Hyperportfolio: A Stock Portfolio Management Application

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Abstract

The fast-moving world of investment has seen a welcoming spot for technology to accompany and manipulate multiple facets of the industry. In the modern age, it is a necessity to approach investment and management of portfolios with a technological accompaniment to surpass the best of what manual methods can accomplish, making both the stock trading and financial technology spaces as the fast-moving, trending, and opportunistic areas they currently exist as. This report describes the pursuits of team MUJEOK CODERZ within the realm of fintech development, namely the construction of a stock portfolio management application that addresses both core functionalities and also pushes beyond this with novel features, as a major project for the University of New South Wales' capstone computer science project (course code COMP[39]900). This process is discussed in detail with an exploration of necessary tools and libraries to accomplish this and their utilisation in a unique and pressured timeline and resource space. Produced features (core and novel) and their initial use cases are listed with a discussion of following involved problems that arose during development and integration, and governing design considerations. A reflection is given to conclude the report regarding ideal improvements to the system given more time and resources. These points of discussion provide a holistic exploration of the development and design considerations surrounding a general fintech categorised system and allows observation into its pursuit within a university project scope.

Contents

1. Introduction

1.1 Existing Systems / Drawbacks

There exist numerous systems within the space of stock portfolio management, a few of which were discussed initially by the team when considering areas of focus for the system being developed. These may be revisited and better now compared against the finished product.

Initially the system was created with core requirements being extracted from core functionalities of "Yahoo! Finance", a property of web service provider Yahoo!'s network. It first launched in 1997,

and has since evolved into a finance platform that on top of core functionalities, has included further features including press releases and financial reports.

Yahoo! Finance offers these strengths as well as further features, such as interactive charts, user customisation, news highlights relevant to stocks, chart drawing, and performance of the ASX2000. However, there are noticeable drawbacks that accompany these, most notably the busy and bloated interface of the platform. Yahoo! has achieved its prominence and monetary platform largely through advertisement, which is a notable accompaniment at each page of the platform. Screen real estate is consumed with remaining space seeing relevant information squashes into it, resulting in a UI that can be intimidating for inexperienced users along with a slow loading time for experienced users needing a faster and more responsive experience.

Further larger entities also exist such as a Google based platform, as well as numerous small and medium sized companies, and startups with the Fintech market a hot spot in recent years. These have also expanded to mobile platforms for a more fluid experience. A notable smaller platform that were previously cited as a reference is Delta, a newer platform with a more modern approach. It has strengths in offering numerous kinds of charts, a smooth interface, and easy transfer from mobile to desktop. However, drawbacks were identified in a non-intuitive UI, incompatible mobile to desktop interfacing, no open-high-low-close charts, and a distinct lack of informative on the platform itself, which makes it difficult to use it as a standalone resource.

The drawbacks from these and other similar systems were identified and addressed in numerous components of the system the team proposed. Many powerful finance platforms, e.g. Yahoo!, hold the necessary information density to be used as a standalone platform which modern systems such as Delta often lack. The team proposed portfolio analyses and detailed company information to step further ahead in this direction. Alongside this, while modern platforms like delta are focusing on user-friendliness through UI/UX more, powerful and information dense platforms like Google Finance and Yahoo! Finance are often crowded by advertisements or inability to display information in a digestible manner. The team decided this needed to have significant focus as the interface is often what can make or break a platform for the user. Most platforms will often offer the same core functionality, but what makes them unique is the holistic experience given to the user, which requires a great deal of focus to be placed on the interface. Furthermore, some focus on extra chatting features and addition of news-feeds, to attract both charting and systematic focused investors. It is usually only the blockchain-centred portfolio applications which emphasise a fluid mobile experience that elevates most platforms to be more diverse and flexible for user needs.

1.2 Aim

Problem Statement

Team MUJEOK CODERZ within the COMP[39]900 group has undertaken the pursuit of developing a stock portfolio management application that includes the core functionality of a financial platform, such as Yahoo! Finance, while exploring a range of additional novelty features within a compact timeline and limited resources. This product will aim to serve as a diverse and general platform that is inviting to investors of numerous backgrounds with an engaging user experience. It pursues the introduction of a more modern and approachable system to a seemingly complex and intricate area of interest, from which a user can access, register, and begin building their portfolio with an informed approach within a matter of a minutes.

Aim/Purpose

The aim of this project, as supplemented in our given specification is *"to construct a rather traditional application -a stock portfolio management system for financial investment."* By the end of the project,

a flexible and lightweight stock portfolio management application will have been built to simulate core functionalities of larger financial platforms with the introduction of further novel features, for the primary benefit of investors and user less experienced wishing to use a fluid platform with digestible and succinct information. The use of external tools and libraries should be utilised to make use of existing solutions as well as a live data feed.

Scope

The scope of the project was strictly governed by a short 8-week development timeline with consistent milestones structured to measure progress of the overall project. This also required accompanying documentation and pitching to satisfy its full completeness.

2 Background

To properly articulate the context of the project, the common terms, the user base, and the overall problem scope are defined in objective terms to diffuse ambiguity between development, and the client (the given specification).

A stock portfolio is a grouping of an investor's stocks held by the investor and/or managed by financial professionals and money managers. It is also given in the specification (our client), a stock portfolio management system is a platform on which one can construct, view, and alter their portfolio and gain information about their portfolio performance, stock trends, and various news and information which could affect these trends.

The problem domain governing the system is largely comprised of the user base which the system will address, explicit requirements needed by the system and its use, the technologies employed to address this, and any intermediate steps and hurdles surrounding these two prominent facets. Core functionalities were initially outline in the client specification, specifically referring to the creation of a portfolio, addition and deletion of a stock within a portfolio, and refreshing/synchronisation of stocks within the current prices. On top of this, innovative and novelty features were requested by which the platform would be able to deliver beyond these core functionalities. The team's addressing of this is further discussed throughout the report, including said features and accompanying development features that were also introduced into the problem scope as a result of being able to address these effectively.

The user base for the system can also be considered as the "stakeholders". The use of the system is strictly defined by the user needs from it. While core functionalities have been specified, these manifest in practicality when walking through use cases for the system (which are used to tangible define the performance of the system at a more microscopic level). Most stock portfolio management systems exist with the primary target being investors, defined as "a person or organisation that puts money into financial schemes, property, etc. with the expectation of achieving a profit.". Different platforms and features are suited to different types of investors, and the proposed functionality discussed attempts to broaden the user base to attract two major types of investors (those using charts, and those using non visual analysis and company announcements).

2.1 Usage Scenario / Domain

The usage domain of this system relies on the proposed features the team has suggested. On top of core functionality, there are novel features that will be implemented that will largely centre around analysis and User-Interaction/User-Experience (UI/UX). The identified users of the system are largely comprised of consumer investors. An investor is specified as a person or organisation that puts money into financial schemes, property, etc. with the expectation of achieving a profit. It is our

intention that the intended audience of this application is not organisations but, rather, consumer investors, i.e. those that are not professional share traders like investment firms, money fund managers etc. Auxiliary users to this primary user base would not comprise enough of the dedicated user base to be significantly considered when making design choices, and stock portfolio management systems exist for very specialised purposes that are often of difficult access in terms of a learning curve to inexperienced participants.

A simple usage of the proposed system would be an investor choosing to track stocks of interest. The proposed system should have the functionality to allow the investor to find the proposed stock through some sort of search functionality, mark the stock to indicate the desire to be notified about significant changes in price or related behaviour, and be able to receive notifications or observe this in a centralised location.

A simple use like this is largely encompassed in the domain of Portfolio Management for Consumer Investors – which overlooks the entire system. On top of the discussed example, numerous use cases and sub-domains are tangibly explored the more further features and their use cases are explored. The above is the general premise and approach by which we begin to explore these and will continue to discuss these examples further into the report.

2.2 System Architecture

To be able to develop the system to the extent intended, numerous third party libraries, tools, and services were utilised to be able to increase the diversity of the system and efficacy of the development cycle all within a compact time-frame.

Major Technologies

Nginx (Reverse Proxy)

Nginx is used used in this application as a reverse-proxy. It redirects requests to `hyperportfol.io/api` to the Django server, and any other requests beginning with `hyperporfol.io` to a Single Page Application (SPA) compiled from a React Application. Additionally it adds some headers for security, and instructions on caching for the browser and Amazon Cloudfront.

Licence: 2-clause BSD

React (Client)

The React JavaScript framework was chosen for building the user interface for this application. It was selected for its popularity, performance, and abundance of libraries and documentation. Our approach was to compile the front-end to a single-page application (SPA), which would be served by Nginx. The SPA is a hydrated client-side, with all API requests directed to the Django application which makes the requests on the clients behalf. This is to ensure that the API keys are kept secure server side instead of being used in the client, potentially exposing it.

A significant portion of the application's logic is performed client-side. Though calculating stock and portfolio metrics client-side causes some small decreases in speed; it allows us to perform precise

calculation against multiple levels of data, as well as conditional logic against data returned, leaving the database to do the heavy lifting like summarising large volumes of transactions.

Licence: MIT

Django/Gunicorn (Server)

The back-end developed, in the Django framework will be served by Gunicorn, a Python WSGI HTTP Server. Django is used somewhat non-traditionally as a REST API server.

Gunicorn was chosen due to its ability to handle load. This is due to its ability to parallelize processes through creating multiple workers, and its optimisation for speed. One drawback is it's poor ability to serve static files, however a separate server can be used to serve this purpose [7]. As our static files were compiled from a React Application and hosted by Nginx, this was of no issue.

Licence: 3-Clause BSD

PostgreSQL

For our database we chose PostgreSQL. Locally this was just run inside of a docker container for our server to connect to, but the live deployment made use of Amazons Relational Database Service (Amazon RDS). The database was mostly handled through a Django object-relational mapping (ORM); though there were some manual creation of Schemas etc as can be seen in the Code Structure below.

Licence: PostgreSQL License (Free and Opensource)

Other Technologies

RapidAPI Yahoo Finance API

For our primary data source, we used the RapidAPI Yahoo Finance API delivered by API Dojo, which delivers the same data as that found on the Yahoo Finance API. This is not officially Yahoo's API but the data is the same as Yahoo Finance's. The API allows us to not only retrieve current stock prices for specific instruments, but also facilitates search, charting and news data. The data source was originally Alpha Vantage but due to difficulties as discussed in the technical challenges section, we migrated over to this API.

