Portfolio Playground

CPSC 437/537

Chris Harshaw
Daniel Keller
Felipe Pires

December 3, 2016

Motivation

We've **all** wanted to trade stocks

Motivation

We've **all** wanted to trade stocks

Motivation

We've **all** wanted to trade stocks

...but are afraid to lose large amounts of money

Motivation

Solution: *Paper Trading* - simulated trading to practice buying and selling securities without actual money being involved.

Motivation

Solution: *Paper Trading* - simulated trading to practice buying and selling securities without actual money being involved.

Enter **Portfolio Playground**, the premier paper-trading web application developed at Yale University!

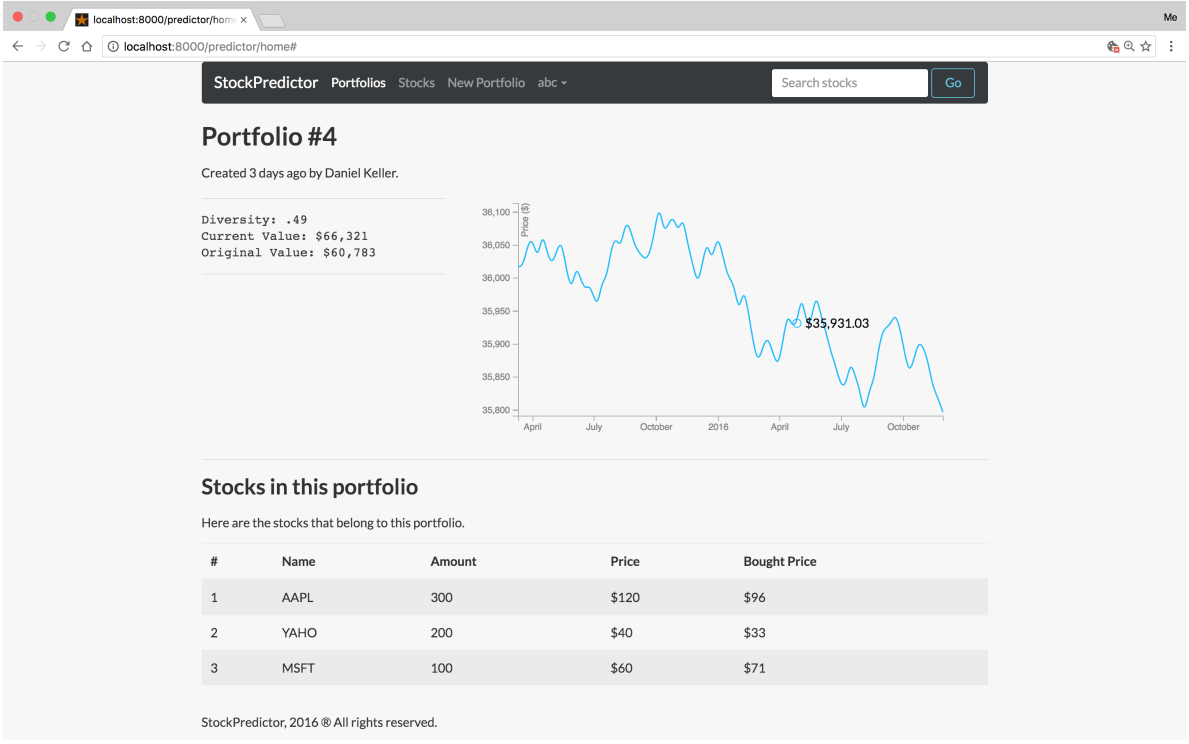
Outline

Main Functionality

Portfolio Playground is a paper trading web-application with three main functionalities

- Portfolio creation and analysis
- Portfolio comparison
- Portfolio recommendation

Main Functionality - Creation and Analysis



Our portfolio creation supports a variety of features including

- Stocks pulled from over 37,000 US equities and mutual funds
- Large amounts of historical stock price data (1970s-2016)
- User inputs include number of shares purchased, portfolio creation date

