# Marist College

## School of Computer Science and Mathematics

### CMPT_496L: Deep Learning w/ Tensor Flow

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# Predicting Stock Prices with News Headlines and CNN

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# Contents

# 1 Abstract

## 1.1 Executive Summary

Quantitative finance has been quite abuzz with the latest developments in Artificial Intelligence and more specifically Deep Learning. To supplement my future career in the financial industry and due to pure curiosity, I would like to propose that my project be my own attempt to predict the seemingly unpredictable currents of the stock market.

Trading stocks on the open market is one of the staples of an investor's experience. While the concept of trying to predict the motion of the stock market accurately is nothing new, and there have certainly been many attempts to do so, with recent development in Machine Learning I believe it would be an interesting approach towards this age old trial. The ability to model and predict an equity's future price, based on the current financial information and news, could be considered the Holy Grail for investors. To use Machine Learning to calculate and predict the performance of a certain company and have that transcribe to usable data for financial advisers and investors would be a great boon, assuming this process takes into account all the relevant factors. Financial balance sheets and various ratios that describe the health of company are the bases of technical analysis that investors undertake to analyze and predict companys future stock prize. Predicting the direction of stock price is particularly important for value investing and with Machine Learning I believe it is possible to expand this particular usage into main stream investing.

# 2  Introduction

## 2.1  Overview of Project

This project aims to put an interesting spin on predictive quantitative finance, by using news headlines and the dates to which they are attributed to predict the stock prices. The crux of this project rests on how global and local events affect the actions of investors and the stability of the overall market, specifically the Down Jones Industrial Average.

One of the events that inspired the creation of the project was the aftermath of the 2016 US Presidential Election. With the results being announced the next day for public distribution, through the major news outlets, the Down Jones Industrial Average (DJIA) experienced a surge in value; however, when looking deeper into the the specific companies that raised the the DJIA a trend was noticed. Companies with closer ties with the Republican party experienced a sharp rise in investment, while their Democratic counterparts experiences a small drop. The connecting thing between these rises and falls lies in the fact that a Republican president had won the office, as opposed to a Democratic one. The implication being that in the wake of a Republican victory, investment in Republican associated companies would be more profitable; assuming that the administration adheres to the trend of giving favor towards companies associated with their respective party. The old saying goes "The pen is mightier than the sword", this projects aims to see if this old adage is true, by finding trends associated with particular words as they appear in the headlines, one might be able to predict the direction that a market will take while said headline is in effect.

Should this project yield applicable results, we may be able to improve our predictive quantitative finance tools by directly interfacing with the new outlets to help determine the direction of markets around the world.

# 3 Background and/or Related Work

This project will be my first entry into the realm of quantitative finance, with my interest in the topic peaked by my previous experience working in the financial industry. In previous semesters, I have taken a machine learning class, which enabled me to have rudimentary experience within this field. However, having a background in finance allows me to understand the factors which could contribute to a shift in market direction. By working through this project I hope to expand my knowledge in both machine learning and finance.

# 4 Methodology

The first step in starting this project was to gather data. The website Kaggle which is a platform for predictive modelling and analytics competitions, contains within it a number of datasets on a plethora of topics. Among these datasets contains ones relating to news headlines and stock prices. The next step was to find one that were relevant to the project (i.e. *all_stocks_5yr.csv* && *Combined_News_DJIA.csv*) and download them. The next step is to massage the data into a format that will be useful for the convolutional neural network that will be used to process the data. Since the datasets were not originally designed to work with one another we must first find within them common points that can be used to coalesce the datasets, in this case "Date".

After all the dates have been formatted to a standardized format and selecting the index that we want to track. The process to parse the data is as follows: run through the date associated with each news headline, and check if there is a matching date within the stock prices dataset. If there is a matching date then store the closing price for that stock in a local variable and write a new entry containing: date, month, day of the week, headline, and closing price to the .csv file, separated by the caret symbol. The caret symbol was chosen for its uncommonality within normal written mediums. The code to do so can be found below

```
# by Dr. Pablo Rivas
# and @Tienza
# (R) 2017
```

```python
import datetime
import pandas as pd

# Index of the company that we want he stock of
index = 'GOOG'

# Date standardization format
dateparse = lambda x: pd.datetime.strptime(x, '%m/%d/%Y')

# Parse stock price
sp = pd.read_csv('all_stocks_5yr.csv', parse_dates = ['Date'], date_pars
stck = sp[sp['Name'] == index]

# Processing for news headlines
nws = pd.read_csv('Combined_News_DJIA.csv', parse_dates = ['Date'], date

# Open the dataset file
text_file = open('formatted_dataset.csv', 'w')

# Insert column titles
text_file.write('Date' + '^')
text_file.write('Month' + '^')
text_file.write('Weekday' + '^')
text_file.write('Headline' + '^')
text_file.write('ClosePriceUSD' + '\n')

for (index, row) in nws.iterrows():
    the_date = row['Date']
    day_of_week = datetime.datetime.strptime(str(the_date), '%Y-%m-%d_%H
    month = datetime.datetime.strptime(str(the_date), '%Y-%m-%d_%H:%M:%S
    stck_by_dt = stck[stck['Date'] == the_date]
    if not stck_by_dt.empty:
        clsprc = stck_by_dt['Close']
```

```python
    # for all top 25 news
        for x in range(25):
            idx = x + 1
            col = 'Top' + str(idx)

            nhl = row[col]
            nhl = nhl.replace('\n', '')
            # Write the data
            text_file.write(str(the_date) + '^')
            text_file.write(month + '^')
            text_file.write(day_of_week + '^')
            text_file.write(''.join(list(nhl)) + '^')
            text_file.write(str(list(clsprc)[0]) + '\n')


# Close the dataset file
text_file.close()

print('Finished Processing Data!')
```

The next step is to transform the news headline into the a format that is useful to the convulutional neural network. Using the module *gensim* and the function *word2vec* located within we are hoping to transform the headline into a vector which then can be passed onto the CNN for processing.

The deep learning model chosen for particular experiment is a convolutional neural network. A convolutional neural network (CNN, or ConvNet) also known as shift invariant or space invariant artificial neural networks (SIANN), is a class of feed-forward, deep artificial neural networks that has had multiple successful application within the area of analyzing visual imagery. CNNs use a variation of multilayer perceptrons designed to require minimal preprocessing and are known for their shared-weights architecture and translation invariance characteristics.

# 5 Experiments

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Sed commodo posuere pede. Mauris ut est. Ut quis purus. Sed ac odio. Sed vehicula hendrerit sem. Duis non odio. Morbi ut dui. Sed

Figure 1: Fish

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# 6 Discussion and/or Analysis

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Figure 2: Fish

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Figure 3: Fish

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# 8 Conclusion

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