License: Commercial (Subscription 50,000 API calls per month, $0.0006 per excess call)

Cypress

Used for automated end-to-end testing (e2e), cypress would perform a series of actions to emulate a user navigating our application. This helped ensure that functionality was not broken during development. For a demonstration see the DevOps video in the media section of the appendix.

Licence: GNU GPL

Docker & Docker-Compose

Docker was used for *containerising* our application, so that it was easier to develop on multiple systems, reducing issues of differing versioning and packages. It also enabled us to make use of Travis CI/CD (Continuous Integration, Continuous Development) for automated testing (with our e2e tests) and automated deployment. Previously we had intended to use Jenkins but opted for Travis due to the fact that it was already a hosted service and required minimal setup as opposed to installing, configuring and deploying Jenkins ourselves.

Licence: Apache 2.0

Travis-CI

Travis-CI was used to run our Cypress tests and deployment automatically whenever a change was made to the master branch of our github repo. If tests passed, it would be reflected as a build status on github and AWS would be prompted to roll out an update of the more recent version of the application. If the tests failed, a video of the failure would be recorded on `cypress.io` and an email would be sent out. See either the Videos at the bottom of the README.me or in the appendix of this document for a demonstration of this process.

Licence: MIT

Mixed Amazon Web Services

The **Amazon Web Services** used to deploy this application to the web were:

- **Elastic Beanstalk**: Hosting of the application servers on Elastic Cloud Compute (EC2) instances.
- **RDS**: A Relational Database Service running PostgreSQL.
- **Route53**: Domain name registration.
- **Cloudfront**: Reduces load times through caching static content on a Content Delivery Network (CDN).
- **Certificate Manager**: HTTPS Certificate acquisition.
- **Virtual Private Cloud (VPC) & Security Group**: Kept exposed ports strictly within a virtual network so that Docker Containers could interact with each other, without being able to be accessed from the internet (With the exception of port 80 on the nginx server.

Combined these services ensure *powerful* scalability, performance, load-times, and availability.

Licence: Amazon Software Licence (Paid, but with some Free Tier)

Licences

For major packages listed above; all are free and open-source (FOSS) with the exception of AWS and RapidAPI. RapidAPI was paid for this project, as our API calls overwhelmingly exceeded the free tier of AlphaVantage; and their next tier would have been out of budget. AWS cost a small amount for domain registration, and a Cloudfront, but the elastic beanstalk is within the free tier.

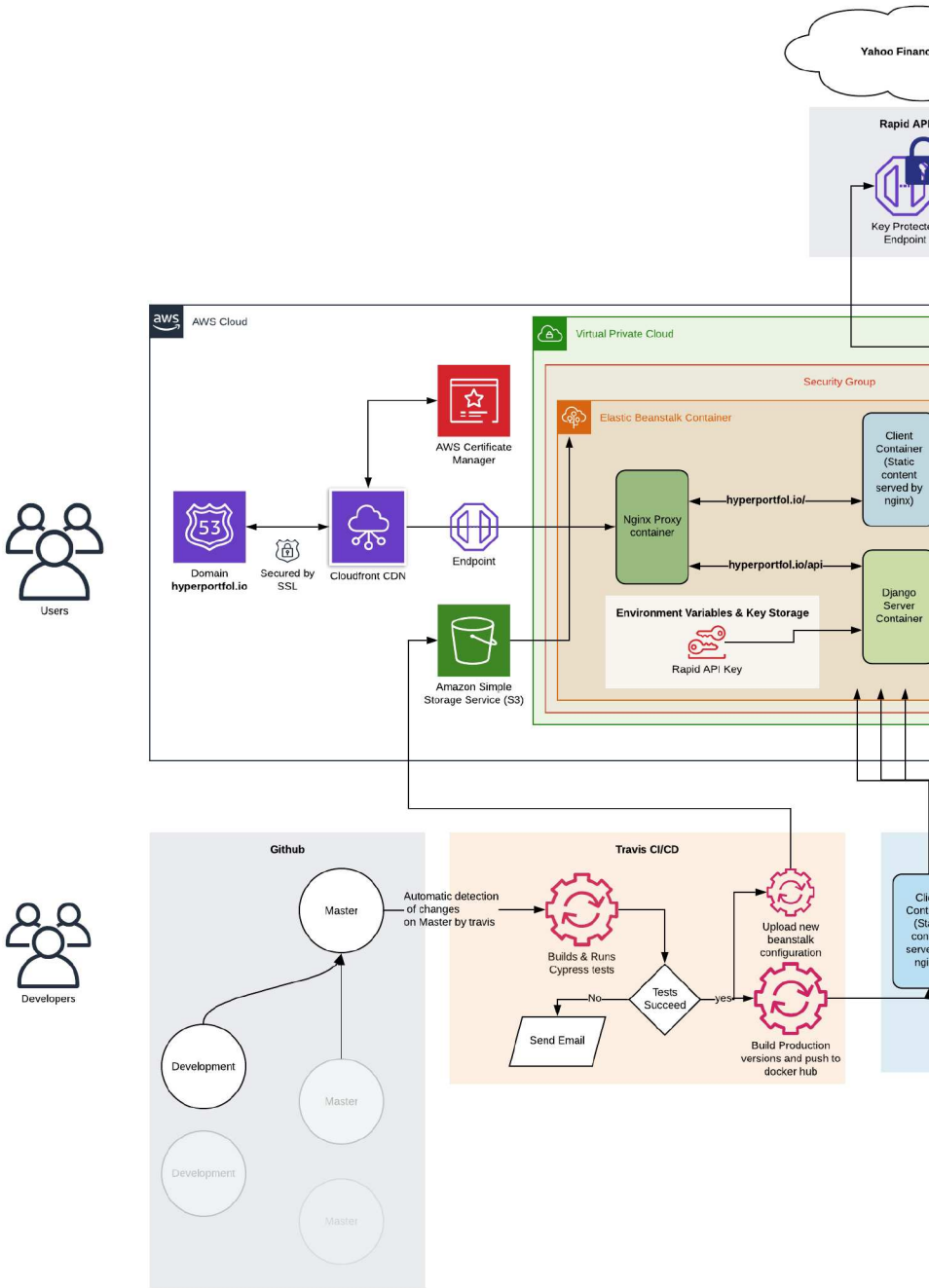
The Highcharts package was also a payed product, used within its free-tier, which included brand watermarks.

Overall this means that this project is under no risk of breaching any licenses. Where non FOSS technologies have been used, they have been payed for according to their plan, and the design of our system has been with these services and their scalability at higher price ranges in mind.

A summary of licences for smaller packages can be found in the appendix.

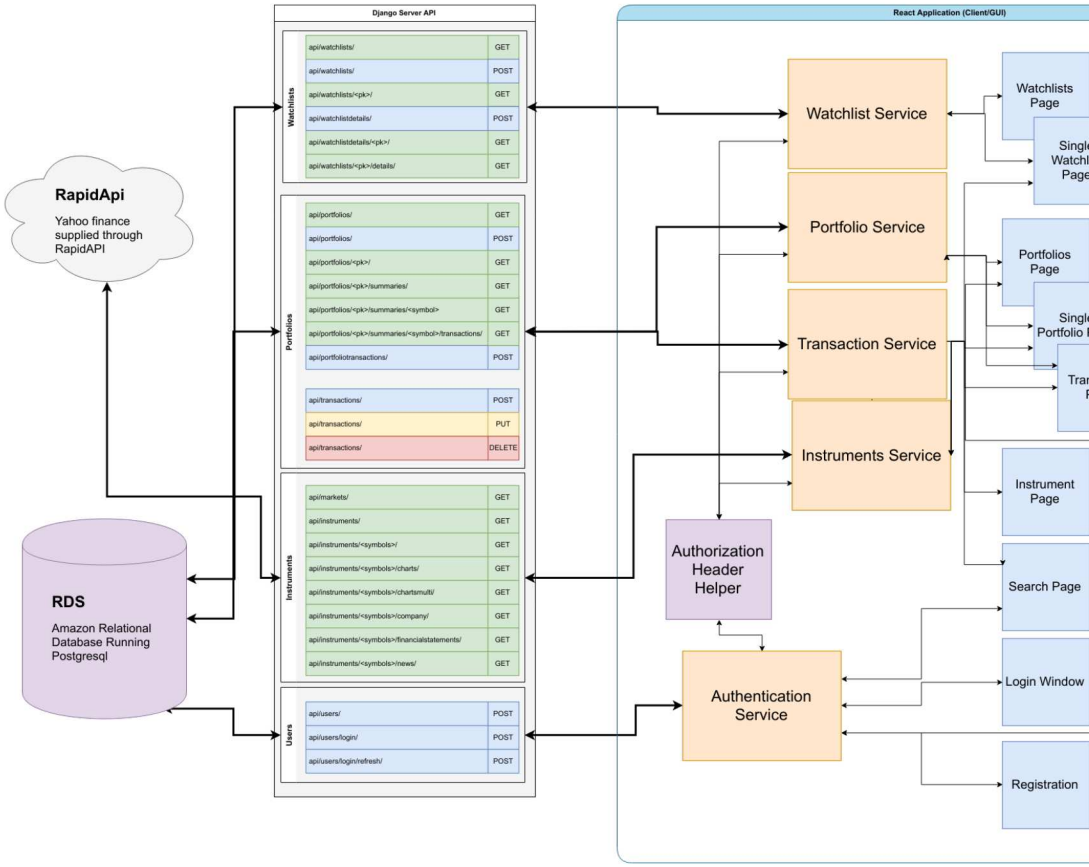
System Architecture Diagram

A system architecture diagram has been produced to depict a holistic view of the system and its technologies, and how said technologies both fit into each other and are used within a broader pipeline to achieve desired functionalities.



The Deployment Architecture

The function of all technologies in this diagram can be found under the **Major Technologies** and **Other Technologies** earlier in Section 2.2.

