Training Pal

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Link to Software Repository:	https://github.com/Daniel-Tilley/FYP_ProtoType_Submission	

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1. Project Statement

The overall goal of this project is to create an easy to use and intuitive web application that will allow athletes and coaches to manage their training data. In addition to this, a standalone mobile app will sit alongside it to offer offline functionality to end users. I will mainly focus on triathlons but there may be scope to add other sports later in the development cycle.

Another aim of mine is to incorporate some form of human interaction into the application. When it comes to availing of services from an individual/group, it's always nice to be able to put a face or a name to what we are being offered. Sometimes we can be no more than a number/username or a reference to either a computer or someone on the other end.

2. Research

Background Research

It is no secret that in today's day and age, the top athletes are using technology in one form or another to enable them to be the best they can be. It is often the case that the difference between winning and losing can come down to something as small as a 100th of a second and that any edge, either physical or mental can make a big difference. (Ride, 2013).

One of the most important aspects of training between a coach and an athlete is to receive accurate and proper feedback to improve performance. (Weinburg R., 2003). Feedback can be given in any shape or form. It may be something as simple as a motivational phrase, or something as complex as a long in depth report. None the less, feedback in any shape or form is a vital part in the development of an athlete. In fact, there have been several studies done which report on the effectiveness of feedback in sport. (Wulf, 2002). By having a coach, an athlete enables themselves to obtain relevant and proper feedback which they can use to better themselves in their disciplines. These were key factors in deciding to add face to face communication into my web application.

One cannot receive feedback however, unless there is something which they can receive feedback about. It is therefore important for athletes to track their data so that it can be analysed by their coach. There are many ways an athlete can track their data, it could be through an app, a website or even through a piece of hardware. None the less, using a website to track and monitor your performance will assist you and enable you to achieve better results. (Hwang et al., 2013). Thinking about it logically, tracking your data allows you to do so much more with it. You can see min and max stats, graph performances to pinpoint KPI's (Key performance indicators) or even compare current entries to previous entries to see how much you have improved.

Alternative Existing Solutions to Your Problem

Strava.com

In today's day and age, technology is more important than ever before. It can assist with our daily lives and can help us to be a better version of ourselves in many different aspects of our life. Strava embodies the self-care aspect of our life and how it is important it is to look after one's self. In fact, according to (Strava.com, 2017) "Strava is the social network for athletes. We're a global community of millions of runners, cyclists and triathletes, united by the camaraderie of sport". It's quite clear to see that Strava have taken the social aspect of life and incorporated it nicely within a sporting environment.

Strava offers a very intuitive and easy to use web and mobile app. The simplistic contrasting colours of white and orange facilitate a very clean and astatically pleasing UI for the end user. Strava also has a decent level of functionality available. It allows end users to do things like create and update training logs and calendars, map training routes and explore the community to find clubs, other users or routes to take. There is also a premium service available for €59.99 per year or €7.99 per month. Although this may seem quite cheap, the functionality offered for the price is very minimal. It builds on top of free features to provide things like heat maps, training plans and goals for users.

Where I feel Strava is lacking is in the coach to athlete connect and in the mutli-discipline sports like triathlon. Strava was developed to create an online community for athletes to store and share training data with one and other. However, you can't interact directly with a coach through the application. This adds an extra layer of complexity for coaches who may have to use several other systems to keep track of all their client's data. Strava may be simple, but it deals with running and cycling quite well. It offers quite a lot of basic functionality to its users, but also leaves them looking for alternatives if they need to enter data for the likes of nutrition, strength and conditioning or even swimming.

TrainingPeaks.com

In contrast with Strava, (Training Peaks, 2017) states that it "provides the complete web, mobile and desktop solution for enabling smart and effective endurance training". They have a wide range of solutions available which allow them to accomplish this. The main one I will be focusing on is the web application. Unlike both Strava and Runtatic, Training peaks offers a good coach to client connection and does this quite well. Training peaks offers two separate editions of its web application. One for coaches and one for athletes. It means that athletes can utilise creation of training logs, events etc. and coaches are able to easily manage multiple athletes at one time. A coach could in theory update or create training logs for multiple athletes all within the same application with minimal copying of data to / from other systems.

