

Closing the World’s Investment Gap

**Initial Design Report**

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# Problem Statement

Money matters – love it or hate it, money has become a cornerstone to survival and society. Despite all the claims that “money doesn’t buy happiness” money is a critical component allowing one to pursue the life they want. Money provides us with the ability to satisfy our basic survival needs (i.e. food, shelter, clothing, etc.), creates opportunities for choices/flexibility, allows you to live your dreams and/or fund the causes you care about. By this point, we believe that we do not need to convince you about the importance of money, as we can appreciate that everyone had some concerns about money at some point or other. Rather, we are here to help you make money, so you can live the life you want!

Fundamentally, there are only two ways to make money – by working and/or by having your assets work for you. We all know the importance of working with most of us having jobs to satisfy our monetary needs, but having your assets work for you is something that most people often overlook. We are here to change that. Alpha Factory aims to reduce the stigma around investing and make it accessible and understandable for everyone. Ultimately, Alpha Factory aims to *close the world’s investment gap* by making investing activities part of everyday life!

Simply put, investing is the act of committing money or other assets to an endeavor with the expectation of obtaining an additional income or profit in the future. (Investopedia). Ultimately, investing allows you to further enhance your wealth as it provides you with the opportunity to earn a return on investment (i.e. additional money in the future). Conversely, if you don’t invest you are missing out on the opportunity for financial growth and/or asset appreciation.

There are many reasons to invest with as many different investment goals as there are people. Common reasons to invest your money include, but are not limited to the following:

1. Grow your money – return on your investments allows your money to build, creating additional wealth over time
2. Save for retirement – you may be working now, but we all know you cannot work forever. Saving money for retirement, and better yet, investing your retirement savings will allow you to live off these funds after you stop working
3. Earn higher returns – if you want to grow your money, you need to put it in a place that offers a higher rate of return than the interest rates provided by your savings account(s). With many investment vehicles (more on these later!) offering opportunities to earn higher rates of return, investing your money provides the opportunity to achieve these goals
4. Reach financial goals – whether these goals involve buying a home/car, putting your children through college, paying off loans and/or starting a business, having an additional source of income by investing your money will help you on that path

As you can see there are many different investment goals with as many, if not more, investment strategies to achieve them. We understand that this can be overwhelming for the average person, but that does not mean that investing should only be available to the few people who understand it. Everyone needs money, and everyone has some financial goals – Alpha Factory is here to help you invest in your future and make your money work for you!!

# Project Scope

With the plethora of different investment goals and strategies present Alpha Factory simply cannot generate portfolios to accommodate them all. As such, we have decided to focus in on a range of investors to optimally satisfy their needs. Luckily, we have decided to focus on you – the average member of the population!

Specifically, Alpha Factory aims to use our platform and proprietary portfolio generation techniques to help the average person with limited knowledge of the financial markets and/or limited time to manage their own asset portfolios/investments. Specifically, we aim to get to know you through our quick questionnaires, so we can create a personalized diversified portfolio of assets at a risk tolerance you are comfortable with while meeting your long-term investment goals. From there, we manage your money for you – this includes automatically rebalancing your portfolio to account for any market fluctuations and reinvesting your investment proceeds (e.g. dividends) to ensure that your money doesn’t take any breaks while working for you. We understand that investment goals change overtime and we offer dynamic portfolio modifications to address your evolving user preferences and inputs.

[MODIFY LATER AFTER SURVEY / MAKING DESIGN DECISIONS]

# Survey of Existing Solutions

Since the invention of the Internet we have greatly changed the way we work, learn and interact with each other – it is time we change the way we invest! In fact, this change is already well underway with several other robo-advisors already out there. Alpha Factory has learned a great deal from our competitors that have been first to market, and we aim to use these lessons learned to not only outperform them but outperform the market as well.

In surveying the existing solutions, we decided to limit our scope to a select number of robo-advisors based in Canada and the United States. Specifically, we decided to further explore Nest Wealth, BMO Smartfolio, Wealthsimple, Questrade Portfolio IQ and WealthBar as they were ranked the Best Canadian Robo-Advisors in 2018. (by greedyrates) Moving across the boarder, we decided to explore Betterment, Personal Capital, Schwab Intelligent Portfolios, SigFig and Wealthfront as they were ranked the Best Robo-Advisors in 2018 by Investopedia.

With changing consumer preferences, and an increasingly technological world, robo-advisors have surged in popularity. Robo-advisors ultimately allow everyday investors to set up a customized, diversified portfolio and provide access to a series of wealth management services that previously only seemed to be available for the ultra-wealthy and financially literate. With a growing selection of robo-advisors with seemingly new firms entering the market on a daily basis and veteran robo-advisors (like those already mentioned) expanding their offerings at a rapid pace, it has become increasingly difficult to pick the best robo-advisor.

In reality, with varying investment goals and preferences the best robo-advisor is a subjective matter highly dependent on the respective financial goals of each individual investor. However, after a comprehensive survey of the top 5 rated robo-advisors in both respective countries, it was noticed that the top-rated robo-advisors shared the following common features:

* Low initial investment – namely the ability to generate a robust and diverse portfolio without requiring massive capital involvement (in contrast, attaining a diverse portfolio of assets traditionally required a great amount of initial capital)
* Low fees – ultimately allowing the investors to retain most of the money their money earns
* Popular investment options – namely having a smaller universe of assets allowing the investors to be familiar with and understand the assets they invested their money in
* Comprehensive portfolio management features – especially those that allow the investors to feel like the portfolio generated is truly unique to their needs and created with their input

While creating Alpha Factory we were conscious about all four of these features and made all our design decisions to ensure that our users obtain all the features that made those robo-advisors a success. More than this, Alpha Factory aims to achieve better returns than the aforementioned robo-advisors with careful consideration of their asset universe, parameter estimation and portfolio generation methodologies.