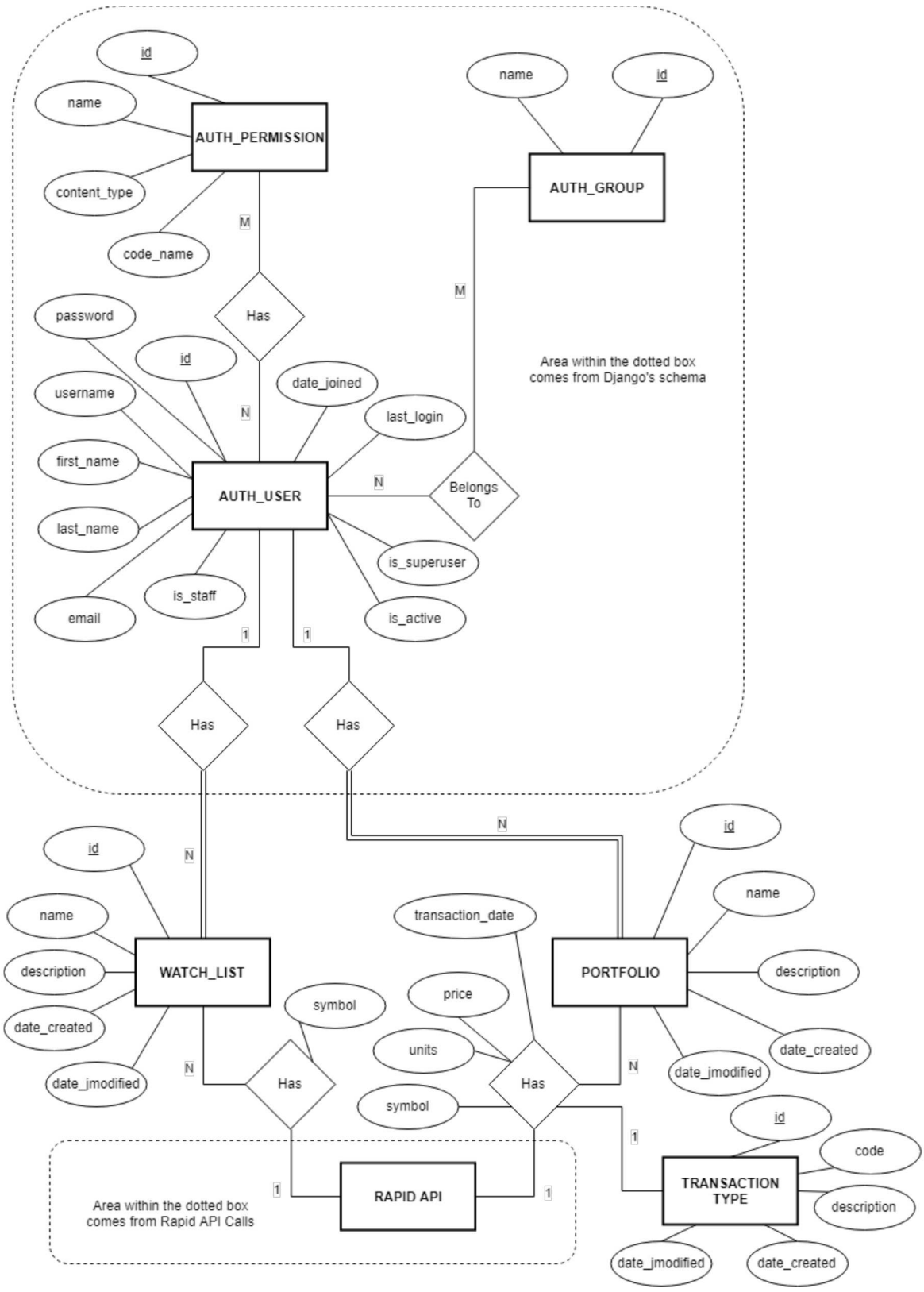


Client Server Diagram

The role of the `.jsx` React Components, such as the Login Window, can be found described in more detail in section 3.

2.2 ER Diagram

An ER diagram has been produced to articulate the relationships between the data fields utilised within the system and their relevant interactivity with each other to enable to desired functionality.


id
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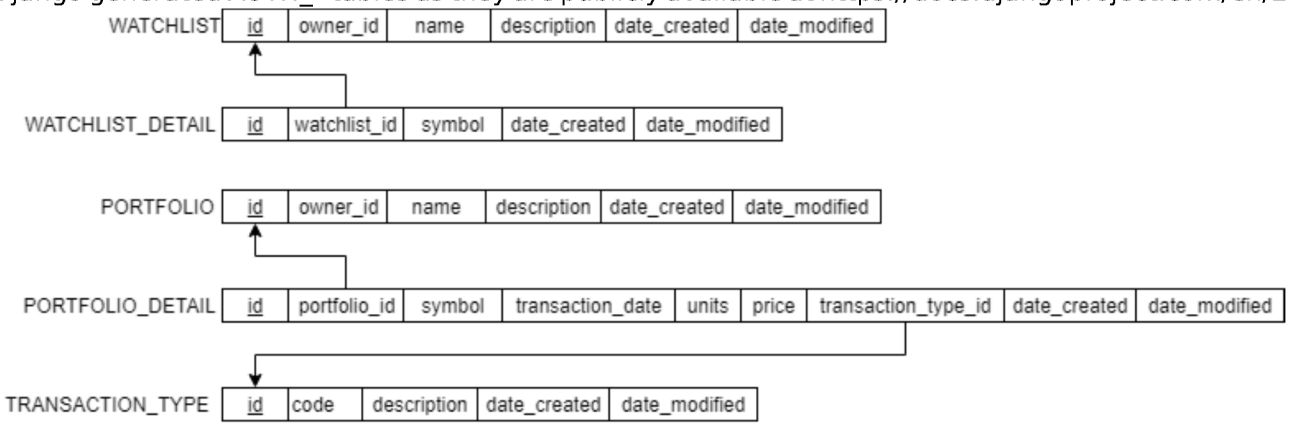
code
TRANSACTION TYPE
description
date_jmodified
date_created

The following Relational Data Model is derived from the ER diagram. NOTE: We did not include the Django generated AUTH_* tables as they are publicly available at https://docs.djangoproject.com/en/2.2/ref/contr



NOTE: owner in WATCHLIST and PORTFOLIO are foreign keys to AUTH_USER which is a django table and hence it is not listed here (https://docs.djangoproject.com/en/2.2/ref/contrib/auth/)

3. Contributions (Epics)

This section first analyses Hyperportfol.io against the project proposal's user stories and then, demonstrates the functionalities of the final product. The epics which were selected to be **out-of-scope** are not included.

Original User Stories	Implementation Status
As a user, I want to securely log into my account to access my portfolio and watchlists.	Implemented
As a user, I want to make an account to make a portfolio and access the site.	Implemented
As a user, I want to be able to log out at any time to keep my portfolio secure.	Implemented
As a user, I want to be able to delete my account securely.	De-prioritized

Original User Stories	Implementation Status
As a investor, I want to create portfolio/s to keep track of the stocks I own.	Implemented
As an investor, I want to measure and view the performance of my portfolio to inform future investment decisions.	Implemented
As an investor, I want to be able to buy or sell stocks and update the portfolio.	Implemented

Original User Stories	Implementation Status
As an investor I want to be able to track when purchases were made so that I can know if certain stocks are under capital gains tax	Implemented

| Original User Stories| Implementation Status | | - | - | | As a user, I want to add instruments to the watchlist to follow their performance. | Implemented | | As a user, I want to be able to delete instruments on my watchlist to only keep the instruments of which I am currently interested. | Implemented |

Original User Stories	Implementation Status
As a user, I want to search a specific instrument to add to my portfolio or watchlist.	Implemented
As a user, I want to view individual stocks page to gain a deeper understanding about the company as well as to view their announcements.	Implemented

- Description of your component
- clearly describe the input and output of the component
- how does your component work after receiving the input
- how does your component produce the output
- example case: example input/output, **SCREEN DUMPS**
- Linking the component with the source code explanation of appendix (to be done after code commenting...)

Core Functionalities

Core functionalities of the system are those which need to be completed to first allow it to be identified as a stock portfolio management system, and assumed priority within the development cycle.

