A Brief Introduction to Cryptocurrency

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INTRODUCTION

The first decentralized cryptocurrency, Bitcoin, was created in 2009. At inception, Bitcoin was intended to be a form of *electronic cash*, more secure and faster relative to existing payment methods, such as cash, credit/debit cards, and bank transfers. Since then, over 4500 cryptocurrencies have emerged, met with varying degrees of success. Some have evolved to encompass different use cases, including serving as programmable money through smart contracts and decentralized applications (dApps), and governance by creating ways to vote online.

The rise of cryptocurrencies has also piqued the interest of amateur investors, professionals, and financial institutions alike, who are looking for new investment opportunities. The cryptocurrency market is small relative to the U.S. stock market – the total market cap of all U.S. stocks is approximately $30000 billion USD, compared to the total market cap for all cryptocurrencies, which is approximately $250 billion USD. However, trends show that the cryptocurrency market is expanding, with the potential to grow in unprecedented ways.

Interest in the cryptocurrency market has risen despite its nascence and relative volatility. Pricing movements for cryptocurrencies are not well understood, compared to traditional asset classes, such as equities, bonds, and commodities. We seek to examine three factors fundamental to understanding cryptocurrencies:(i) date of network inception, (ii) consensus algorithm, and (iii) market capitalization, which are critical to understanding the quality of a cryptocurrency as a technology and investment.

RELATED WORK

Our starting point was Coinbase and Coinbase Pro, both of which are exchanges that facilitate cryptocurrency trading. They use beautiful, user-friendly interfaces that depict well-rendered pricing visualizations for both the casual and professional buyer.

https://pro.coinbase.com [1]

Next, we searched for visualizations that depicted the history of cryptocurrencies in an educational format. Since cryptocurrencies have surged in popularity, there are many on Internet that showcase pricing information. With these examples in mind, we wanted our project to be especially effective at conveying insightful information.

One effective example is this animated bubble visualization illustrates money invested into coins the market over time:

https://bit.ly/34fIIo8 [2]

We also came across this project by students at Harvard University on the rise and fall of cryptocurrency:

https://cs171-final-project.herokuapp.com/index.html [3]

APPROACH

One of our biggest challenges is that there are many existing visualizations of pricing data online. In addition to Coinbase, almost all exchanges depict price changes over time. We will have to be creative if we want our project to look different and show unique insights. Another challenge is that we all have different backgrounds when it comes to cryptocurrency experience. Our goal is to make a visualization that would be informative for experts, but still easy to understand by those who do not know a lot about cryptocurrencies.

In the beginning, we brainstormed visualizations that we could not find online. We could not find any existing ones that categorized coins by consensus algorithm, which is used to incentivize participation in the network. These participants are called miners, and rewarded with coins after solving the complex, cryptographic puzzles required to validate transactions. While there exists a multitude of accessible sources documenting historical and current prices, there is little insight available as to how these factors may impact the value of a coin, which we define as the size of its market cap.

We do not think that it is feasible for us to predict prices; a phrase often repeated in finance, "Past performance is not indicative of future returns". However, we can look at how some defining characteristics may have played a role in its current market cap position. This compelled us to think more deeply about the factors that define a cryptocurrency, such as the date of network inception, uses case and type of blockchain (the ledger used to record all transactions for a particular coin, and is categorized into public / private / semi-public). Additional things we can look at are the relationship between coins that use certain algorithms and the number of transactions across different coins, which may help us spot trends that are not commonly discussed.

We will use three data sources: (i) the number of cryptocurrencies and market capitalization data scraped from CoinMarketCap that will give us a dynamic list of all the cryptocurrencies, of which we will focus on the top 25 by market cap, (ii) a list of coins by consensus algorithm from CryptoSlate, and (iii)

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historical pricing data from CoinMarketCap to get the year of the inception of the network.

We will begin by introducing blockchain technology and our thesis for why we chose this topic. We have a dynamically changing number of cryptocurrencies that updates with every refresh, as illustrated in **Figure 1**.

We created several visualizations in a "scrollytelling" format.

As illustrated in **Figure 2**, the first visualization is a line chart of the total market cap of all cryptocurrencies. We explain the significance of market cap in the world of cryptocurrencies, as a metric used to determine the value of a coin. We also highlight the meteoric rise in prices in late 2017, and the subsequent 80% crash.

As illustrated in **Figure 3**, the second visualization is a floating circle, representing the speculative bubble created in part, by irrationality and unrealistic expectations.

As illustrated in **Figure 4**, the third visualization examines the first factor- the date of network inception. It is a timeline of creation dates for the top 25 cryptocurrencies, ranked ordinally by market cap. We originally wanted to analyze the top 100, but the visualization appeared too crowded. We wanted to combine insights from the two data sets in a creative fashion. Rankings are normally displayed in a standard table format, and the viability of the network since inception is not discussed often.