## Survey of Existing Solutions – Deeper Dive

Prior to discussing Alpha Factory’s design and methodology we provide a deeper dive into each previously mentioned competitor. Alpha Factory ultimately used these competitors as case studies in creating their own design decisions. Note that this section can be skipped without much impact on subsequent sections.

1. Betterment LLC

With over $10B in assets under management (AUM), Betterment is one of the robo-advisor behemoths. What makes Betterment so appealing to inexperienced investors is that it has no minimum account balance for its basic plans, while still offering top-tier portfolio management services through its premium plans. Betterment also advertises that “you can potentially keep an additional 2.9% of your investor returns each year” because of their passive investing approach[[1]](#footnote-1), minimal rebalancing and tax-efficient techniques.

Based on their risk questionnaire Betterment provides you with a customized portfolio of low-fee stock and bond index funds.

1. Personal Capital

Personal Capital aims to provide an all-in-one financial platform by allowing their clients to connect their existing bank accounts to the platform to track their spending and retirement savings on top of their portfolio’s performance. With over $5B in AUM, Personal Capital largely follows modern portfolio theory, namely Mean Variance Optimization (MVO) to construct the optimal portfolio of assets by maximizing the portfolio’s returns subject to customized risk constraints. As with Betterment, Personal Capital improves upon the basic MVO by employing tax loss harvesting and rebalancing.

It is worth noting that Personal Capital charges the highest fee (i.e. 0.89%) but justifies it by providing additional wealth/financial planning tools and a dedicated team of financial advisors.

1. Schwab Intelligent Portfolios

Schwab has disrupted the disruptive robo-advisor space by taking the low fees as low as they can go. That is, Schwab charges no account fees or commissions, rather earning money from Schwab ETFs and select third-party ETFs. It is worth noting that unlike the other robo-advisors discussed, Schwab does require a minimum $5,000 balance to open an account.

As with Betterment, Schwab creates custom portfolios of ETFs based on investor responses to their questionnaires and employs automatic rebalancing and tax loss harvesting for accounts with a value greater than $50,000.

It is worth noting that Schwab claims that the operating expenses investors pay for the ETFs in their portfolio are the same as they would have been if they invested in them on their own. As such, the operating expenses paid varies depending on the makeup of their portfolio and ranges anywhere from 0.03% to 0.40%.

1. SigFig

SigFig attempts to differentiate itself by catering to those with an existing online brokerage as it allows you to keep your existing investments with their robo-advisor creating an “intelligent, tax-efficient, diversified portfolio.” Like its peers, SigFig uses a risk-assessment questionnaire for creating customized portfolios for their clients. Like Schwab, SigFig has a minimum account balance of $2,000 and manages accounts under $10,000 for free but starts charging an account fee of 0.25% for any amounts greater (note that they only charge you on the portion exceeding $10,000).

1. Wealthfront

Like Betterment and Personal Capital, Wealthfront is a robo-advisor behemoth with over $7.5B in AUM and builds investors custom portfolios based on their answers to risk questionnaires. Like SigFig, Wealthfront manages your first $10,000 for free and charges 0.25% for amounts exceeding $10,000.

As with the other behemoths, Wealthfront offers a wide range of portfolio management services and various account types considering various nuances like tax-loss harvesting. For example, under this strategy, individual stocks representing an index are purchased instead of the index ETF such that they can be sold for tax-loss harvesting.

Alpha Factory considered the design decisions of these, and several other competitors in creating their own business plan – refer to Section XX. Decisions pertaining to management fees, initial investment balances, portfolio management features and asset selection was of particular interest during the comparison. Next, we turn our attention to the Canadian robo-advisors to further consider the asset selection based on the market that’s closer to home.

Looking at the Canadian counterparts we noticed that they also strived for the same common features as their American peers (namely, low initial investment, low fees, popular options and comprehensive personalized features) in various ways. For example, Nest Wealth aims to keep fees low by capping management fees a $80 regardless at how big your account grows, with the other four advertising management fees ranging from 0.35-0.70% and comparing the hypothetical returns you’d make with those lower fees with the 2.17% average mutual fund fee. (Questrade IQ).

Furthermore, all five of the robo-advisors considered offer customized portfolios matched based on each individual’s investment style, risk tolerance and savings goals and provide a different range of other features in an attempt of differentiation. Additionally, they all cited “overwhelming research” suggesting that passive investment outperforms active investors attempting to beat the market, with Nest Wealth summarizing it best saying, “using this as our foundation, we build your portfolio to ‘be the market’, rather than try to ‘beat the market.’”

In looking at Nest Wealth, BMO Smartfolio, Wealthsimple, Questrade Portfolio IQ and WealthBar, what stood out most is their selection of the asset universe. Namely, they all built their investment portfolios from a different number of ETFs (e.g. Nest Wealth built portfolios from seven different ETFs, Wealthsimple considered ten different ETFs, etc.) as they are a low cost and efficient way to ensure a diversified portfolio and gain exposure to various asset classes like bonds, real estate and equity. As such, Alpha Factory considered exploring creating an asset universe solely comprised of ETFs and conducted a deeper analysis of asset selection with this in mind – refer to the Asset Universe Selection section below.