3.1 User Management

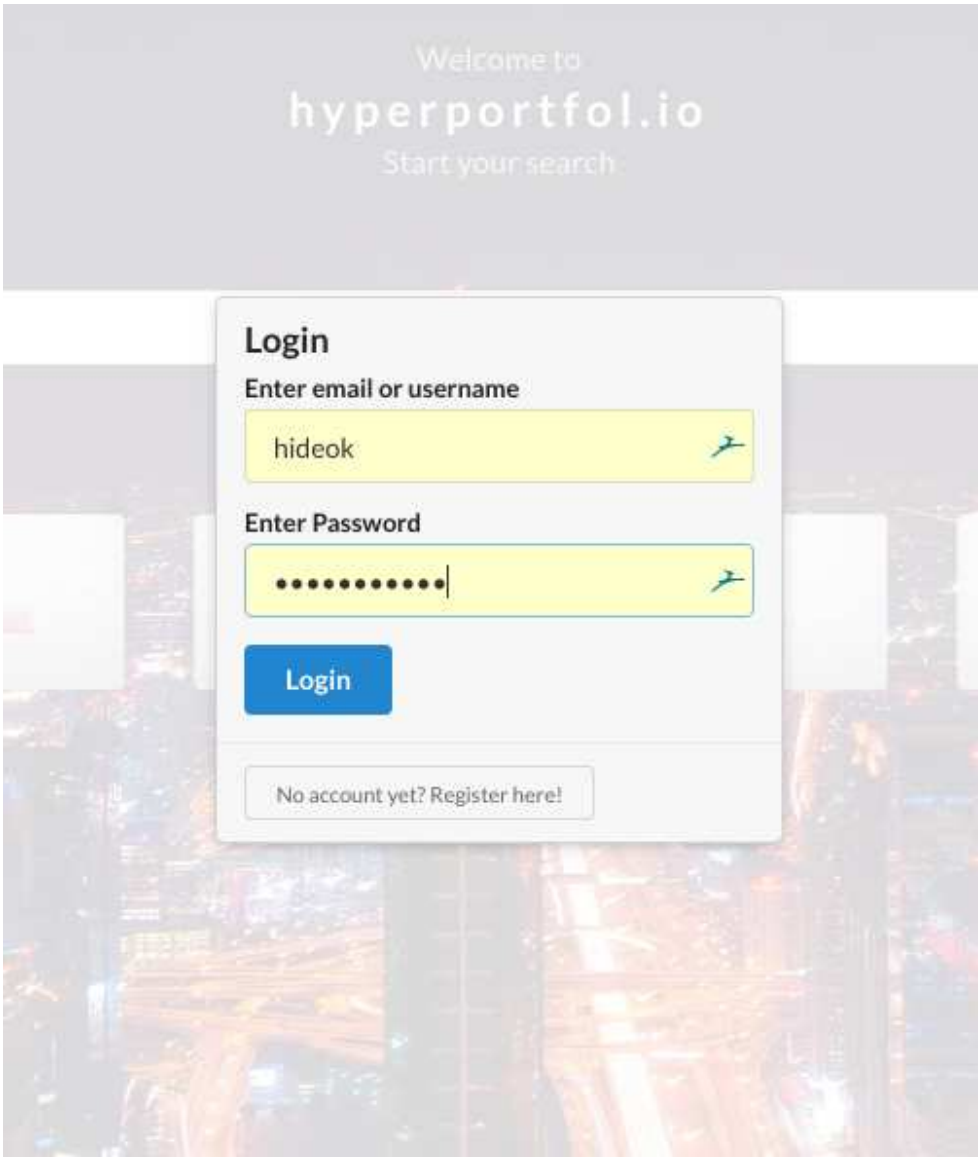
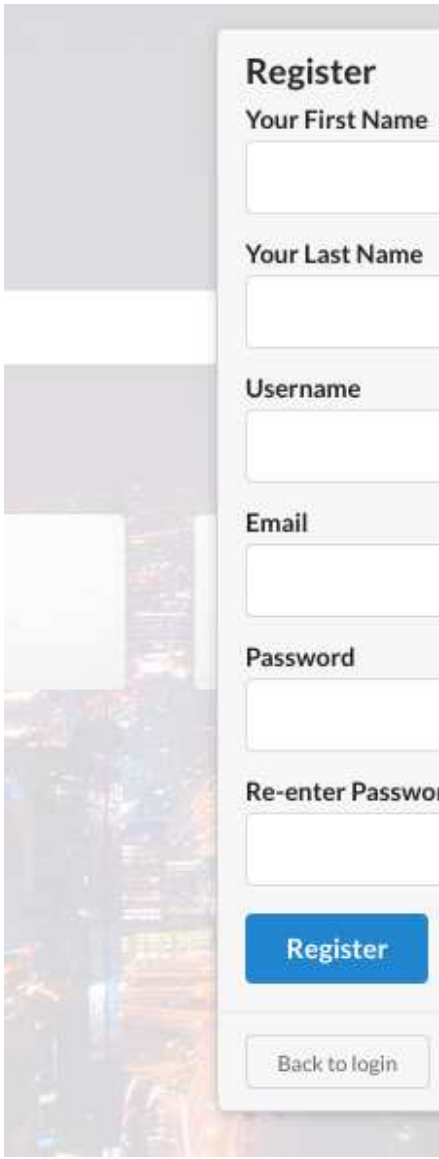
This functionality involves securely handling user's registration, logging in and logging out.

The code for the modal form for logging in is found in `frontend/src/components/pages/users/LoginModal.jsx`. Logging in and authentication depends on functions described in `frontend/src/services/authenticationService.js` in order to communicate with the Django REST API (which uses the jwt_views from the rest_framework_simplejwt module via the endpoint `api/login/`) and aquires a JWT token. The form data is secure when entered over HTTPS, the default for hyperportfol.io, and JWT tokens ensure the desired security after logging in. Future requests to the API are verified by the JWT token. As a user, I want to make an account to make a portfolio and access the site. Similar to logging in there is a modal form, `frontend/src/components/pages/users/RegisterModal.jsx`. Registering uses the `authenticationService.register` function in the service file described above.

As a user, I want to be able to log out at any time to keep my portfolio secure. Logging out removes current tokens from session service, so it is impossible to resume the existing session and the user must log in again for a new session. The logout button is located on the navbar, found

at `frontend/src/components/navbar/Navbar.jsx`, though the logout function can also be found in the `authenticationService` service mentioned above.

As a user, I want to be able to delete my account securely. Though function was implemented in the authenticationService, account deletion was de-prioritized.

Login Page	Registration Page
	

3.2 Portfolio Management

The basic portfolio functionality consists of portfolio summary, creation/deletion of multiple portfolios, buying/selling stocks and listing the current stocks as well as the history of stock transaction.

The code for the portfolio management can be found in `frontend/src/components/pages/portfolios/`,

for the components, `frontend/src/services/portfolioService.js` for the services for retrieving data from the Django REST API. The code for Django's portfolio endpoints can be found in `app/portfolios/api/` in the files `serializers.py`, `views.py` and `urls.py`.

Once again JWT tokens mean that authentication is secure, and if the page has been visited recently it will continue the existing session.

*To see examples of this, see the **User Guide** under Appendix A; the fourth and fifth images will show portfolio pages.*

Portfolio Summary

3.3 Watchlist Management

The watchlist functionality allows the user to create/delete multiple watchlists, add/delete instruments on the watchlist as well as adding from the search results page.

Input/Output (needs code)

The code for the watchlist management can be found in `frontend/src/components/watchlists/`, for the components, `frontend/src/services/watchlistService.js` for the services for retrieving data from the Django REST API. The code for Django's watchlist endpoints can be found in `app/watchlists/api/` in the files `serializers.py`, `views.py` and `urls.py`.

*To see examples of this, see the **User Guide** under Appendix A; the second and third images will show watchlist pages.*

3.4 View and Search Instruments

Instruments can be searched from most pages, and clicking on instruments will take the user to a page of information, news, and charts about that particular instrument.

Searching Components are stored in the `frontend/src/components/searchbars/` folder., whereas the Components for constructing the instrument viewing page can be found in `frontend/src/components/pages/instrum`

The functions for both viewing instruments and searching for them all fall under `frontend/src/services/instrument`

The Django REST API's endpoints for searches and instruments can be found at `app/instruments/api/` in the files `views.py` and `urls.py`.

*To see examples of this, see the **User Guide** under Appendix A; the last two images will show searching and viewing instruments.*

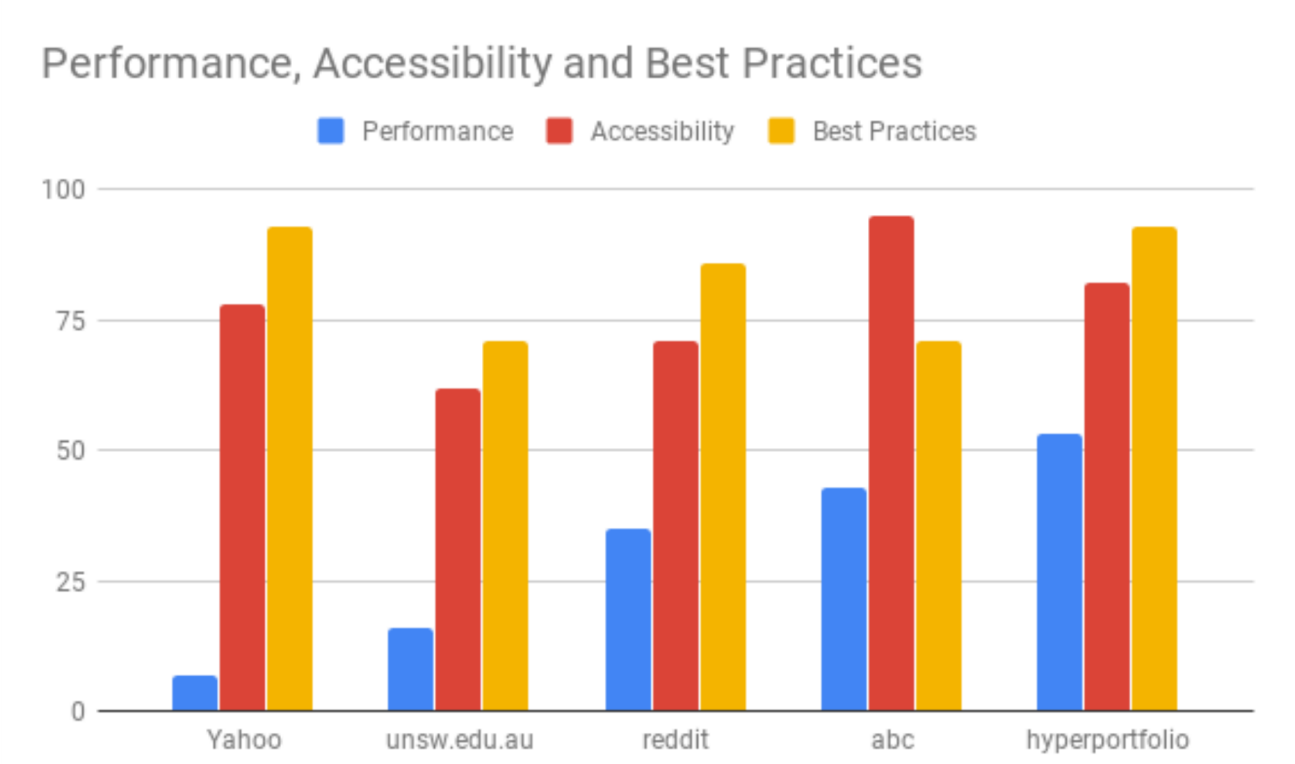
Novelty Features

Novelty features were developed strictly following the completing of core functionalities and served a sa platform to allow the system to extend beyond existing systems and showcase it's uniqueness and what would truly make users choose it over existing platforms.

3.5 Interactive UX/UI

As suggested by the project specification, we attempted to produce a "fantastic UI" in many ways including use of **micro animations**. This is a non-functional feature that significantly improves user experience by providing an immediate feedback to user's movements such as mouse hovering over a button.