Main Functionality - Creation and Analysis

Suppose we have a portfolio P consisting of stocks $P = \{s_1 \dots s_N\}$, where x_i is the number of shares of stock s_i, D_i is the dividends for stock s_i, and P_i^t is the price of a single share of stock s_i at time t. Then we can define,

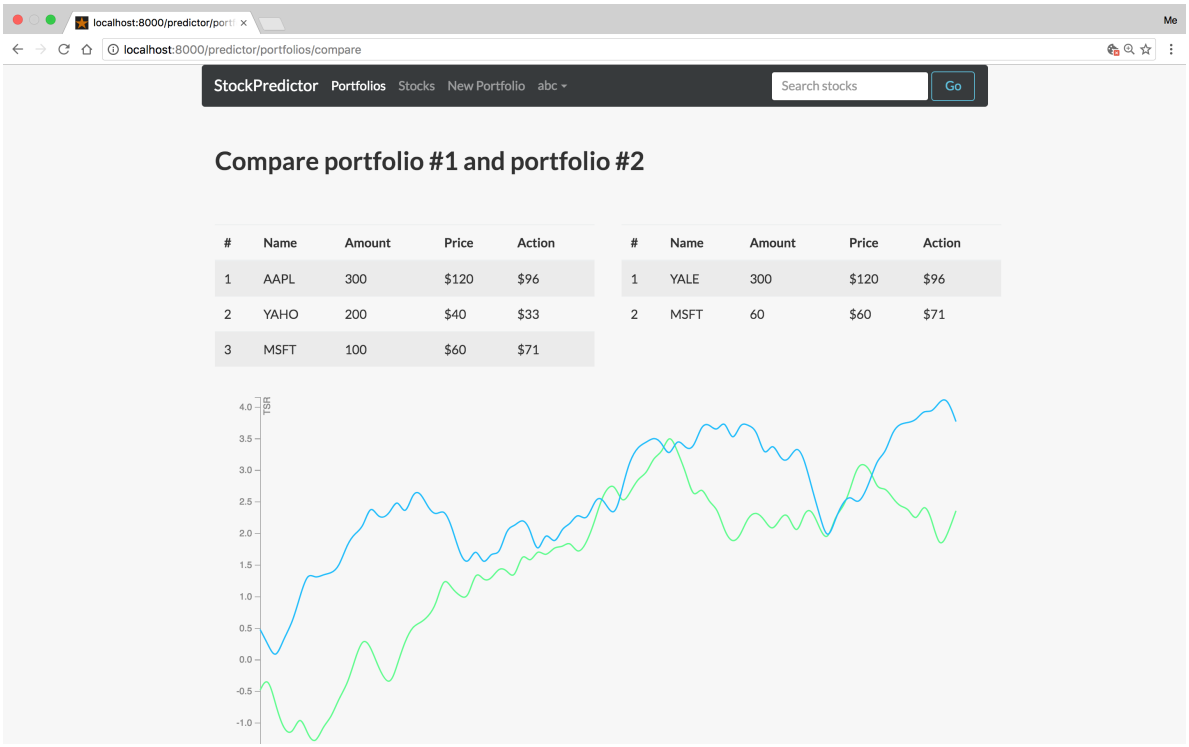
Total Stock Return - (Weighted Percent Increase)

$$TSR = \sum_{i=1}^{N} x_i \left(\frac{P_i^{t_f} - P_i^{t_0} + D_i}{P_i^{t_0}} \right)$$