# Project Framework

To aid with making the appropriate design decisions, Alpha Factory has completed a deep exploration of their project framework. Being conscious of their stakeholders’ desires, objectives and constraints enabled them to ensure the best robo-advisor was created.

## Stakeholder Analysis

First, Alpha Factory conducted a deep analysis of their stakeholders. Doing so, enabled Alpha Factory to better define their project and ensure the support of their stakeholders along the way – this will ultimately allow for Alpha Factory to deliver a higher quality final product. In addition, conducting the stakeholder analysis allowed us to understand the stakeholders better thereby ensuring that the final product is well received by all relevant groups.

The stakeholder analysis conducted is comprised of 3 major steps, each of which is further descripted in the subsections below.

### Step 1: Identify all Stakeholders

As a first step, Alpha Factory explored and identified all the parties who are affected by the work, who have influence or power over it, or have an interest in its successful conclusion. The stakeholders, along with the categories they belong in are presented in Table A below.

|  |  |  |
| --- | --- | --- |
| Stakeholders Affected | Stakeholders with Influence | Stakeholders with Interest |
| Potential New Investors / Customers | Supervisors – Prof. Roy Kwon and Hassan Anis | Potential New Investors / Customers |
| Existing Robo-Advisors (i.e. competitors) | Design Team – Ameer Shaikh, Amr Mahmoud, Daniel Kecman, Stefan Momic | Existing Robo-Advisors (i.e. competitors) |
| Existing Robo-Advisor users | Canadian Engineering Accreditation Board | Existing Robo-Advisor users |
| Traditional Investment Firms (e.g. Financial Advisors, Mutual Funds, etc.) |  | Traditional Investment Firms (e.g. Financial Advisors, Mutual Funds, etc.) |
| Traditional Investors | Traditional Investors |

**Table A:** List of key stakeholders

### Step 2: Prioritize Stakeholders

To ensure successful adoption of Alpha Factory we decided to prioritize on key stakeholders – that is, those we believe have significant influence and/or will be the end users of our product. Ultimately, determination of the key stakeholders frames the objectives and constraints of the design which in turn has a great influence on the design decision made. In prioritizing the key stakeholders, we divided them in three groups – those we need to keep satisfied (i.e. the most important), those we need to keep informed (i.e. medium importance) and those we should monitor and considered but requires minimum effort. The prioritization of the key stakeholders is provided in Table B below.

|  |  |  |
| --- | --- | --- |
| Keep Satisfied | Keep Informed | Monitor |
| Potential New Investors / Customers | Canadian Engineering Accreditation Board (CEAB) | Existing Robo-Advisors (i.e. competitors) |
| Existing Robo-Advisor users |  | Traditional Investment Firms (e.g. Financial Advisors, Mutual Funds, etc.) |
| Supervisors – Prof. Roy Kwon and Hassan Anis |  | Traditional Investors |
| Design Team – Ameer Shaikh, Amr Mahmoud, Daniel Kecman, Stefan Momic |  |  |

**Table B:** Prioritization of key stakeholders

As can be seen from Table B above, the most important stakeholders are future users which includes any new investors and existing robo-advisor users (who will likely switch to a better robo-advisor). This is closely followed by the Supervisors and Design Team who have significant influence over the project.

To ensure the Capstone Project is legitimate, the Canadian Engineering Accreditation Board needs to be informed and the Design Team must ensure that all CEAB requirements are met.

Lastly, the Design Team is wise to monitor their competitors and base select design decisions in a way to achieve their desired competitive advantages. Additionally, Alpha Factory should monitor Traditional Investment Firms to see how they react to the threats from new competitors and their customers/clients with the hope of luring them over. It is worth noting that Traditional Investors are less of a focus than Existing Robo-Advisor users as they are less likely to switch to robo-advisors than investors who already use robo-advisors.

### Step 3: Understand your Stakeholders

Lastly, the help frame the desired product functions, constraints and objectives, Alpha Factory surveyed their key stakeholders to understand their goals and objectives. Each stakeholder along with their unique goals are provided in Table C below.

| Key Stakeholder | Goals and Objectives |
| --- | --- |
| Potential New Investors / Customers | The main goal of new investors includes:   * Easy adoption – make investing easily understandable even with minimal financial literacy * Low initial investment, low fees, popular investment options and comprehensive portfolio features * Better than average returns making investing in Alpha Factory worth their while |
| Existing Robo-Advisor Users | The implicit goals of Existing Robo-Advisor users relate to the ability to get a better product/platform than the one they currently use. This includes:   * Achieving better performance/higher returns than their current robo-advisor * Obtain a friendlier user interface * Attain a platform with a lower minimum balance, lower fees, more popular investment options and/or more comprehensive portfolio features |
| Supervisors | Ensure that the tool developed integrates both the mathematical, statistical and financial modelling techniques learned throughout the EMSF major along with the relevant computing technologies. |
| Design Team | The Design Team aims to:   * Reinforce the mathematical, statistical and financial modelling techniques learned by creating a practical design product * Create a great user-friendly product that can be adopted and sold to potential consumers * Achieve the best portfolio performance/returns among the 2018-19 EMSF graduating class as evidenced by their portfolio validation and backtesting * Learn and implement additional financial modelling techniques that have not been covered as part of the EMSF major, especially those that would aid in increasing portfolio performance |
| CEAB | Ensure key Engineering Accreditation requirements are met. Namely:   * Ensure design integrates mathematics, basic sciences, engineering sciences and complementary studies to develop a product that meets specific needs * Ensure the project is creative and governed by the discipline standards |

