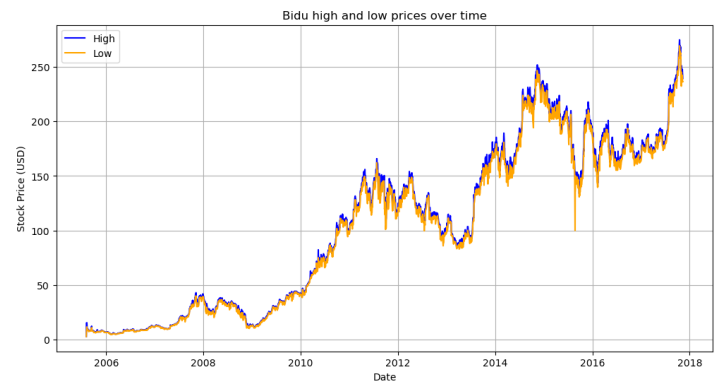
Below I also present the evaluation diagram for our big sequence. As expected until 1997 the balance keeps going up because of the intraday trading. Right after most of our balance goes away as we buy amazon stock in bulk and then we sell after 2015 when it reaches the extreme 'high' values to make our profit.



##### 5) Small sequence.

For our small sequence we follow the same approach using different stocks since with Amazon 1000 transactions are enough to only make a profit of 3 million dollars with the above method and while 3 million dollars are a lot of money they aren't nearly enough if we have a time hack in our hands. So for this sequence we will focus on intraday trading and 3 different stocks: aaba, bidu and tesla. The explanation for why I chose these 3 stocks becomes much easier if we first watch their time series with the graphs below. First we begin with intraday until Aaba stock appears in 12-04-1996. Right after we switch to Aaba, which has a historic low price of 0.65 and a historic high of 125 dollars. After experimentation we choose to buy whenever the low price is less than 1 dollar and sell whenever it is higher than 120. As we can see from the graphs this doesn't interfere chronologically with our next stock which is Bidu. For bidu sadly we won't sell at historic high prices since we want to sell before tesla stock appears to create a high budget in order to buy tesla stock in bulk when it is cheap. However we will sell at the spike we notice in 2010-2011. Bidu stock historic low is 2.70 dollars at 2005 which is when we buy and we will sell at a high price of over 110 dollars in 2010. All our bidu stock exchanges are constrained before 19-11-2010 which is when the tesla stock appears. Finally now we move on to the tesla stock which is how our big profits are made. From the intraday trading, aaba and bidu stocks we now have 37190407 dollars to invest in tesla. For tesla the historic low is at 8 dollars and after that it goes up to 20+ dollars. However we can't only rely on the 8 dollars price, even though the volume is very high

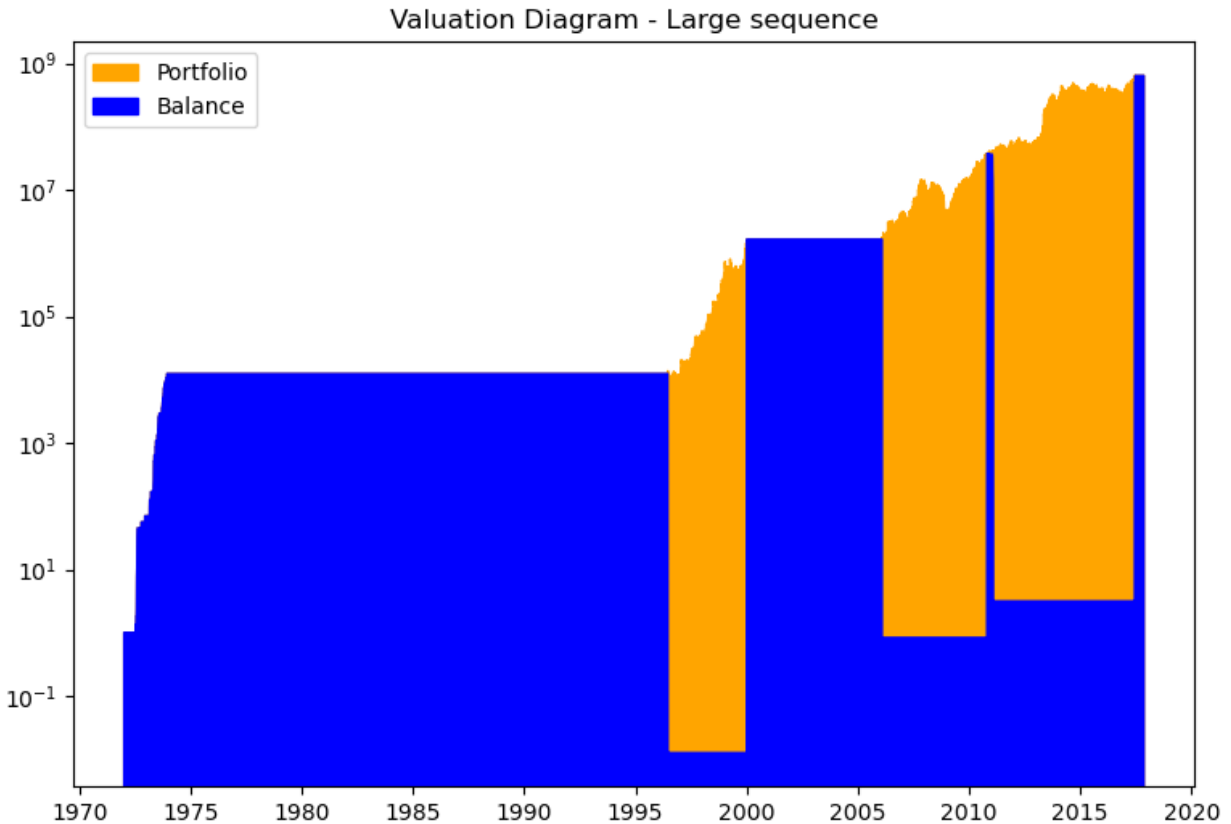
because of our 10% restriction. Thus we buy whenever the price is lower than 25 dollars and sell whenever it is over 380 with the historic high being 389. Finally when we finish selling our tesla stock we are left with 635246421 dollars after 992 transactions. One problem with this specific strategy using these stocks is that there is a big space between 2000 and 2005 after we sell the aaba stocks and before we move on to the bidu ones where we are not investing on anything. That's happening because I couldn't find any stock that I could use for that period of time to make big profits. However if this spot gets filled then our profits could be even higher.



**Success:**

After 992 transaction(s), your profit is 635246421.8926201 dollars.





5) Wrapping up this assignment with a very simple strategy we managed to create extreme profits for both the small and big sequence. The biggest restraint we had to overcome was the 10% of the volume in the stocks which kept us from making more than a trillion dollars. In our small sequence we also faced a small winter period where we didn't buy or sell for more than 5 years but despite that the results were very good for the amount of transactions we used. Our big sequence on the other hand didn't face any problem and rewarded us with extreme amounts of profit!