**Chapter 1**

**Introduction**

**Introduction:**

Stock market prediction has attracted much focus from business as well as academia. Due to the non-linear, volatile and complex nature of the market, it is quite difficult to predict. As the stock markets grow larger, more investors pay attention to develop a systematic approach to predict the stock market.

Stock market prediction is the act of trying to determine the future value of a company stock. In the era of the digital computer, stock market prediction has moved into the technological realm. By taking advantage of modern digital computation and public economic database which allow people to explore the hidden information among these platforms.

In the last few years, initial evidence has been established that artificial intelligence techniques are capable of identifying non-linear structures in financial market data [1] [2]. In this project we primarily focus on deep learning to predict the future price though prediction tasks on financial time series are extremely difficult.

We build a gated recurrent units (GRU) neural network, one of the most advanced deep learning architectures [3] to predict the future prices. Surprisingly there has been no notable previous attempt to deploy GRU neural networks on a large, liquid and survivor bias free stock universe to assess its performance in large scale financial market prediction tasks. Last but not least we provide an in-depth guide on data processing as well as development, training and deployment of GRU networks for financial time series prediction.

**Background and Problem with Related Work:**

A lot of work has been done for predicting stock market trends. Most of those words based on traditional machine learning [4] [6]. But after better computation power and with lots of data available, deep learning is outclassed and outperformed machine learning in every possible way. Deep learning is a subset of machine learning. A deep learning model is able to learn that through its own computing “brain”. It’s similar to how a human would perceive something, think about it, and then draw a conclusion. To achieve that, deep learning uses a layered structure of algorithms called an artificial neural network [7]. Its’ design is inspired by the biological neural network that the human brain uses. Most of the previous research based on simple machine learning model.

The challenge for time series prediction is also a big factor. There are some research by using feed forward neural network like multilayer perception [1] but those network are not time series model. Feed forward neural networks have done well in classification tasks, however in dynamic environment, we need techniques that account for history. A time series is a series of data points indexed in time order. Most commonly, a time series is a sequence taken at successive equally spaced points in time. Time series analysis comprises methods for analyzing time series data in order to extract meaningful statistics and other characteristics of the data. Time series model is purely dependent on the idea that past behavior and price patterns can be used to predict future price behavior.

In [5] they use standard recurrent neural network to predict the future price. Recurrent neural network can be used to map input sequences to output sequences, such as for recognition, production or prediction problems but practical difficulties have been reported in training recurrent neural networks like vanishing gradient problem [8]. Vanishing Gradient Problem occurs when we try to train a Neural Network model using Gradient based optimization techniques.

Long short term memory (LSTM) is an excellent neural network to remove the Vanishing Gradient Problem and there are some excellent research to predict future prices using LSTM like deep learning with long short-term memory networks for financial market predictions [8]. But compare to GRU, LSTM has some redundant information. GRU has fewer parameter than LSTM and thus may train a bit faster or need less iterations to generalize. Writers of the paper ‘An Empirical Exploration of Recurrent Network Architectures’ showed that the GRU outperformed the LSTM on most tasks with the exception of language modeling [9].

**Present State and Contribution:**

We build a gated recurrent units (GRUs) neural network, one of the most advanced deep learning architectures [3] to predict the future prices. Gated recurrent units neural networks usually just called ‘GRU’ are a special kind of RNN, capable of learning long-term dependencies which does not have any vanishing gradient problem. We evaluated our result by calculating root mean square error on various dataset and get a good result like percentage of root mean square error only around .002.

**Motivation and Prospectus:**

The main beneficial of this project are the customers of brokerage firm. A brokerage firm, or simply brokerage, is a financial institution that provides the buying and selling of financial securities between a buyer and a seller. Brokerage firms/houses serve a clientele of investors who trade public stocks and other securities, usually through the firm's agent stockbrokers. If the brokerage firm can predict the future prices of stocks they will provide informative information to their customers. So the customers of that firm can take smart buy-sell-hold decisions and thus they can earn more money. Since customers gaining more profit, the number of customers will increase day by day and brokerage firm will also make more profit as brokerage firm charge money for every single trade.

To extract the hidden patterns of stocks is very challenging due to the volatility of stock market. Volatility is a statistical measure of the dispersion of returns for a given market index. Volatility can either be measured by using the standard deviation or variance between returns from that same market index. Generally, the higher the volatility, the riskier the security. By extracting the hidden patterns we can reduce the volatility of stock markets. Thus this project can be used for examining the future socioeconomics.

One of the smart implementation of this project will be making smart artificial trading agent. The artificial agent will be guide us about when to buy or sell or hold for gaining more profit. Moreover an automated trading BOTS can save peoples’ time and can guide for smart decisions.

**Conclusion:**

In this chapter we have given a basic introduction of the project. In the next chapter we will discuss about the theoretical concepts and the algorithms related to this project.