**Table C:** Stakeholder goals

## Functions

To meet the goals of all our stakeholder Alpha Factory was developed to have several key functions. First, we wanted to ensure that we had an easy user-friendly interface that offered the support and explained the essential investment strategies we used in an easy to understand way. Second, we wanted to ensure that clients/customers were able to effortlessly provide inputs and feedback at any time – we understand that financial goals change overtime and we wanted to ensure that users can repeat our questionnaires and/or change their views at any time. Ultimately, this ensures that their portfolio is always right for their specific needs. Finally, and most importantly, we wanted to use all the user-inputs and responses to the questionnaires to create customized portfolios just as unique as our customers. Specifically, given the return goals of our clients, over a specific time horizon, Alpha Factory generates a portfolio that has a projected return greater than our equal to that amount while minimizing the risk and most importantly keeping it within our customers’ risk-tolerance levels.

Beyond simply creating the portfolio we wanted to provide our clients with the analysis of the risk and return profile of their portfolio (and any others they might want to input) over various horizons by backtesting over real data. Moreover, we provided portfolio analysis by computing and displaying various portfolio performance metrics such as alpha and Sharpe-Ratio and given any portfolio we can find a portfolio that dominates the one provided considering a specific performance measure.

## Objectives and Constraints

Having identified the goals of the key stakeholders the objectives and constraints were easily identified. We have provided a further discussion on each objective and constraint below.

### Objectives

1. Achieve the best portfolio performance – both the Design Team and potential Alpha Factory users greatly benefit for achieving the highest returns possible. This includes having the optimal asset universe, portfolio generation strategies and parameter estimation techniques.
2. Achieve the most user-friendly interface and design – with first impressions mattering a lot, especially in the digital world, a good user-friendly design goes a long way in how the final product is received among stakeholders. Simply put, good design and everyone wins!

### Constraints

Along with the objectives presented above, the Design Team was faced with the following constraints when selecting and making Design Decisions.

1. User Preference: low initial investment – the Design Team must select the asset universe, portfolio generation strategies and parameter estimation to ensure that clients/customers can obtain a diversified portfolio without requiring a large initial investment
2. User Preference: low fees – conscious with user preferences for lower fees the Design Team must consider strategies resulting in lower management time and/or fees (e.g. less robustness and/or rebalancing, outsourcing certain costs, etc.)
3. User Preference: popular options/easy to understand assets – with users preferring to understand/know the assets they are investing in; Alpha Factory was constrained in selecting the asset universe. Specifically, a large asset universe with complex securities would be too overwhelming for the users.
4. User Preference: comprehensive portfolio features – Alpha Factory was constrained with the need to consider user inputs and create customized portfolios for each of their user’s unique financial situation and goals
5. Time – with the project deadline less than 3 months away the Design Team experienced significant time constraints, limiting exploration/implementation of more complex financial models

# Design Decisions

## Business Logic

Demonstrate thorough understanding of the models/methodologies through literature review

### Asset Universe Selection

### Source of Financial Data

### Portfolio Generation Strategy

### Parameter Estimation

### Considerations for Robustness

### Portfolio Validation and Analytics

## Front-End

### User Interface

### Wireframe and Sketch of User Interface

### Gathering User Input(s) and Feedback

### Display of Computed Data

### Decision on Technologies Used

(Include a DfX Analysis)

## Back-End

### Choice of Database / Data Source for Raw Data

To store its various forms of data, Alpha Factory uses MongoDB, the popular database service that allows for the deployment, operation, and scaling of NoSQL databases on its servers. Mongo offers a free version of their services, which were estimated to be more than adequate for the purposes of Alpha Factory and made the choice to use MongoDB for our back-end database services quite easy. In addition to the fact that we could use this database service for free, the other prominent reasons for deciding to use MongoDB are as follows:

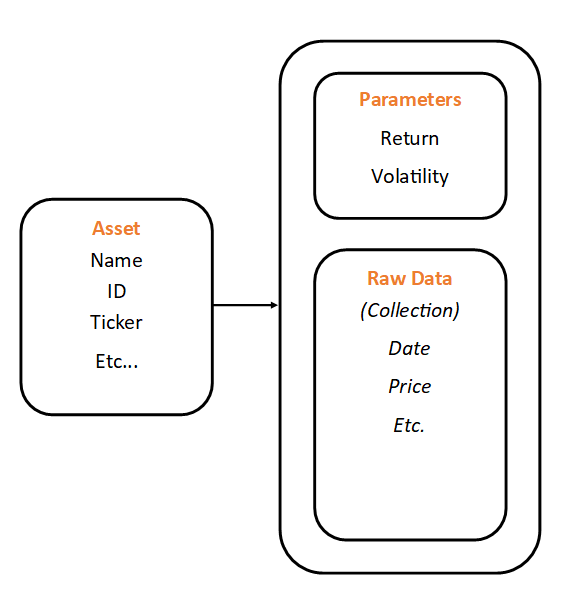
1. Document oriented storage: Data in MongoDB is saved on the system in the form of JavaScript Object Notation (JSON) documents, meaning the creation and maintenance of the data is not as strict as it would be with a classic relational database management system. Each document can vary in size and format, so there is no restriction on making each dataset as useful as possible.
2. Intuitive querying: In the absence of SQL, MongoDB uses its own querying system to search through the data efficiently. Since the queries are specific to MongoDB, they are easy to work with and leverage the other properties of the database.