Diversity - (Weighted Correlation Coefficients)

$$Div = 1 - \frac{1}{Z} \sum_{i<j}^{N} x_i x_j Cor(P_i, P_j) \in [0, 1]$$

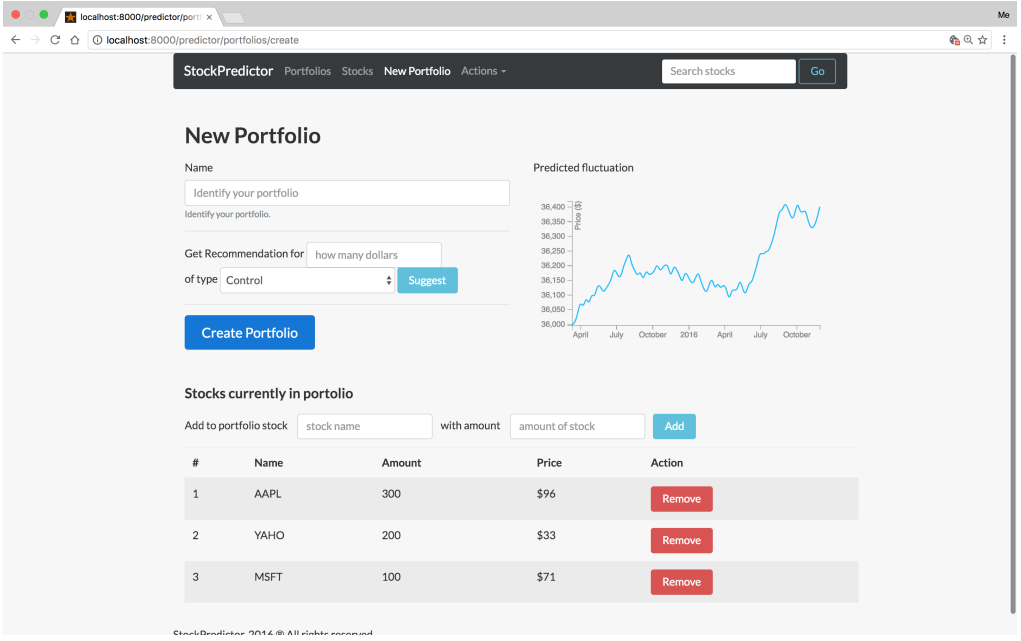
Main Functionality - Comparison



Our portfolio comparison supports a variety of features including

- Stock price, total stock return, and diversity comparisons
- Aesthetically pleasing visualizations

Main Functionality - Recommendation



The most unique feature of Portfolio Playground is its state-of-the-art recommendation algorithms. The algorithms used are

- Random
- Highest Return
- Diverse Options

Recommender Algorithms - Random

The Random algorithm recommends a random portfolio under a total budget constraint.

Highest Return

1. Initialize portfolio $P = \emptyset$. Until budget constraints active,
   1. $P \leftarrow P+$ random stock, random number of shares (under budget constraint)

Recommender Algorithms - Random

The Random algorithm recommends a random portfolio under a total budget constraint.

Highest Return

1. Initialize portfolio $P = \emptyset$. Until budget constraints active,
   1. $P \leftarrow P+$ random stock, random number of shares (under budget constraint)

This can be used as a "control portfolio" and can also test the Efficient Market Hypothesis!

Recommender Algorithms - Highest Return

The Highest Return algorithm recommends an optimal forecasted portfolio under budget constraints such as total portfolio budget and maximum investment per stock.

Highest Return

1. Fit a Vector Autoregression Model to historical stock data
2. Forecast the stock prices d days away
3. Initialize portfolio $P = \emptyset$. Until budget constraints active,
    1. $P \leftarrow P+$ stock that maximizes TSR

Recommender Algorithms - Diverse Options

The Diverse Options algorithm recommends an optimal portfolio under budget constraints and *diversity* or *correlation* constraints.

