Introduction

Most people would like to take a glimpse of the future. Having the ability to know what will happen tomorrow would most certainly influence the decisions we make today to ensure that we better situated in life. For example, wouldn't you like to invest in the next Amazon today or even better, get in on the ground floor of the next Bitcoin? While it's not 100% perfect, using the techniques of machine and deep learning we can use historical data to help us notice trends and make bold predictions. Just as the saying goes, "history repeats itself', and we're going to use that history to get the future prices of the cryptocurrencies Bitcoin and Ethereum.

We have limited time, so I won't bore you on the history of where Bitcoin came from and how Ethereum is changing the world with decentralization. What I will mention is that while these two currencies have been around for a while, there has been major interest in them recently which led to large investments in them leading to their values increasing rapidly. From one bitcoin costing a little under $300 in 2015 to exploding to over $18,000 in 2017 (Fig 1) an early investor would be sitting pretty with that 80% return. The same goes for Ethereum which was as little as $.64 in 2015 to reaching highs of $700 in 2017 (Fig2). These price changes were great for early investors, but what about later investors who wanted the same returns? Unfortunately, nothing great lasts forever and the prices have dropped, Bitcoin currently sits at around $9000 while Ethereum is around $800.

Figure 1: Bitcoin Price from 2015-2017

Figure 2:Ethereum Price from 2015-2017

The joy of having all of these momentum swings and prices changes is that it gives us so much data. We get a front row seat in see the ups and the downs of these two currencies and we should be able to get meaningful insights by just looking at the data. As previously mentioned our goal is to predict the future prices of Bitcoin and Ethereum using machine learning. To do this we will use data from coinmarketcap.com and use a Long Short Term Memory (LSTM) model in addition to a model built by Facebook named Prophet. Let's see how these models perform.

LSTM

Long Short Term Memory (LSTM) models work on the fact that past events influence following ones. The model wants to use past information to make predictions by taking in data, deciding what part of that data is useful, keeping that, and then repeating until a prediction is made. Let's use the sentence "He was born in Spain and speaks" as an example of how LSTM modeling works. The model will take the relevant information, in this case that's he, Spain, and speaks, to predict that the next word is more than likely Spanish. We can sum up LSTMs thought process as asking three questions: What should I save? What should I ignore? What should I forget? Through these questions we can create a working network that gives reliable results.

Now that we have an understanding of how LSTM modeling works let's implement that into the Bitcoin and Ethereum prices. The model works best with a substantial amount of data, so we'll go back to 2016 to get information about the currencies. To do this we'll enlist the help of coinmarketcap.com. They've made things easy for us by putting historical cryptocurrency information for most currencies in one place and even allowing users to pick the time range that they want to view. Coinmarketcap.com gives users the open, close, high and low prices in addition to the volume and market cap of the currency (Fig 3). All of this useful information will be used in our LSTM model to make predictions.

Historical data for Bitcoin

Currency in USD
Open/Close in UTC time

Apr 6, 2018 - May 6, 2018

Date	Open	High	Low	Close	Volume	Market Cap
May 05, 2018	9,700.28	9,964.50	9,695.12	9,858.15	7,651,940,000	165,055,000,000
May 04, 2018	9,695.50	9,779.20	9,585.96	9,700.76	8,217,830,000	164,956,000,000
May 03, 2018	9,233.97	9,798.33	9,188.15	9,743.86	10,207,300,000	157,087,000,000
May 02, 2018	9,104.60	9,256.52	9,015.14	9,235.92	7,558,160,000	154,869,000,000
May 01, 2018	9,251.47	9,255.88	8,891.05	9,119.01	7,713,020,000	157,350,000,000
Apr 30, 2018	9,426.11	9,477.14	9,166.81	9,240.55	8,673,920,000	160,302,000,000

Figure 3: Bitcoin Price Data

Using Python, we're able to load the data for Bitcoin and Ethereum from coinmarketcap.com and make some plots to investigate how the prices changed since 2016. Let's take a look at the how the closing price and volume of Bitcoin and Ethereum has varied since 2016 (Fig 4 & Fig 5). As previously stated, both Bitcoin and Ethereum saw incredible rise in

value from 2016-2017 before that value drastically dropping in early 2018 and looks to be rising again. In regard to the volume, the trends follow that of the pricing. Both currencies are currently getting a lot of interest in terms of trading and we're upticks in both pricing and volume. Now that we know our data is correct and useful let's build our model.