### Storage of Financial Data (Both Raw and Computed Data)

To use the financial data from the previous section in Alpha Factory’s business processes and portfolio generation, we are taking that data and storing it with our own database, which was stated in the previous section to be MongoDB. In storing the data for the different items in our asset universe, the format of each asset’s dataset is expected to be similar, and in addition to similar formats, with each asset being its own ‘object’, any interactions between the assets can be done seamlessly, like finding different ways to track the relation of different assets over various different horizons for the purpose of better predicting the movement of our asset universe as a whole.

In addition to the raw data, the computed data related to each asset needs to be stored on our databases as well, such as parameters for returns, volatility and correlation, as well as the data pertaining to these assets in the various portfolios that get created through Alpha Factory’s business logic and processes. Once again, the choice to use an object-oriented database, and MongoDB in particular, allows a very straightforward organization for this data. The plan for how these objects are going to be set up can be seen below.

For the raw data, the main objective is simply to ensure that all the data needed for estimating the parameters of each asset is readily available and can be called upon when these values need to be used or updated. So, within the overlying object for each asset, the raw data will be contained in another object type that is then embedded in its asset’s structure. Lastly, as the calculated values are also a part of each asset’s object, they are also included, but in such a way that the data and computed values are two separate objects that have a chance to interact with one another. Figure X shows how this might look within MongoDB’s structure, and this practice of nested objects and collections pertains to most of the data that will be found in the database:



**Figure X:** Layout of an Asset Object with a MongoDB database

### Setup of Data Access Layer for Data (Both Raw and Computed Data)

The data access layer of a database is the actual set of commands and functions that allow data to be accessed from the database and used in the business logic and other parts of Alpha Factory’s processes. For relational databases, these are also known as the CRUD functions (create, read, update, delete). In object-oriented databases, the same functions need to be implemented between the data and the rest of the application, but since the data is stored as an object to begin with, the level of complexity that needs to be inserted into the creation of the data access layer is significantly reduced. The framework for the main functionality of the data access layer is outlined below:

1. Creating:

Within each individual data and object type that is initialized for use in Alpha Factory, the object-oriented style of MongoDB means that all that it necessary to be able to add more objects into a collection is a function for initializing the parameters of the new instance of that data type.

1. Reading:

Like SQL, which aids in getting information from relational databases based on a querying language, the method for reading certain documents and getting specific information is based on searching through your datasets by the various fields that each document contains. The results of these searches can then be used in other functions and calculations.

1. Updating:

The two ways to update documents in MongoDB are through updating an existing document, where the fields that needs to be replaced are listed as parameters, as well as the new values that these fields should take on. This can be done with one collection, or with many collections in one statement, with each collection receiving its own set of parameters. The other way to update a collection is to replace it entirely, which is equivalent to deleting an existing object and then creating a new one in its place but in one method instead of two. The choice of whether to update or replace will come down to the individual task that is required in the business logic.

1. Deleting:

There are built-in functions in MongoDB that can delete objects and collections in a dataset. The function ‘drop’ and its counterparts are responsible for these tasks, and are made so that dropped/deleted items are removed from memory and that storage becomes available for other data.

### Cleaning Data & Dealing with Missing Data

In the process of collecting the raw data for each asset in Alpha Factory’s asset universe, there is a very good chance that the data collected will not be perfect, and that there will be data missing or data that has been corrupted and is not usable in our processes for a variety of reasons. To combat these scenarios and mitigate the effects that this unusable data poses on the rest of Alpha Factory’s processes, the following approach is taken for the various kinds of data issues and tasks that can come up during data collection:

1. **Missing data**: If there is missing data for a certain asset, there are two ways that it can be addressed. If the time horizon for which the data is missing is small enough, then the whole data point can be given a constant value that can be read as a valid data value, but which tells the user that the point is missing so that it will be exempt from calculations. For example, if the price for a certain asset couldn’t be found or brought into the database for the span of a week, then the values for that week would be given a valid date, but the price would be given a value of NULL or N/A, and checks within the rest of the code would be made to find and omit any of these values.
2. **Data cleaning and maintenance**: If a dataset is shown to be ‘damaged’ and is causing problems to other components of Alpha Factory’s design, the current solution in place would be a manual investigation and fix of the data. Since each individual problem with a dataset could carry a different underlying error, the most important factor is correctly determining the root cause of the error, and the most accurate approach to this is through human quality assurance.