Diverse Options

1. Fit a Vector Autoregression Model to historical stock data
2. Forecast the stock prices d days away
3. Initialize portfolio $P = \emptyset$. Until budget constraints active,
   1. $A = \{s | corr(s, x) < \sigma \ \forall \ x \in P\}$ (options diverse from P)
   2. $P \leftarrow P+$ stock from A that maximizes TSR

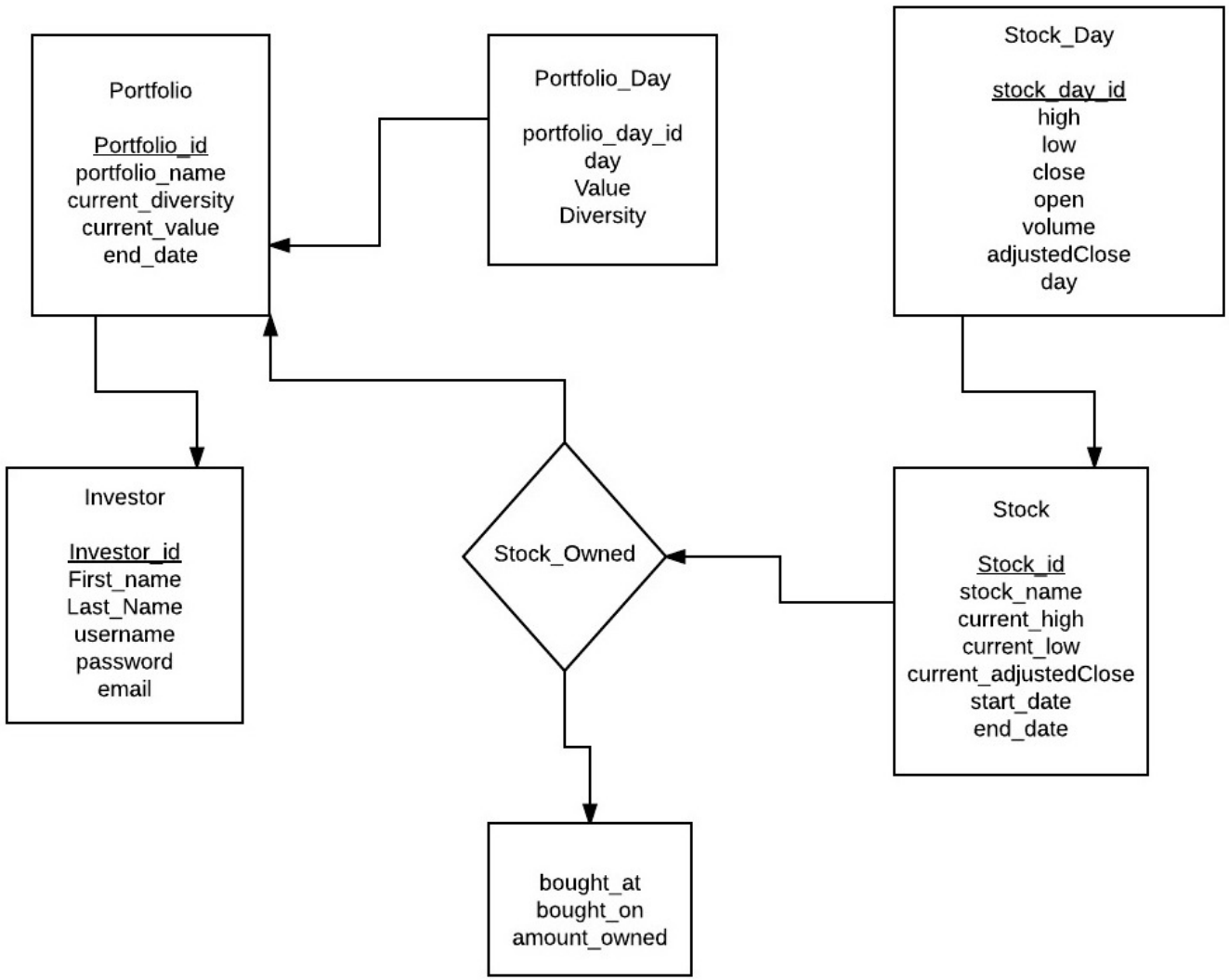
Database Design

What need to store

- user information
- portfolio information
- historical stock information

We are using Django DB and calling Tiingo API.

Database Design



Front End Design

What are the design decisions?

Front End Design

The front end tools we used were

- `react.js`
- `D3.js`
- `guilp.js`
- `bootstrap`

Questions

Questions?