As illustrated in **Figure 5**, the fourth visualization examines the second factor- consensus algorithms. The top 25 by market cap change color according to their consensus algorithm. This is to incentivize participation in the network, and participants are called miners. They are tasked with solving complex, cryptographic puzzles required to validate transactions, and are rewarded with coins.

As illustrated in **Figure 6**, the fifth visualization examines the third factor- market cap. As mentioned earlier, market cap can be used to evaluate the value of a cryptocurrency. It is defined as the circulating supply of coins x current price. This is a commonly used metric adapted from how securities are evaluated in the stock market, which is defined as the number of outstanding shares x current price.

As illustrated in **Figure 7**, the sixth, and final visualization, groups the top 25 by consensus algorithm, and the size of the circle determined by its relative market cap to other coins. We had created a three-layer tree map, but after much debate between our group and with advice from Professor Kim, we decided to remove it from our project.

EVALUATIONS

A large point of feedback for the visualization was the effectiveness of the scrollytelling. Our original prototype had bugs with this feature, which caused certain visualizations to stay on the screen overlayed on other visualizations. This was obviously not what was intended. Instead, we refactored some of our visualizations to use a singular svg element, such that the scrollytelling module could easily keep track of when to load visualizations and when other visualizations were not active.

Figure 1. Dynamic number to show coins on the market

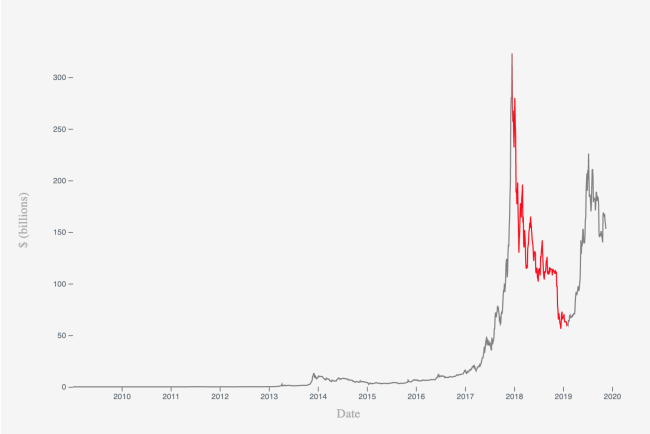

Figure 2. Total market cap visualization.