### Hosting

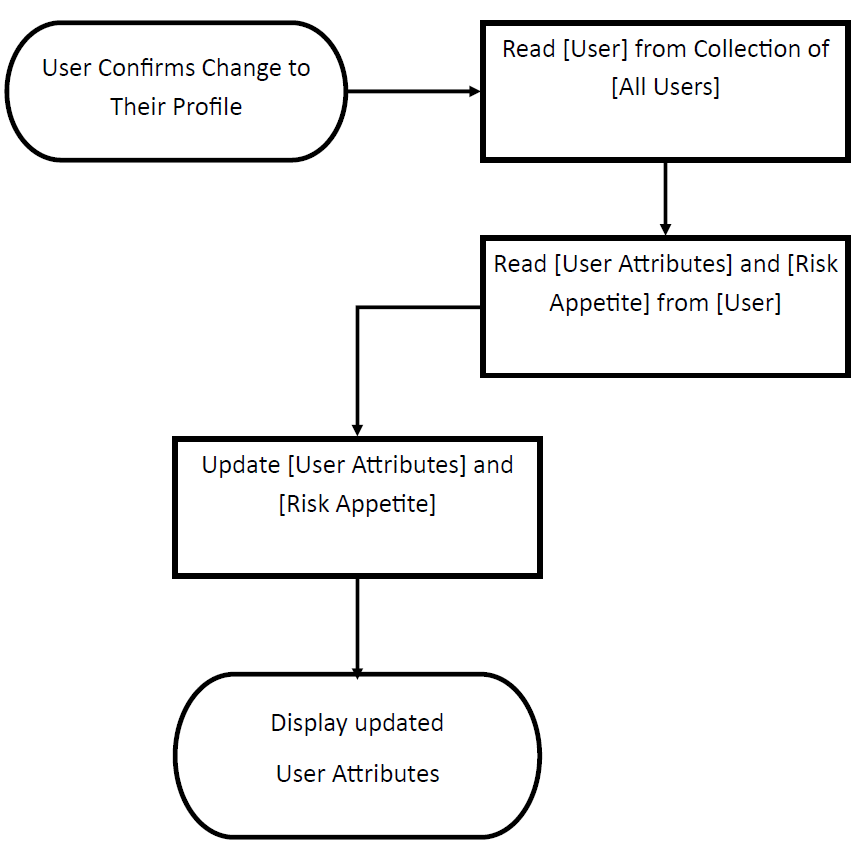
The hosting service for MongoDB is Atlas, which comes from the creators of MongoDB and allows users to choose from the popular hosting platforms, while simultaneously providing services for MongoDB databases. In the case of Alpha Factory, we chose to support the application with Atlas, using the Google Cloud Platform as the actual host for the database. With the first 512 MB free through Atlas, we decided that using Atlas’ services, which includes all the benefits listed below in Figure X that the service claims to provide, was the best way to host our database. As we work toward gathering and updating the financial data for our asset universe, we will take care to monitor our data usage to judge whether continuing with this service is the best way to support Alpha Factory’s scaling needs.

| Benefit | Explanation |
| --- | --- |
| ****Automated**** | The easiest way to build, launch and scale apps on MongoDB |
| ****Secured**** | You get access to Multiple levels of security available to give you peace of mind |
| ****Scalable**** | Deliver massive scalability with zero downtime as you grow |
| ****Highly available**** | Your deployments are fault-tolerant and self-healing by default |
| ****High Performance**** | The performance you need for your most demanding workloads |
| ****Updated**** | MongoDB Atlas gives you access to the latest MongoDB features |

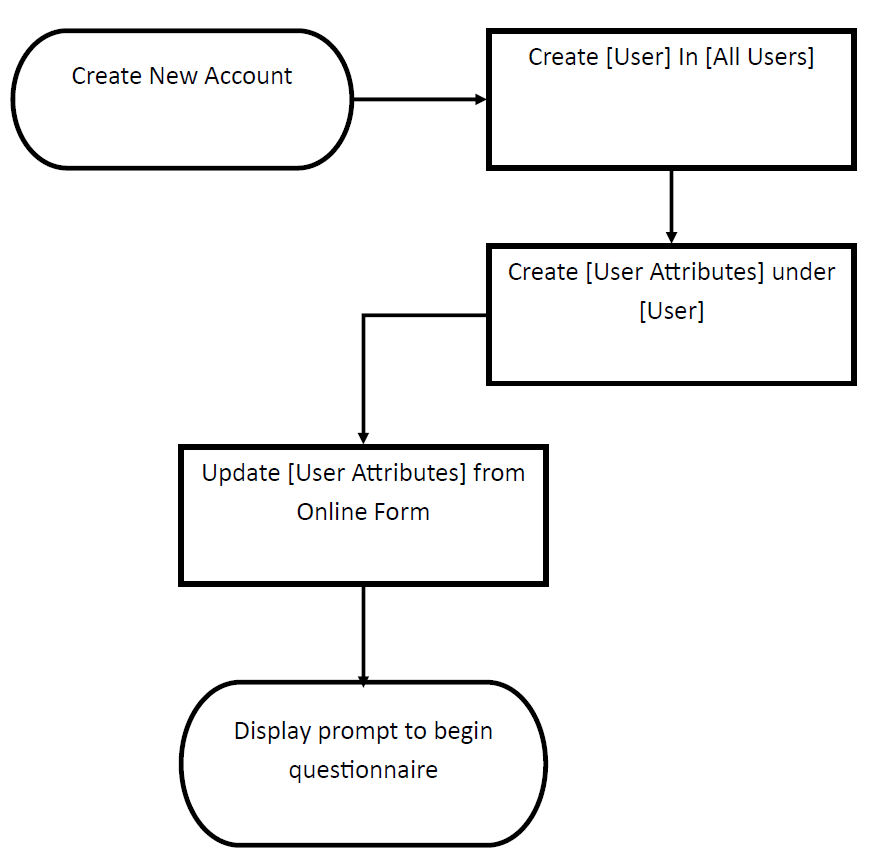
**Table X:** Benefits of hosting a MongoDB database on Atlas