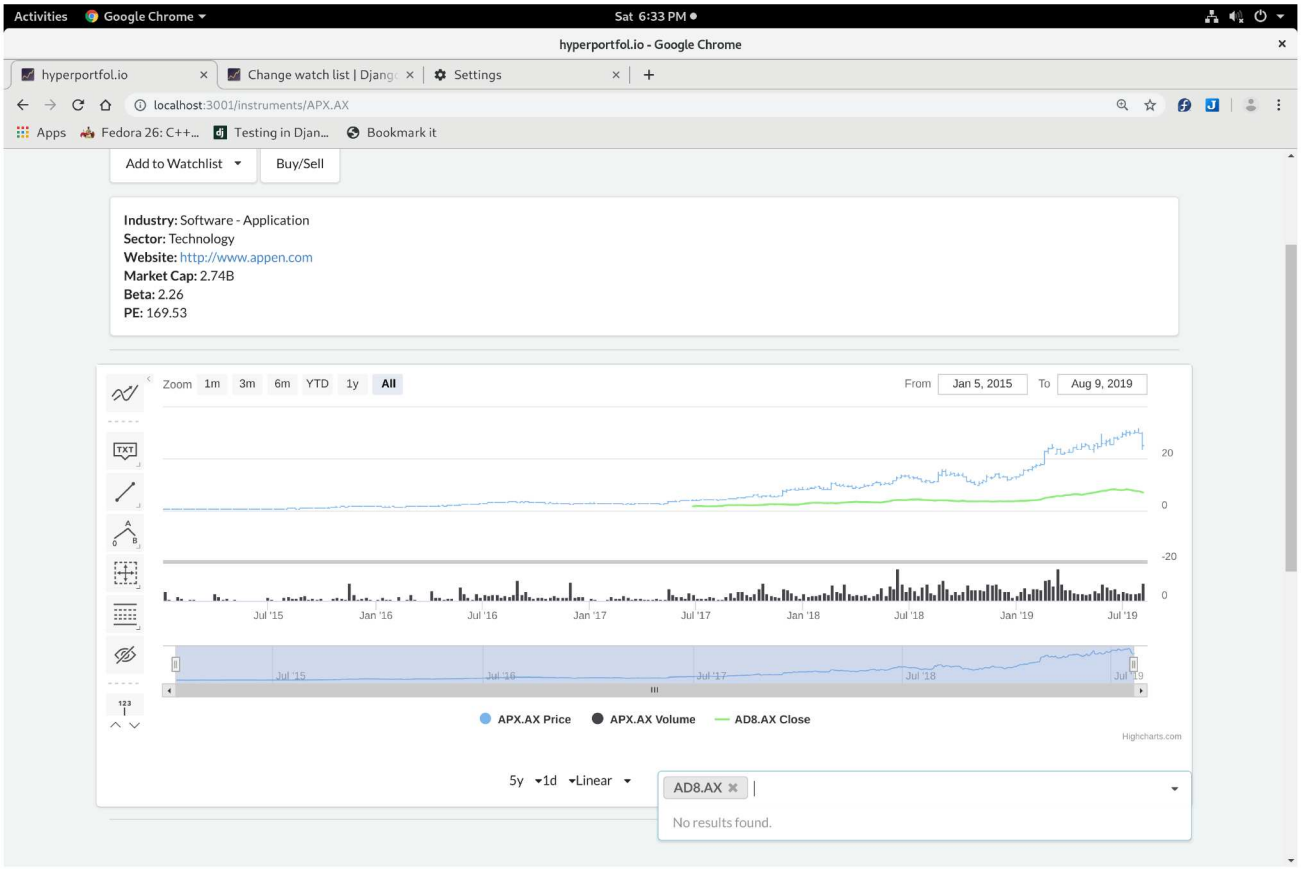
Furthermore, we deployed various “at a glance” features such as sparklines and mini bars on the individual portfolios pages, along with the visual indicators such as colours for gain/loss and +/- indicators as well as presenting the best performing shares on the portfolios page.



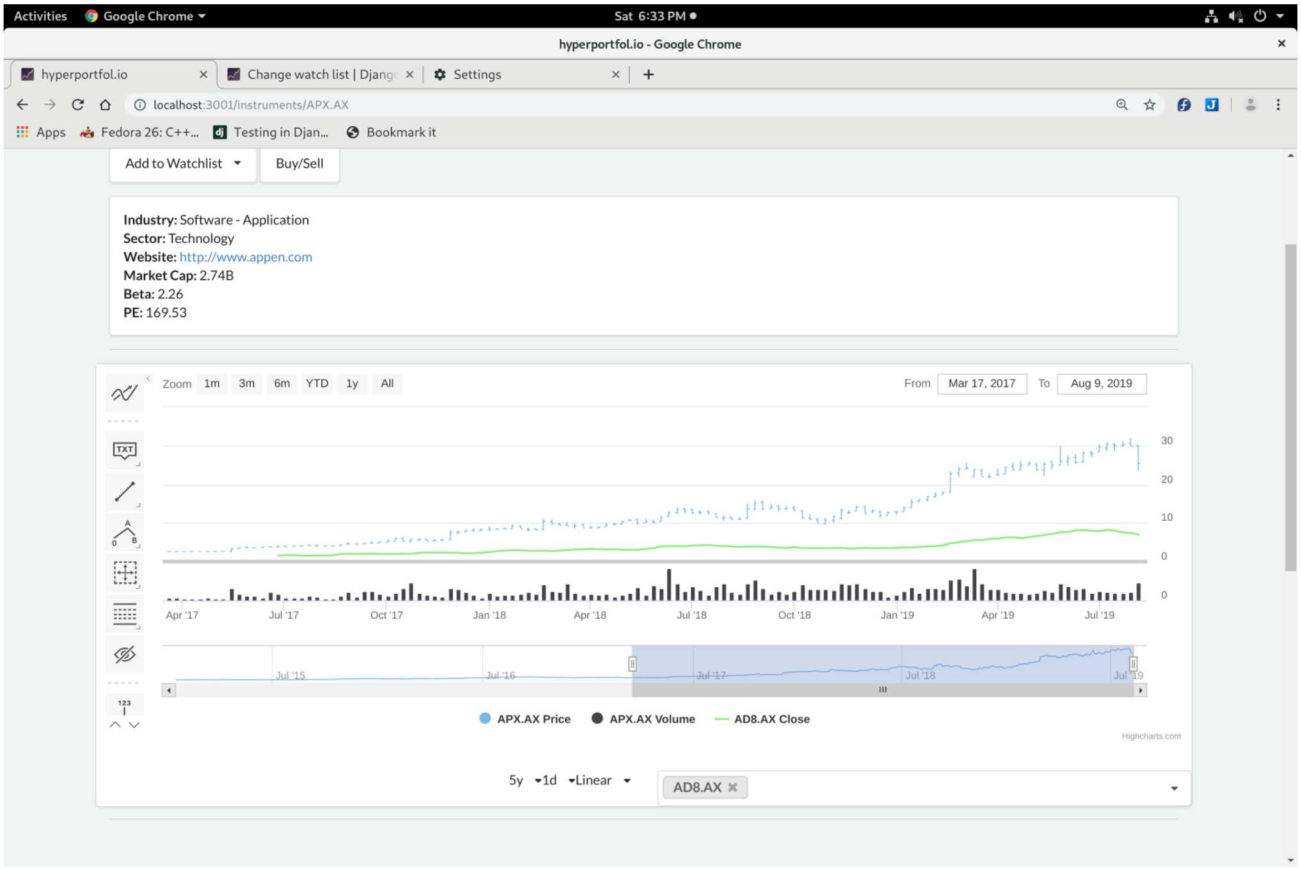
3.6 Charts Analysis

As suggested by the course, we made use of existing libraries and components and with the implementation of the charting on the instruments page, we used a Stockchart component from Highcharts which allows the configuration of a GUI which contains miscellaneous tools for technical analysis, such as applying indicators such as a Simple Moving Averages to Linear Regression. However to further extend this capability, we implemented searches to add dynamically extra series to the charts to allow us to compare different stocks to each other on the chart. However sometimes an ordinal scale is in insufficient when comparing series on a chart so we also implemented a control to switch the chart to a logarithmic scale as logarithmic scales are better at comparing rates of change.

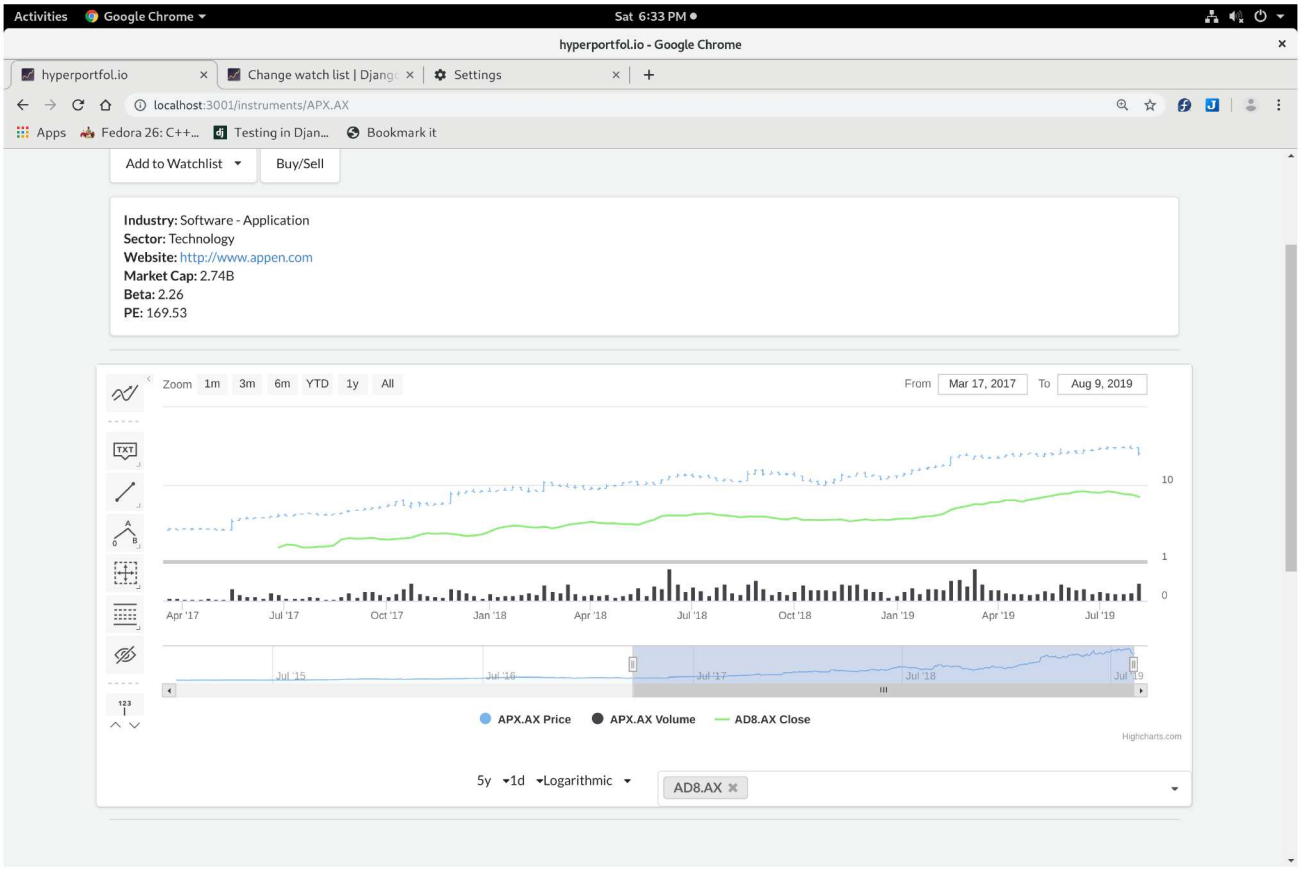
For example, in the instruments pages for APX.AX, we may decide that we want to compare against AD8.AX, so beneath the chart, we enter the code ADX.AX into it and select the result. The series is rendered onto the chart is follows:



We're only really interested in the period where both of the codes have been trading so using the range selector, we restrict the period to roughly the latter half of the chart where they were both trading as seen below:



At a glance, AD8.AX appears to be growing much faster than AD8.AX but when we change the y axis to a logarithmic scale, we see that they are roughly changing at the same rate.



3.7 Related News for Individual Instruments

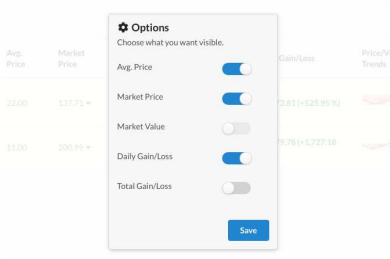
In each instrument page, we show a list of news items related to the instrument as it is helpful at times to see what news relating to the company is available on the internet. Using the RapidAPI endpoint we are able to get news feeds onto the page for reference.

However, compared to Yahoo finance which gives a lot of prominence to the news compared to the graph, we feel that the graph is more important and so we have reversed the emphases as news is at best speculative.

hyperportfol.io	Yahoo Finance
	

3.8 UI Customisation

Portfolio and watchlist pages can be customised to show selected information, assisting users to quickly find what they need within a mass of data.



3.9 Analysis and Reports

As shown under Charts analysis, the system allows us to do some technical analysis using charts under each instrument page. Reports can be generated using the report button on an individual portfolio page; see the User Guide in the Appendix for an example.

4. Implementation Challenges

Moving from AlphaVantage to RapidAPI (Then further yahoo issues)

Alpha Vantage's free API key had an incredibly low limit on API calls; up to 5 API requests per minute and 500 requests per day (Alpha Vantage, 2019). This limit was further exasperated by the fact that all of Alpha Vantage's end points only requested one symbol at a time, so implementing search was impractical. As a result we opted to move across to RapidAPI's Yahoo finance API. This service provided a greater number of calls and no limit per minute, along with an end point for searching, as well as the ability to get quotes for multiple instruments, at the cost of both slightly worse speeds and a higher error rate. However, even though we now had a lot more available calls, especially as we were still developing at this point, we were making API calls at a rate much higher than we were expecting to.

To minimise the error rate and the number of calls made, we added the following fixes to the Django code that accesses the RapidAPI calls: * We started caching the calls with Django's caching decorator to 2 hours. This allowed us to reduce the number of API calls required. Naturally the trade off is that we reduce our accuracy to real time. * We checked the response if it contains the JSON attrribute on a valid result. The reason for this is that the API doesn't return errors via the HTTP response codes but with a return code 200 but with the error message. As a result we needed to test whether the returned response had the correct attributes. * Furthermore we added a loop to the calls to keep going unless the return code is 200. We noticed that errors were still coming so we added a retry method based on a solution recommended from a blog post *"Best practice with retries with requests"* (Peterbe.com, 2019).

Aggregating data with d3

The portfolio's view page required aggregated data for portfolio totals and totals of all portfolios along with the best performing shares and worst performing shares. To get the data for these levels, total transactions by the owner, portfolio and symbol levels are retrieved but then need to be aggregated to the appropriate higher levels. As a result, d3 was used as it allowed us to aggregate data to the various groups efficiently.

Consistency on different platforms

Early on in the project there were consistent issues standardising the behaviour of the application in development across multiple computers/platforms. We introduced docker into the system to get around this. It also had the bonus of making deployment more straightforward.

Breaking functionalities

Any project has the issue of potentially impacting one functionality while developing another. We experienced this issue multiple times; and by the 5th week it was time to bring in end-to-end testing. In order to determine that these sorts of issues would be quickly detected we established an automated testing setup using **cypress**.

Jenkins to Travis

Initially we proposed to implement Continuous Integration/Continuous Deployment via installation, configuration and deployment of Jenkins for use in our development process but due to feedback from the tutor that this is out of scope and the effort is best spent within the application itself, we eventually changed to using Travis as: * It is a hosted solution * Had a more succinct setup

This allowed us to get some of the benefits of CI/CD.

5. Design Considerations

In depiction of the overall system, numerous boundaries and constraints were set by the client and the governing time frame/permitted resources that pushed the team to identify certain design considerations. These ultimately shaped the progression of the project and slowly, the intended finished product.

Core Functionalities

Entering Transactions at Arbitrary Dates (including from a past date)

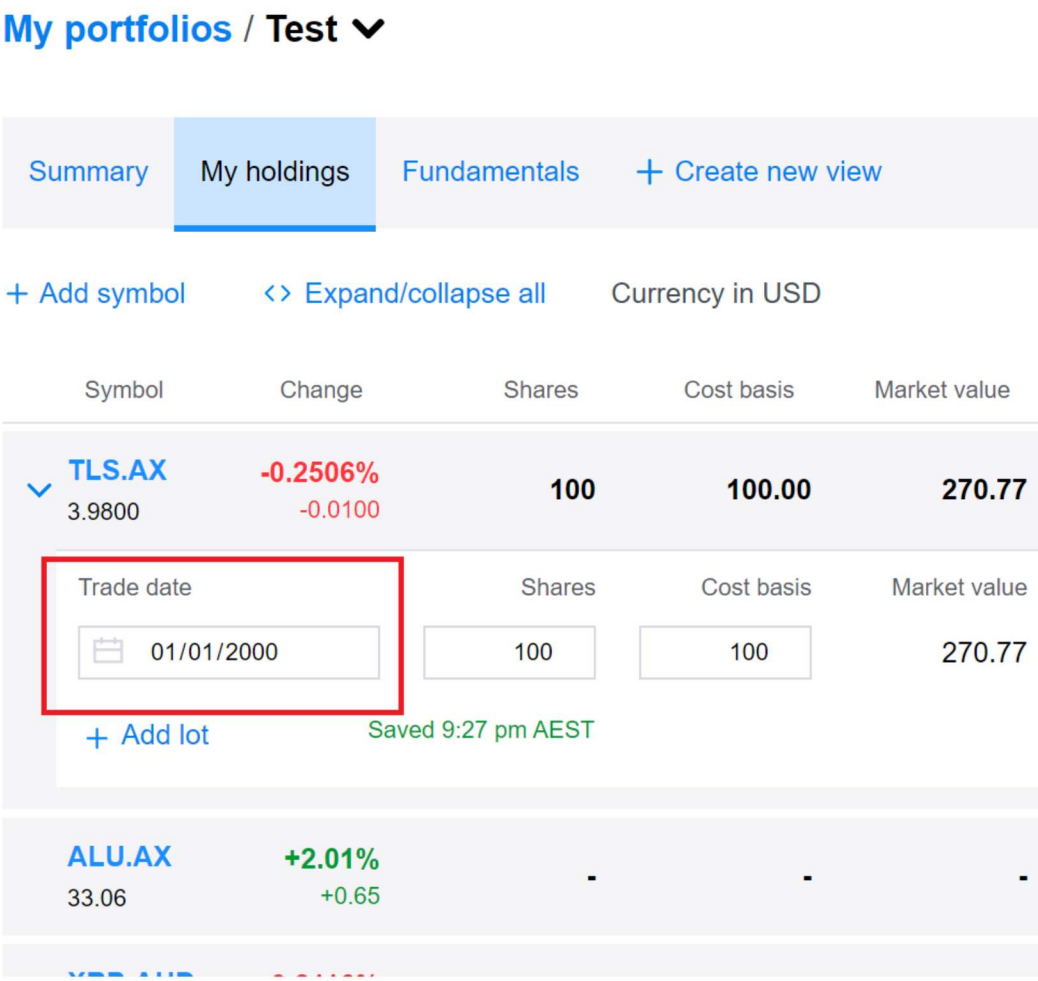
The system allows us to enter transactions (BUY/SELL) of instruments at arbitrary dates although it defaults to the current date and time. As a portfolio management system (rather than an actual share trading system), the system is designed to allow people to manage their portfolios based on the shares they hold, and/or create portfolios based on hypothetical scenarios etc. In order to achieve this, the ability to create transactions at any arbitrary date is required. The Yahoo finance system currently allows the user to do the same.

For example, some scenarios include:

<Scenario 1: Replicating One's Existing Portfolio> A new user John has 1000 shares in Telstra bought over several transactions in the past. He decided to use the Hyperportfol.io system as his existing share trading application, Comsec, only shows recently executed transactions and past transactions need to be retrieved via CSV/XLS download. He would like to just view his past transactions when he wants. As a result, he wants to migrate his past transactions into the Hyperportfol.io system and continue to use that in the future to keep track of all his transactions.