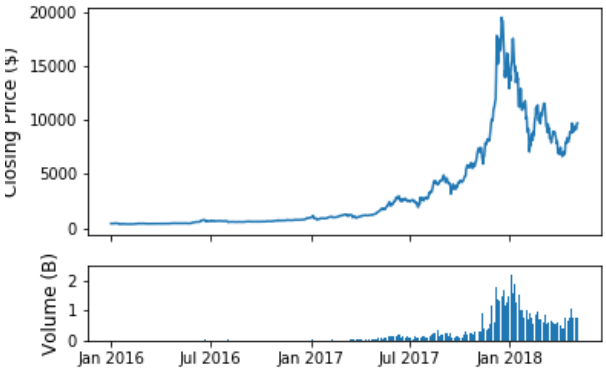

Figure 4: Bitcoin Price and Volume

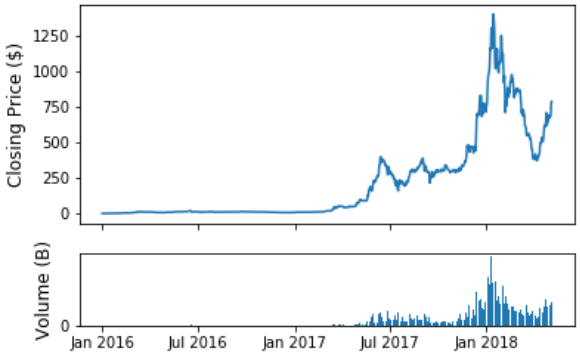

Figure 5: Ethereum Price and Volume

With 2 years of data we have a lot of information to work with and to build our model we'll need to make sure we're using this data the right way. The LSTM model needs two sets of data, a training and test set. For our model we're going to have Jan 2016 to March 2018 be the training set and April 2018 be the test set. This will allow us to train on periods of when the currencies were priced low and also when the price was extremely volatile. Also, we'll have to normalize the prices so that they are between -1 and 1. This will help with our model as our inputs will be more consistent. We'll also split our training and test data into tables with 10 rows each so that we can feed more information into the model.

Python makes LSTM modeling fairly easy with the Keras module. We're able to input our data windows, set the number of epochs we want, set a prediction time and see what the prices will be for that time. Let's set use 10 epochs and see what the LSTM model we built prices Bitcoin and Ethereum for the next 5 days. Looking at the results it's clear that our LSTM model thinks

that both Bitcoin and Ethereum prices will increase in the next 5 days. However, we do see one issue, the model is giving the next day prices that are extremely lower than today's price, Bitcoin is currently around $9600 while Ethereum is around $790. So, what's the price drop? We have to remember that our model is taking training data all the way from 2016 when both currencies were priced way less than they are now. The model's method of keeping what's important means that in takes into consideration those low prices and the times in 2017 when the prices were higher. We also have to remember the sharp decrease in prices in 2018. Remember that our model asks, "What's should I keep?" and in this case it has a lot of information from previous days that it got to keep.

Bitcoin Prices	**Ethereum Prices**
6988.13	403.41
8254.66	495.72
8732.42	558.73
9460.29	630.42

Prophet

When you think of Facebook you probably think of friend requests, pictures, and what Mark Zuckerberg is doing with your data. But beyond data privacy scandals and news feeds Facebook employs numerous smart data scientists that deal with countless amount of user and advertiser data. These data scientists are tasked with using data to make decisions in order to set and achieve goals. The problem they faced is that having automated forecasting leaves out the case of dealing with problems like seasonality and getting data scientists that specialize in exact forecasting for an exact field is rare. Thus, Prophet was created. A forecasting tool that takes into account things like seasonality, holidays, historical trends and outliers, Prophet is touted by Facebook as being straightforward and reliable to use for forecasting. Let's see how it does with predicting Bitcoin and Ethereum prices.

Using Prophet proved to be fairly easy, all the model needed in the data were the dates and close prices. Since we already had that data from coinmarketcap.com to use in our LSTM model we don't have to run that section again. Prophet seems to be fairly plug and play with the options to edit based on how you want to forecast. Since we just want some quick results we'll just give the data and read our outputs. Here's what Prophet gave us.

Bitcoin			**Ethereum**		
yhat	**yhat_lower**	**yhat_upper**	**yhat**	**yhat_lower**	**yhat_upper**
8784.17	7313.80	10161.04	672.47	532.06	823.64
8649.51	7186.35	10159.78	640.54	490.57	784.15
8622.35	7114.95	10013.33	647.38	507.14	779.06
8585.02	7137.49	10010.35	649.57	510.43	792.34
8631.76	7117.08	10224.38	660.10	518.37	799.88

Yhat represents the forecasted price, while yhat_lower and yhat_upper represent the upper and lower forecasted prices respectively. What's most interesting here is that Prophet predicts that the prices will drop just like LSTM did, but Prophet didn't have a drastic decrease like LSTM. Prophet also doesn't think that the prices will steadily increase like LSTM said. While LSTM had the prices having increased around 30% in five days, Prophet sees price fluctuations but mainly has the prices stay within a certain range. The lower and upper prices also follow the same trends. So, while you press your luck and side with the upper limit, Prophet still predicts that you'll see fluctuations.

Conclusion

So, did we predict the future? Not quite. Deep learning is providing us with the tools to make forecasting easier but there's more that we can do. In our case, having data from 2016 negatively affected our results. Ethereum was less than a dollar then! But having so much data helped our models get trends and make predictions. There's a lot more that can and will be done in the upcoming years in the world of data analytics. Having the groundwork with things like LSTM and Prophet are setting us up for great things in the future.

Appendix

LSTM:

http://colah.github.io/posts/2015-08-Understanding-LSTMs/

http://blog.echen.me/2017/05/30/exploring-lstms/

Prophet:

https://research.fb.com/prophet-forecasting-at-scale/