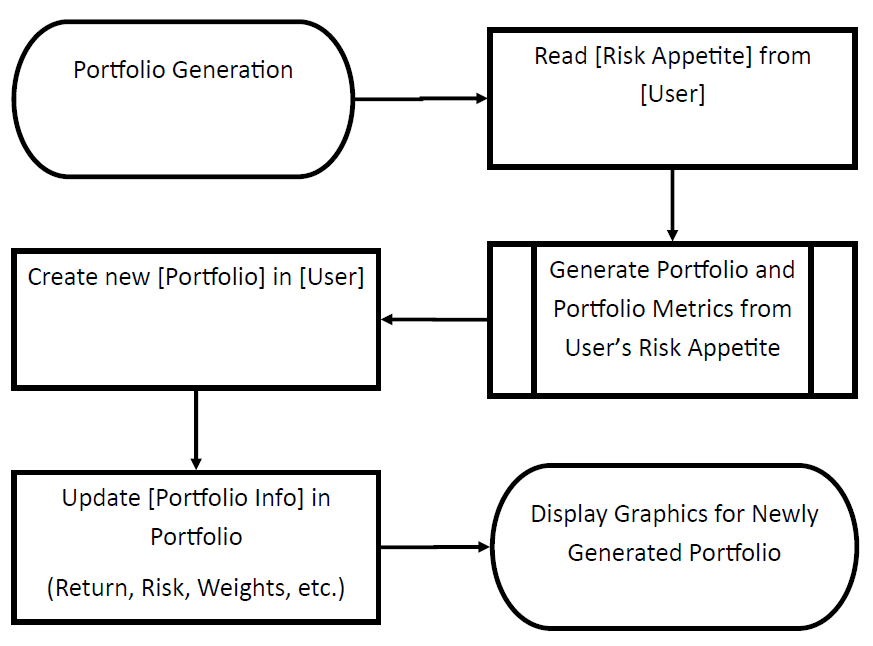
### Flowcharts and Decisions on Technologies Used

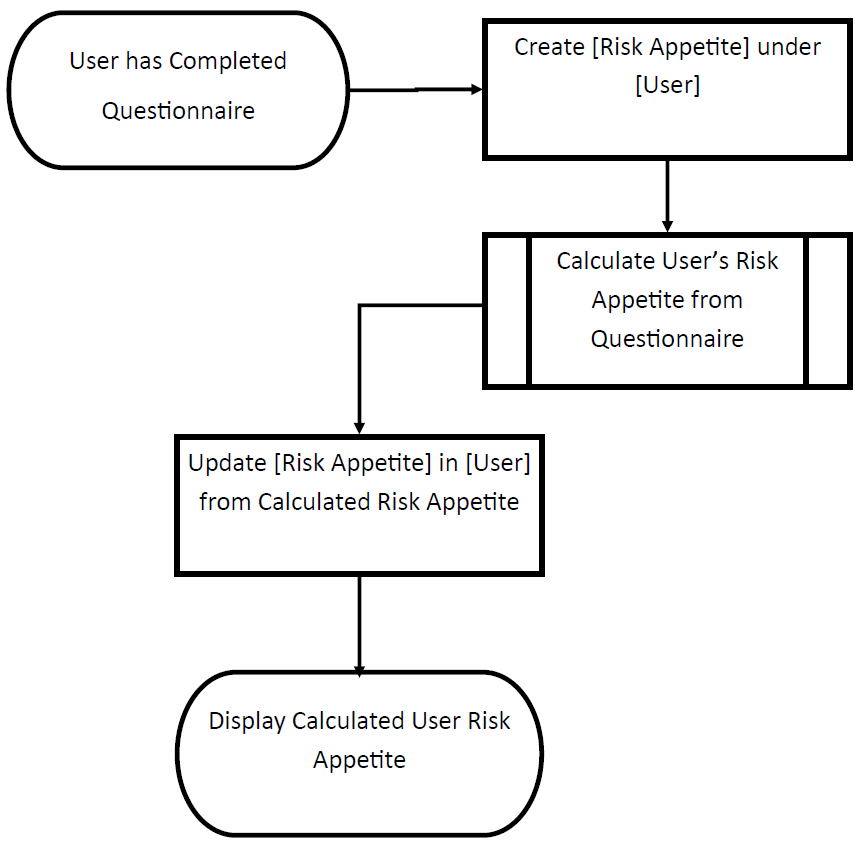
The following are flowcharts that go into the processes that are entered into when making interaction with the database in Figure X (Amr’s flowchart). They give a sense as to what happens on the back-end with the database as the user is using the web application.



**Figure X:** Flowchart for Changing User Info

**Figure X:** Flowchart for Creating a New User Account

**Figure X:** Flowchart for Portfolio Generation

 **Figure X:** Flowchart for Completed Questionnaire

### Database Selection

In choosing to use MongoDB, there was a decision to make as to whether to use a relational database management system (RDBMS) that uses the Structured Query Language (SQL), which has historically been the most popular way to retrieve information from a database for use in other applications. While this can provide a very structured way of accessing the data, particularly across different tables and data structures, it is very difficult to adjust the setup of the database once it has been initialized because of how tables are linked to one another. Therefore, an extended period is required for initial planning to ensure that all subsequent changes to individual data structures are targeted towards improvements in efficiency more than towards altering the functionality.

The alternative to the RDBMS is the Object-Oriented Database Management System (OODBMS), which tackles many of the limitations faced by the RDBMS. The main differences between the two are the use of SQL for querying information and the format in which the data is stored. Whereas an RDBMS stores data in tables linked by primary keys, an OODBMS stores data in ‘documents’ as objects, which can take on various forms and are minimally restricted in terms of format. The advantages of this approach, and specifically how they apply to the application, are summarized below:

| Advantage | Explanation |
| --- | --- |
| Wider variety of allowed data types | * Allows for data to be stored in an increased number of formats, allowing more flexibility to the database and its potential uses * Objects in the databases can be used as their own data types, for a more extensive set of data types available |
| More coherent modelling capability | * By organizing each data structure as an object, there can be more extensive links between various data structures to form a more realistic model for your data * The database can be an active component of the application and business model, removing the disconnect between the data and the rest of the system |
| Performance | * As a newer technology that was implemented with efficiency in mind, Object-Oriented Databases have been shown to provide better performance results when compared to Relational Databases |

