Detecting Anomalies In The Stock Market Using Quantum Counting and Grover's algorithm

CPS 840 - Quantum Software engineering

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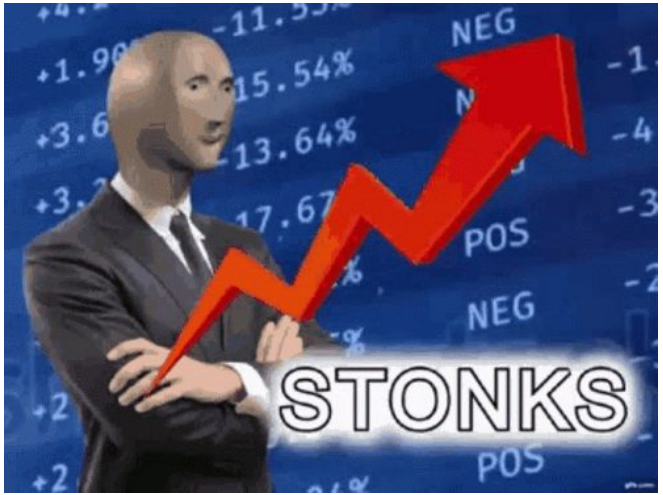
Speed Up For Traders

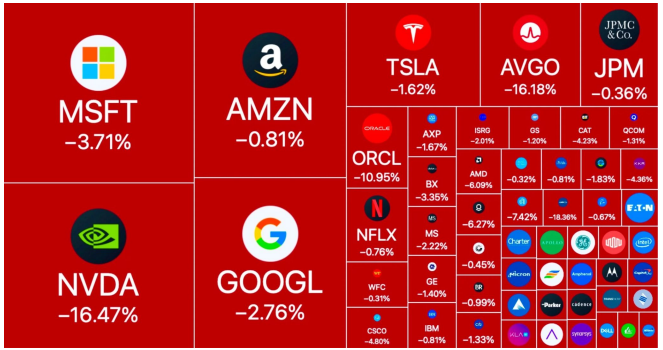
As we know Grover's algorithm gives random search a quadratic speed up.

While a quadratic speed up is good, unlike exponential speeds, for most cases it's not worth the extra cost and effort.

One of the places that any speed up can be worth a lot of money and effort is day trading.

So we want to bring this quadratic speed up to the the ones who value speed the most.





Adaptation

Trading firms already spend millions on computers, algorithms and access to data.

Add passive quantum computing to continuously run a random search on the database, based on the firms quant strategy, returning all outliers.

This allows for n^2 more decision cycles everyday. A huge advantage, allowing for more informed and faster decision making.

Encoding

Fetch data

For this experiment we used yfinance python library

Set Qubits

We used 5 qubits as 2^5 qubits lets us encode up to 32 stocks and we are using 20

Oracle Phase Flip

The Oracle flips the phases of the specific outliers we are looking for.

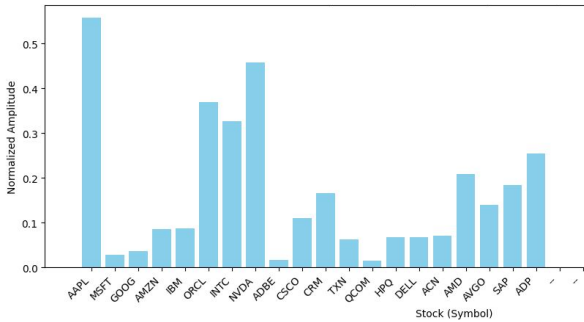
Classical | Quantum

Normalize

We now have to normalize the data so we can encode them as amplitudes for each qubit

Set amplitudes

With each combination of bits from |00000> to |11111> the amplitude is set to the normalized value for each attribute we will search for



1.

Quantum Counting, there may be different number of tickers that are ‘anomalies’ at each run.

Adjust Threshold.