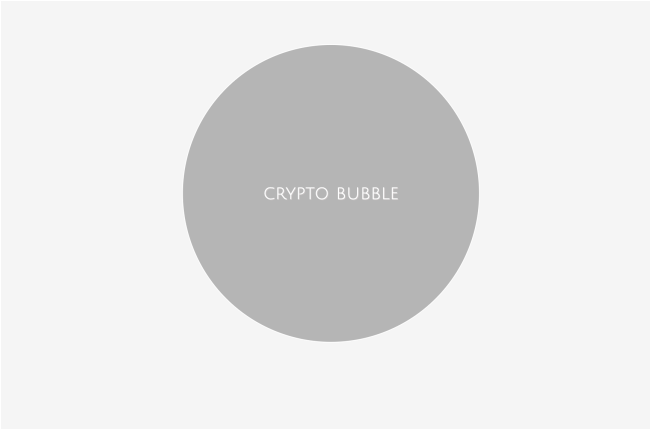

Figure 3. Floating bubble pop animation

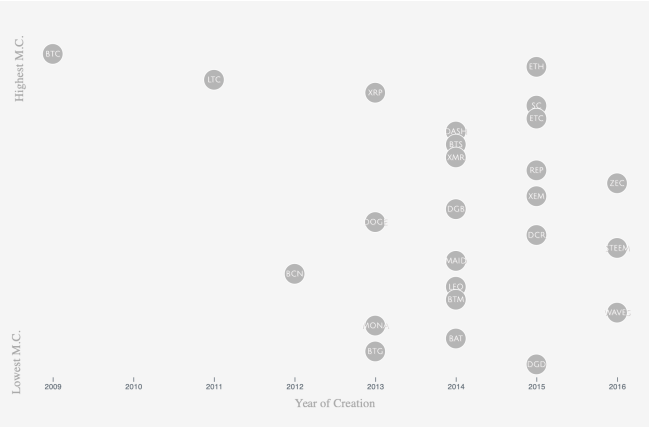

Figure 4. First coin timeline visualization – introducing coins

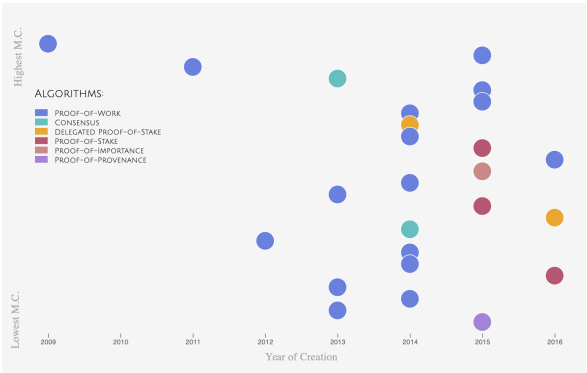

Figure 5. Second coin timeline visualization – filtering by hashing algorithm

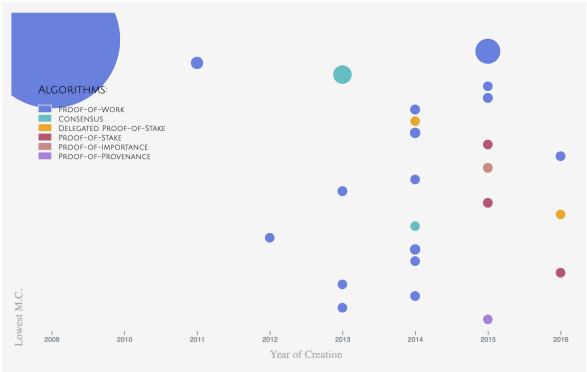

Figure 6. Third coin timeline visualization – growing colored circles by market cap

While scrolling is not perfectly smooth, it does a good job of conveying to the audience the narrative structure.

On the topic of narrative, this was something that our prototype was lacking. While we did have a solid idea in mind, the intention was to create solid visualizations and come back to the narrative flow afterwards. Once those were in place, we were better able to fit the visualizations to the narrative. We could then emphasize the important words in our story to tie it all together.

A large part of the aesthetic were the colors used in the interface. At first, our original colors were clunky; we agreed that the colors were sometimes indistinguishable. Additionally, our neutral color shifted more towards a light grey. This seemed to fit much better thematically within the project itself, matching the font incredibly well.

Another major component that we had to iterate on was the page layout and the effects. At first, our prototypes had short, wide, graphs that spanned horizontally across the page and left room at the top for narration. Since our text was scrollytelling right over our visualizations, we needed to implement a fade animation that would make the words disappear so that the reader could see the graphics clearly. This proved to be somewhat of a challenge, as there is actually no simple, straightforward way to determine whether or not text is visible on a page. After experimenting with the computed style function, bounding client rectangles, and tag positions, we were able to create a Javascript package that paired with CSS opacity stylings to achieve our desired effects.

However, as we began to improve our visualizations, their aspect ratios changed, and we soon realized that it would be more appropriate to position the text on either the left or right side. After tweaking and debugging the scrollytelling containers for both the graphic and the prose, we finally ended up with our current text layout, that incorporates both a central column and a column on the left side. Since it was still important for the reader to focus on the correct text descriptions that corresponded to each story point, we kept the fading animations to drive the reader to focus on the relevant text.

Apart from refining the subtleties of the visualizations and transitions, the last step was to refine the implementation design of the project. Admittedly, it was not structured incredibly well due to the nature of the scrollytelling module. However, after taking time to separate scrollytelling steps into separate files, our productivity increased as our time to debug drastically decreased. It is absolutely one of the major shifts in the project that made us successful.

RESULTS AND DISCUSSION

Our primary goal was to better understand cryptocurrencies, given the vast amount of interest surrounding them. In addition, there is a ton of information and misinformation, and the ability to sift through all crypto metadata will lead to investors making better decisions and developers understanding the technology stack better. We chose to focus on three factors: (i) date of network inception, (ii) consensus algorithms, and (iii) market capitalization.

Our project resulted in several major insights:

- Since the inception of Bitcoin in 2009, there have been over 4800 cryptocurrencies to have been created, and counting.
- At the end of 2017, the cryptocurrency market crashed, with the speculative bubble driven by irrational expectations popping. This resulted in over 80% of total market value evaporating over the course of 2018.
- Among the top 25 cryptocurrencies by market cap, more were created recently than in the beginning.
- Among the top 25 cryptocurrencies by market cap, the proof-of-work (PoW) consensus algorithm was the most popular.
- Among the top 25 cryptocurrencies by market cap, Bitcoin dominates as the largest, by far.
- Among the top 25 cryptocurrencies by market cap, coins that used the POW consensus algorithm had the largest market share, by far.

There were two major lessons to be learned from our project. The first was how difficult scrollytelling was. It was a huge challenge to implement all of our visualizations as we had hoped for, and working with the enter, append, and exit patterns while passing the same dataset through several visualizations took more time than to create the visualizations themselves. The second was learning how to plan extremely well, and not being overly ambitious. The multiple iterations of this project allowed us to scale back from our original vision.

The only true limitation of this project was the scrollytelling. There are many disparate data sources that can provide us with unique insights. For future works, examining the hundreds of metrics might be useful for anyone who is interested in cryptocurrencies.

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