<Scenario 2: Creating a Hypothetical Portfolio> On the 9th of August, 2019 John is deciding whether or not to buy 200 more Telstra shares but is uncertain. He is NOT confident but he would like to see how it goes if he did. So he creates another portfolio with the same balance of his existing holding and then creates the new hypothethical transaction in this new portfolio. This allows him to see how well or bad it would have went if he did the action.

Furthermore, below is a screenshot which highlights Yahoo Finance's identical capability of being able



to purchase from a past date:

Negative Transactions

The Hyperportfol.io does not restrict a user from entering a negative transaction. e.g. Selling shares that a user does not own. At first this may seem like an error or bug, but this has intentionally been allowed in order to facilitate transactions Short Selling. Short Selling is where an investor is speculating on the price of an instrument decreasing, so he sells the instruments at the current price and then buys the amount that he sold later at the reduced price within a specified allowed time (though it's possible that the price will go up instead and in that case, the investor would lose money).

As defined by Comsec, "Short-selling is entering a position where you sell stock which you do not own, with the intention that you will close the position by buying the stock back some time in the future." (Commonwealth Bank of Australia, 2019)

Future Work

This section outlines possible future improvements which we came up with while doing the project as well as based on the feedback from our tutor, Dr. Seung Ryu.

Service Workers

One suggestion made by Dr. Ryu during the final Week 10 demo was to add email notification when prices were above/below a certain user-defined threshold. Whilst emails specifically would be difficult to implement with how our site is designed and hosted; we could have introduced Service Workers. These would mean that at the permission of the user, the Client application would run a process locally to constantly get updates on the prices of the stocks that user was watching. If a stock went above/below a certain user-defend-price the Service Worker would be able to initiate a *Push notification* on their mobile or desktop. This would take roughly 1-2 weeks to implement.

Caching

Current implementation of the caching means that if one user requests the price of `MSFT` and `GOOGL`, at the same time then another just requests the price of `MSFT` it wont be retrieved from the cache of the previous two. When viewing individual stocks this is not an issue; however when viewing portfolios or watchlists this means both a slightly higher amount of information for the server to have to store, as well as more of a chance of needing to load an un-cached stock (leading to 1-2s longer load).

Server-Side Rendering and Progressive Web Application

Server-Side Rendering (SSR) is a technique used for JavaScript frontends which can decrease load time when a web-application is first loaded. This would further improve performance metrics of our site, which is important for user appeal and user retention.

Though the site already can already be saved locally as an app on a mobile device from the website (Chrome settings dots, then *Add to Homescreen*), it requires an active internet connection to even load. Adding Progressive Web-App (PWA) functionality to this web-application would mean that the site would still perform many of its functionalities offline (albeit with limited access to live stock-data).

Copy/Clone of Portfolios Being able to purchase from an arbitrary date opens the potential for future improvements by allowing the user to "copy" or "clone" an existing portfolio to facilitate scenarios such as creating hypothetical scenarios as stated back in Entering Transactions at Arbitrary Dates under Core Functionalities.

Grouped Portfolio Views As multiple portfolios get accumulated to a total value across all portfolios, another improvement would be to create "Portfolio Groups/Views" which group together the portfolios that should be totalled together.

Prediction

We were initially against implementing prediction, as we believed it was not emphasised in the specification, nor would provide the user with much added value (prediction algorithms are unlikely to be accurate, and more likely to be dangerously misleading).

Eventually despite this we experimented briefly with prediction. Though we were able to get some results locally, we decided it was unsuitable for our design. Our approach required a system which was fast, responsive, and reliable. In addition to the compute time required for prediction of a given stock, it's RAM usage would have been high for our Amazon t2.micro virtual server; and may have led to increased unreliability.

6. Conclusion

The team initially set out to improve upon modern stock portfolio management systems by introducing a range of features that would cater to more audiences after the core functionality was built. The development of this system occurred under a rapid 8-week timeline that eventually saw the construction of such a web-application that was able to address core functionalities with basic web

development and the use of external tools and APIs, and a focus placed on development tools to increase the efficacy of the development cycle.

In the future, the produced system could see further improvement by increasing security, such as strong password verification and the introduction of a two-factor authentication (2FA) system around an inherently high-risk platform (in real practice); more user customisability with the introduction of user settings and UI customisation; more analytics available beyond strict portfolio stats (e.g. venturing into risk analysis); and discussions have been raised about the viability of predictive models, which assuming they are correct and reliable, would be a meaningful addition to step further ahead of other existing systems.

Appendices

Appendix A User Manual

For the best experience of using the app, we recommend visiting our website, currently hosted on AWS.

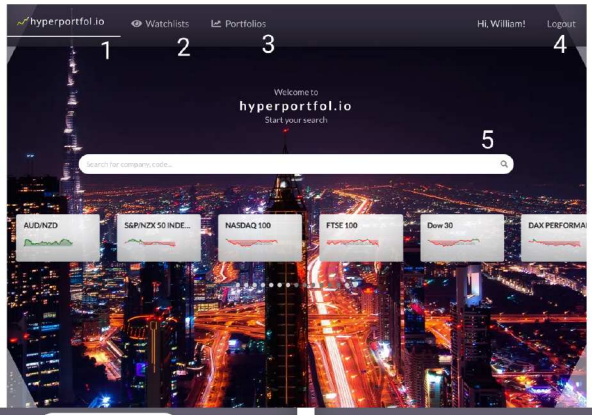
Website can be found on:

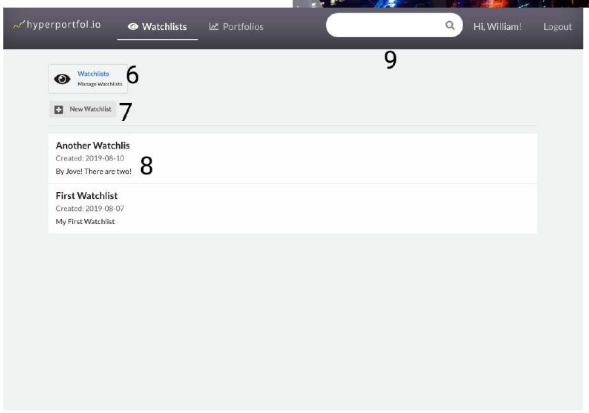
https://hyperportfol.io

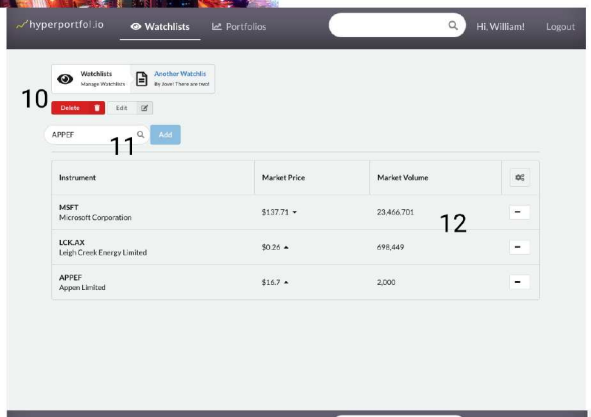
You can Register/Login with the button in the top right.

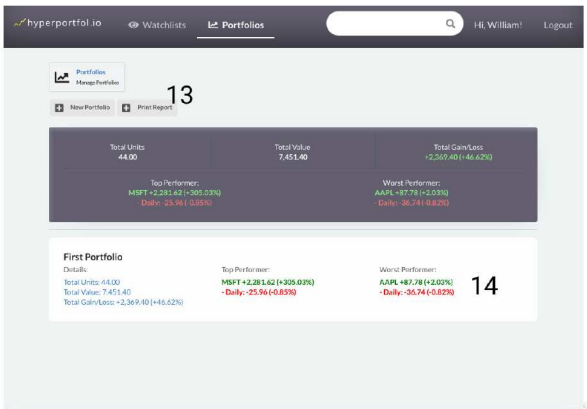
Registration only requires address of `[A-z]@[A-z].[A-z]`, and will not be verified. (This is in part to avoid our storage of peoples emails for a educational site).

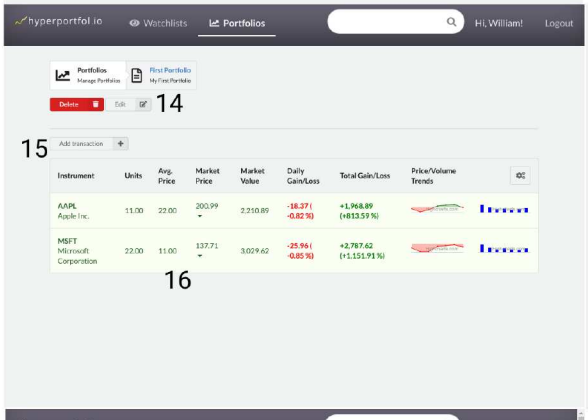
Upon Registering/Logging in you will face this screen.