➔ **Z-score**

An outlier can be defined by anything that is x * standard deviation away from the mean. or by its z-score.

➔ **Adjustable Threshold**

Use quantum counting to adjust the threshold on what Z-score is an anomaly. This insures that we get a hit each run.

2.

Grover's Algorithm, Now that we know that we have **n** anomalies and what the Z-score threshold is we perform the search.

Find.

➔ **Adjust the Oracle**

Based on the new definition of ‘anomaly’ we can adjust the oracle to mark the anomalies

➔ **Rotate**

Rotate the amplitudes **n** times to find the anomalies.

3.

Post Processing, We need to explain the results for appropriate and quick decision making

Explain.

➔ **The quarteira**

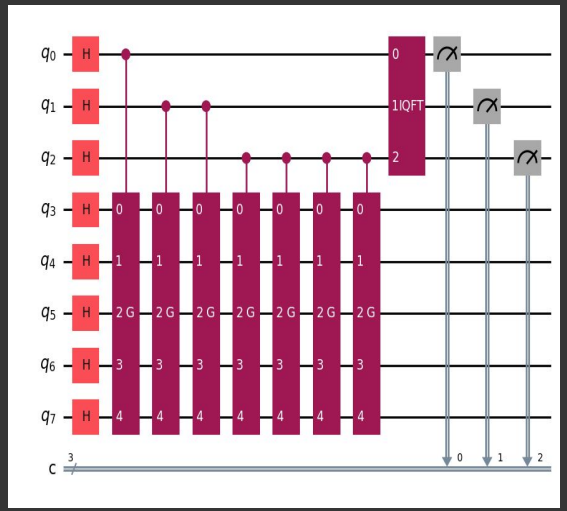
A table for each type of ‘anomaly’

- eg. trailing P/E, ROE, etc.

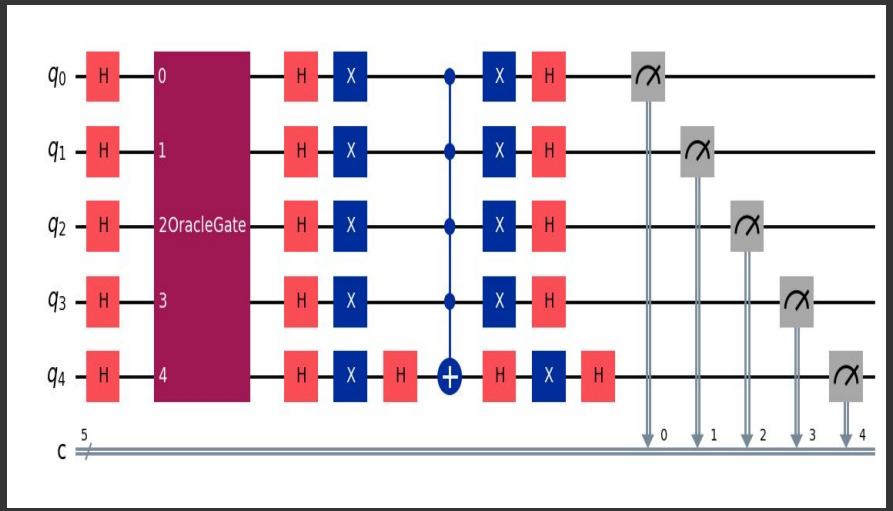
➔ **The threshold**

This algorithm always returns anomalies so the z-score threshold can determine how much of an outlier the stock is.