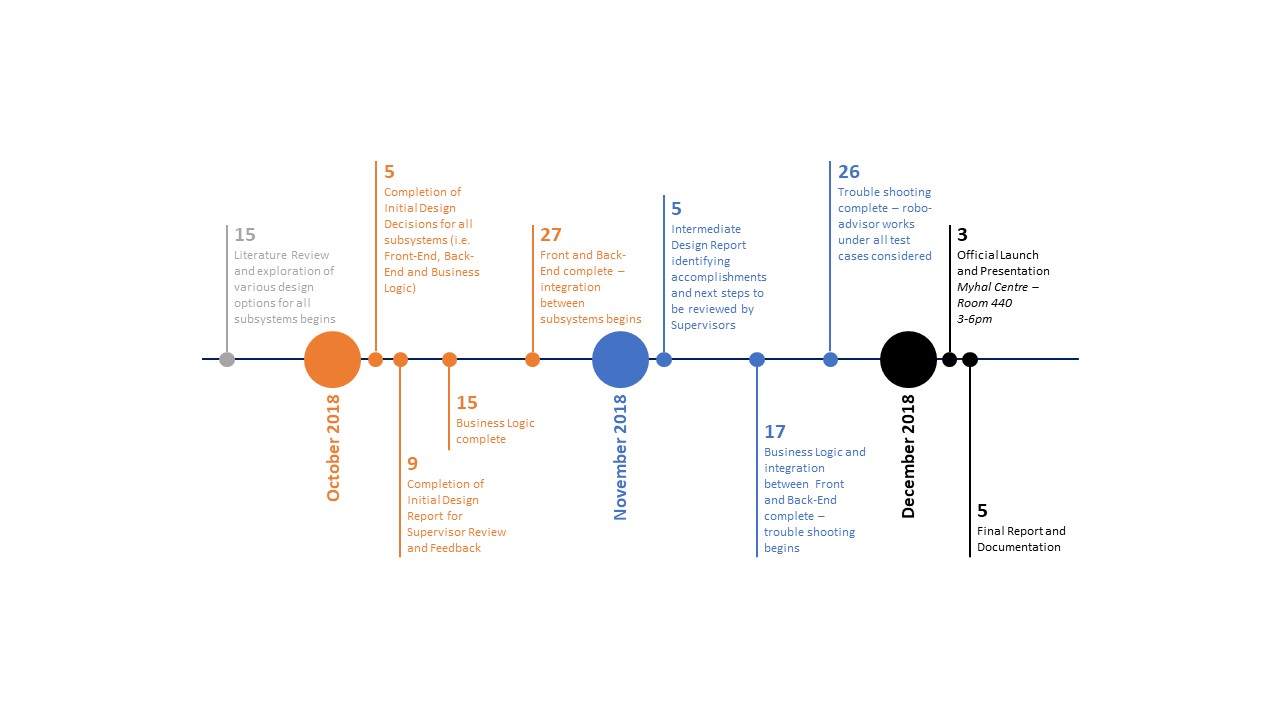
**Table X:** Advantages of an Object-Oriented Database Management Systems

# Analysis of Service Environment

# Project Plan and Timeline

The official launch and presentation of Alpha Factory will occur on December 3rd, 2018 from 3-6pm in room 440 of the Myhal Centre for Engineering Innovation & Entrepreneurship at the University of Toronto. The Final Report and documentation of Alpha Factory will be released shortly after, but no later than 5pm on December 5th, 2018.

To ensure timely delivery, Alpha Factory has imposed an internal deadline of November 29th, 2018. Currently, they aim to have a draft of the Final Report and complete robo-advisor platform by that time. To meet these deadlines, the team has laid out the following timeline with the corresponding milestones.

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**Figure X:** Project Timeline

Additional notes regarding select milestones from Figure X above are provided in Table Y below.

| Item | Detailed Description |
| --- | --- |
| Oct 15: Business Logic complete | A completed Business Logic constitutes:   * Completion of asset selection and financial data location * Completion of portfolio generation algorithm * Completion of parameter estimation * Complete justification for all design decisions made including asset selection, portfolio generation and parameter estimation * Thorough understanding of all models and methodology used completed as part of Literature Review |
| Oct 27: Front and Back-End complete | A completed Front-End constitutes:   * Ability to gather user inputs and feedback * Ability to hook up to Business Logic and display computed data (e.g. graphs, tables, numbers, etc.) * Complete user-friendly design and user interface   A completed Back-End constitutes   * Ability to clean data and/or deal with missing data * Database selection and initialization including the ability to store raw and computed data from the financial data selected and generated by Business Logic |
| Nov 17: Integration between Business Logic and Front-End / Back-End | With the subsystems integrated, completion of this stage implies the ability to:   * Compute and present the final outcome (e.g. optimal portfolio given the user inputs) * Perform all the required analytics (e.g. backtesting, portfolio performance metric calculations, etc.) * Validate portfolios generated by the system |

**Table Y:** Detailed descriptions for select milestones

# References

1. Passive investing methods seek to avoid the fees that may occur with frequent trading. With the main goal being to build wealth gradually, the primary investment mantra of passive investment strategies is that of buying securities with the intention of holding them long term. With the underlying assumption of passive investors being that the market posts positive returns overtime, passive investment strategies do not seek to profit from short-term market fluctuations as active traders would. [↑](#footnote-ref-1)