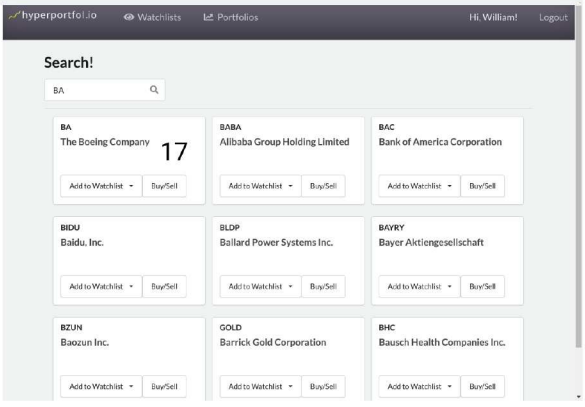

hyperportfol.io
Watchlists
Portfolios
Hi, William!
Logout
1
2
3
4
Welcome to
hyperportfol.io
Start your search
5
AUD/NZD
S&P/NZX 50 INDE...
NASDAQ 100
FTSE 100
Dow 30
DAX PERFORMA

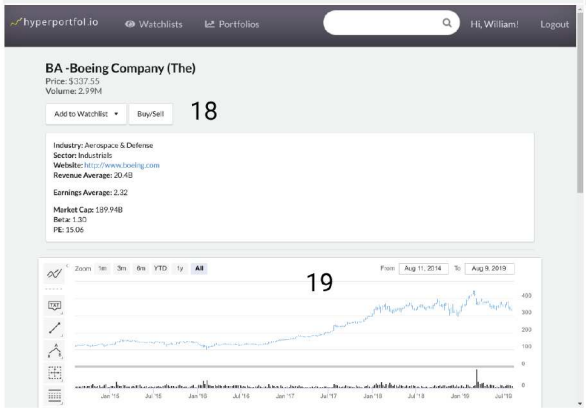

hyperportfol.io
Watchlists
Portfolios
Hi, William!
Logout
9
6
7
Another Watchlis
Created: 2019-08-10
By Jove! There are two!
8
First Watchlist
Created: 2019-08-07
My First Watchlist


hyperportfol.io
Watchlists
Portfolios
Hi, William!
Logout
10
11
Delete
Edit
Add
Instrument
Market Price
Market Volume
MSFT
Microsoft Corporation
$137.71
23,466,701
LCK.AX
Leigh Creek Energy Limited
$0.26
698,449
APPEF
Appen Limited
$16.7
2,000
12


hyperportfol.io
Watchlists
Portfolios
Hi, William!
Logout
13
New Portfolio
Print Report
Total Units
44.00
Total Value
7,451.40
Total Gain/Loss
+2,369.40 (+46.62%)
Top Performer:
MSFT +2,281.62 (+305.03%)
Daily: -25.96 (-0.85%)
Worst Performer:
AAPL +87.78 (+2.03%)
Daily: -36.74 (-0.82%)
First Portfolio
Details:
Total Units: 44.00
Total Value: 7,451.40
Total Gain/Loss: +2,369.40 (+46.62%)
Top Performer:
MSFT +2,281.62 (+305.03%)
- Daily: -25.96 (-0.85%)
Worst Performer:
AAPL +87.78 (+2.03%)
- Daily: -36.74 (-0.82%)
14


hyperportfol.io
Watchlists
Portfolios
Hi, William!
Logout
Portfolios
Manage Portfolios
First Portfolio
My First Portfolio
Delete
Edit
14
15
Add transaction
Instrument
Units
Avg. Price
Market Price
Market Value
Daily Gain/Loss
Total Gain/Loss
Price/Volume Trends
AAPL
Apple Inc.
11.00
22.00
200.99
2,210.89
-18.37 (-0.82 %)
+1,968.89 (+813.59 %)
MSFT
Microsoft Corporation
22.00
11.00
137.71
3,029.62
-25.96 (-0.85 %)
+2,787.62 (+1,151.91 %)
16


hyperportfol.io
Watchlists
Portfolios
Hi, William!
Logout
Search!
BA
BA
The Boeing Company
17
Add to Watchlist
Buy/Sell
BABA
Alibaba Group Holding Limited
BAC
Bank of America Corporation
BIDU
Baidu, Inc.
BLDP
Ballard Power Systems Inc.
BAYRY
Bayer Aktiengesellschaft
BZUN
Baozun Inc.
GOLD
Barrick Gold Corporation
BHC
Bausch Health Companies Inc.


hyperportfol.io
Watchlists
Portfolios
Hi, William!
Logout
BA -Boeing Company (The)
Price: $337.55
Volume: 2.99M
Add to Watchlist
Buy/Sell
18
Industry: Aerospace & Defense
Sector: Industrials
Website: http://www.boeing.com
Revenue Average: 20.4B
Earnings Average: 2.32
Market Cap: 189.94B
Beta: 1.30
PE: 15.06
Zoom
1m
3m
6m
YTD
1y
All
From
Aug 11, 2014
To
Aug 9, 2019
19

The frames in order are:

- A home screen of a logged in user.
- A watchlist list page, displaying watchlists of the logged in user.
- Stock information for stocks being watched in the selected watchlist.
- A Portfolio list page.
- A individual portfolio, and summaries of stocks in it.
- The results of a search for 'BA'.
- The Instrument Page of The Boeing Company.

Elements observed are:

1. Hyperportfolio logo which will take you back to dashboard
2. Navbar button to watchlists
3. Navbar button to posrtfolios
4. Navbar button to log out user
5. Search bar
6. A 'Step', these can be used to return to a previous page in the same area.
7. Button to create a new watchlist, will create a modal which requires a Name and Description.
8. A watchlist, these can be clicked to view a watchlist.
9. A search bar which will show options if left to load, or upon pressing enter will take you to the more extensive search page.
10. Buttons to delete and edit a watchlist.
11. A searchbar to add a given stock to the currently selected watchlist. One the stock is selected, the add button will be enabled allowing the stock to be added to the watchlist.
12. Stock symbols being watched.
13. Buttons to create a new watchlist or go to a report page where owned stocks can be printed or saved as a csv.
14. Buttons to delete or edit a portfolio.
15. Button to add a new transaction.
16. Information on owned stocks, grouped by symbol. Upon clicking one you will be taken to all transactions you have made for that stock.
17. A card, the title can be clicked to take you to a Instrument Page summarizing that stock. The button can also be added to a watchlist or added as a transaction to a portfolio through the "Add to watchlist" dropdown or "Buy/Sell" button respectively.
18. Options to add to a watchlist or portfolio (buy/sell).
19. Chart of stock.

Appendix B Development Manual

Documentation Both the backend and the frontend have significant commenting, and the frontend has some documentation hosted at https://docs-hyperportfolio.netlify.com.

Local Development

Requirements: docker, docker-compose, a stable internet connection.

There are a number of environment variables which must be set.

When developing locally, it is recommended you store your *server* environment variables in a `.env` file within the `src/` directory.

```
DEBUG=0
SECRET_KEY=<you can choose your own secure key>
SQL_ENGINE=django.db.backends.postgresql
SQL_DATABASE=stocks_django_prod
SQL_USER=stocks_django
SQL_PASSWORD=stocks_django
SQL_HOST=db
SQL_PORT=5432
DATABASE=postgres
RAPID_API_KEY=<Send an email to Mujeok Coderz to request this>
```

Most of these variables don't need to be secure for local development; however RapidAPI is a service which can be abused. If you choose to provide your own RapidAPI key then keep it secure; if you want to use ours for assessing the program please send us an email.

The site can be hosted locally using `docker-compose` up inside of the `src/` folder.

```
$ docker-compose up
Starting src_db_1 ...
Starting src_nginx_1 ...
```

Appendix C Third-Party Functionalities

B.1 Django

B.2 Highcharts

B.3 Cypress

etc

Proper references and brief descriptions of ALL third-party functionalities (clouds/services/APIs/libraries/code) used by the team, with justification for their use and discussion how their licensing terms impact results of this project.

Appendix D Use Techniques and Source Code

D.1 Used Techniques

D.2 Code Structure:

Appendix E Media

E.1 UX: Demonstration of the site in action

Devops: How our site is deployed from Master.

Work Diaries and

Work Diaries

z5143237 - James Holman
z5146050 - Phet Photirath
z5116701 - Amri
z5115423 - Elisa

Link to Trello

Mujeok Coderz Trello

Licenses

As can be seen below from `licence-checker`; all used packages by the fronted were free and open-source, with the exception of Highcharts. For Highcharts we use their free tier, which requires their watermark to be placed on graphs. As NPM typically uses an *enormous* number of packages, this is the summaries of the licences rather than the individual packages themselves.

```
- MIT: 1325
- ISC: 99
- BSD-3-Clause: 66
- BSD-2-Clause: 33
- Apache-2.0: 29
- CC0-1.0: 26
- BSD*: 7
- MIT*: 3
- Public Domain: 2
- BSD: 2
- WTFPL: 2
- CC-BY-4.0: 1
- (MIT OR WTFPL): 1
- UNLICENSED: 1
- Unlicense: 1
- Custom: https://www.npmjs.com/package/highcharts-export-server: 1 <- We used the free version of their l
- AFLv2.1,BSD: 1
- (MIT OR Apache-2.0): 1
- Custom: https://github.com/dominictarr/event-stream: 1
- MPL-2.0: 1
- (BSD-3-Clause OR GPL-2.0): 1
- (MIT AND Zlib): 1
- (WTFPL OR MIT): 1
- MIT,Apache2: 1
- (BSD-2-Clause OR MIT OR Apache-2.0): 1
- (MIT AND BSD-3-Clause): 1
- CC-BY-3.0: 1
- BSD-Source-Code*: 1
- (Apache-2.0 OR MPL-1.1): 1
```

Additionally; these are the PIP packages used by Djano, as described by pip-licenses.

```
Django                          BSD
 Jinja2                         BSD
 MarkupSafe                     BSD-3-Clause
 PyJWT                          MIT
 PyYAML                         MIT
 autopep8                       Expat License
 certifi                        MPL-2.0
 chardet                        LGPL
 coreapi                        BSD
```

```
coreschema                    BSD
coverage                      Apache 2.0
django-cors-headers           MIT License
django-jenkins                LGPL
django-rest-swagger           FreeBSD License
djangorestframework           BSD
djangorestframework-simplejwt MIT
gunicorn                      MIT
idna                          BSD-like
itypes                        BSD
openapi-codec                 BSD
pep8                          Expat license
pipfile                       BSD or Apache License, Version 2.0
pycodestyle                   Expat license
pyflakes                      MIT
pytz                          MIT
requests                      Apache 2.0
simplejson                    MIT License
sqlparse                      BSD
toml                          MIT
uritemplate                   BSD 3-Clause License or Apache License, Version 2.0
urllib3                        MIT
```

References

Commonwealth Bank. (2019). *What is short-selling?*. [online] Commsec.com.au. Available at: https://www.commsec.com.au/support/frequently-asked-questions/1401.html [Accessed 10 Aug. 2019].

Bengtsson, P. (2019). *Best practice with retries with requests*. [online] Peterbe.com. Available at: https://www.peterbe.com/plog/best-practice-with-retries-with-requests [Accessed 10 Aug. 2019].

Yahoo! Finance, (2019) [online] yahoo.com. Available at: https://au.finance.yahoo.com/ [Accessed 9th Aug. 2019].