Results

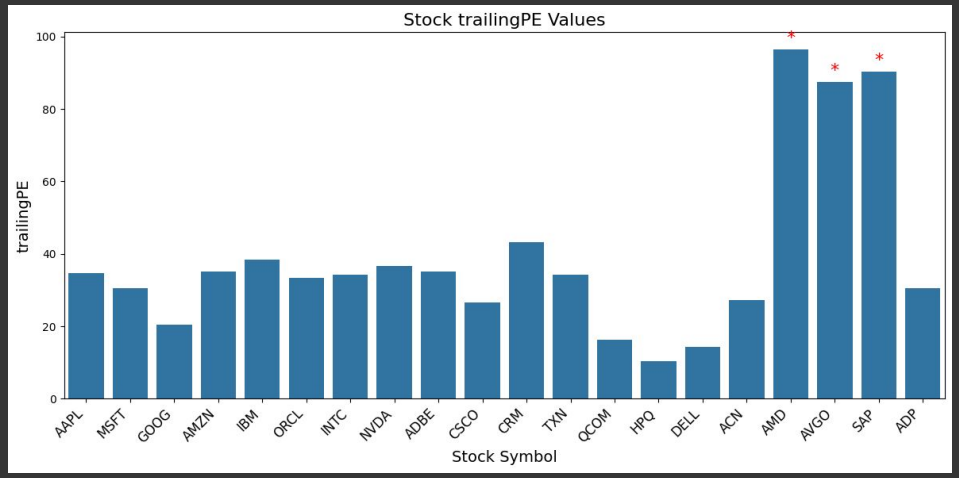


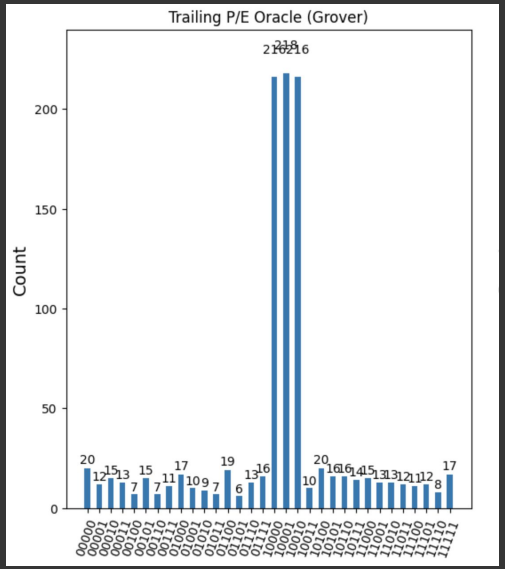
Quantum Counting



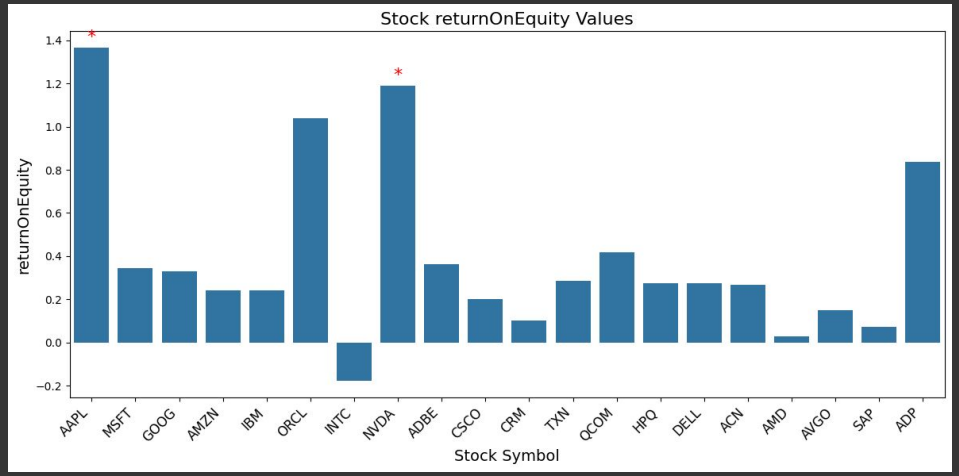
Grover's Algorithm

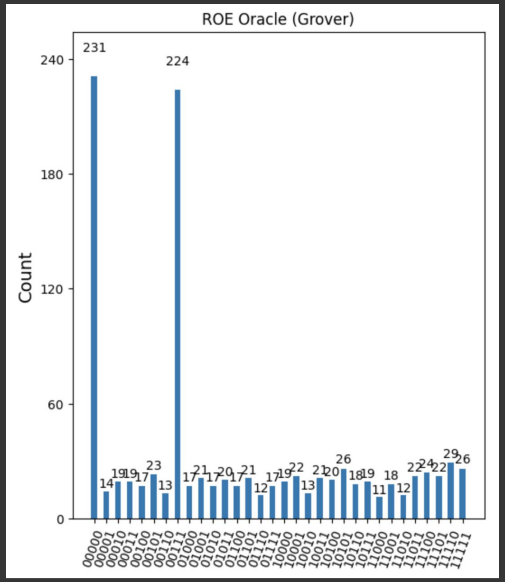
Trailing Price to Earning Ratio

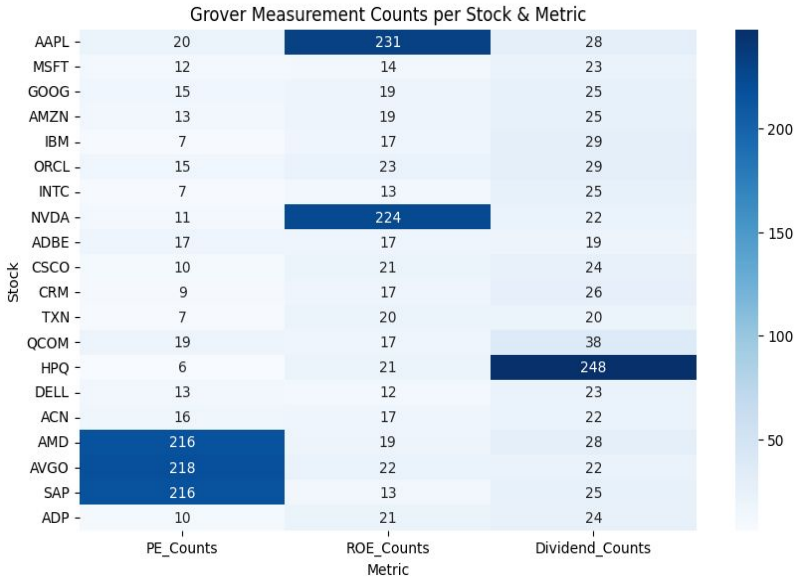


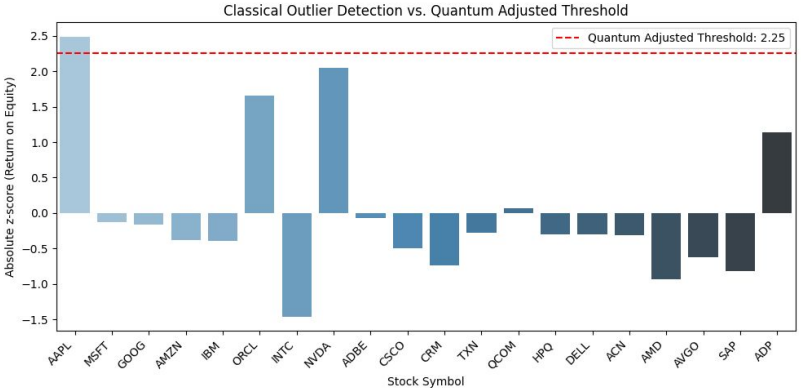


Return on Equity









As we can see this algorithm could effectively find outliers in the stock market using quantum computers.

Simple :)

Not really, the over head and accuracy is very important to consider. Making sure that classical computers and quantum computer communication is seamless is the first step.

We also need to remember that there is a lot of classical computation being done to enable this, and adding the searching feature to run with those computations could yield better results.

Thank you!

Your Thoughts?