Training peaks offers are very simplistic UI to its users. The colours used are quite bland and dull, yet the level of performance is quite high. It's quite clear that a lot of work has gone into the functionality more so that the UI itself. Unlike the vibrant and pleasing colours of both Runtastic and Strava, Training Peaks adopts a solid grey background with some shades of blue thrown in here and there for good measure. Aesthetically, it is probably the worst out of the three for its lack of vibrancy and use of dull colours. As far as functionality and features go, training peaks is a fully paid for service that offers users a full week trial. The coaching edition is priced at either $19 or $49 per month along with a flat $99 fee for licences. The athlete's version is priced at $19.95 per month or $119 annually. Features provided to the athlete include basic input / update functionality, find a training plan or find a coach. There are also graphs and statistics which are created based on data which has been input by the user. Coaches can build and share workout plans, analyse athlete data and create athlete profiles.

Although Training Peaks deals with the functionality side of things quite well, where its lacking is in its over simplistic and dull UI. Some of the text can be quite small and layouts are often squashed together. Another thing training peaks falls down on is its pricing. $119 annually for a service might not seem like a lot, but compared to the other two applications, it's almost twice as expensive for similar functionality.

Runtastic.com

Like Strava (Runtatic.com, 2017) "offers products and services that all focus on gathering and managing sports data to motivate people to do sports and to link like-minded people." They embrace a similar community approach to sports like Strava. It is evident from a first glance at the Runtatic platform that it revolves heavily around this model. There are small features placed in the application which allow you to do things like cheer on users currently out exercising, join groups and add friends to motivate / get motivated from.

Runtatic offers great connectivity with both own brand or existing hardware and software. They offer basic create and update functionality for things like activities, training plans and personal info and a few other features here and there. Another plus is that they have support for entering data within several different sports unlike Strava. With regards to aesthetics, it's a very simplistic, yet distracting application at times. There can be several things highlighted on a page at once and you may have to do a bit of searching to find your desired page, but the app itself is quite intuitive to use. Like the previous two sites, Runtatic also offers a premium service, however, like Strava, the premium functionality is limited and may not be needed by most users. They boast the ability to offer users enhanced statistics, nutritional input and guides as well as unlimited functionality for several of their free features. Pricing ranges from €49.99 per year to €6.63 per month.

Once again, what is missing from this application is that coach to client connect. This community based application makes it difficult for coaches to keep track of their clients in an easy to use and efficient manner. Coaches may need to duplicate data or switch between applications / systems if they need to alter or create new training plans etc. for different clients.

Technologies Researched

Angular

Angular is a commonly used framework that allows developers to easily make applications for the web. Angular provides developers with functionality such as declarative templates, dependency injection and end to end tooling to allow developers to solve challenges they may be presented with. (Angular.io., 2017).

Angular was created and is currently maintained by google and has been around since 2010. It is becoming quite a widely-used framework now a day for several different reasons. It allows developers to create a single page MVC application that is driven and rendered completely through the browser. By doing this, you can limit the number of requests between both the client and the server, hence increasing things like loading and rendering time and decreasing wait times.

Angular also allows for separation and structure in your development. Features like templating and modular development allow for greater separation of code and can make things easier to identify. There is quite a steep learning curve with angular however, due to the fact it is written in typescript. However, the reward of sticking with the technology can be very fruitful in the long run. Angular can force developers to be much smarter in the way they work and develop code which can lead to less bugs and more time spent on productive coding.

React

Unlike Angular, React is not a framework and is instead a library. Its focus is around UI and ease of implementation. In fact, (Reactjs.org., 2017) states that "React makes it painless to create interactive UIs". React was created and is maintained by Facebook and has been around since 2013.

React itself has quite a fast learning curve associated with it since it is only a library and is based around JavaScript. React is becoming more popular and mainstream nowadays with many people choosing to adopt it over the likes of angular or vue.js due to its simplicity. However, one of Reacts biggest advantages can also be viewed as its biggest weakness. Its simplicity requires more input from the developers with regards to dependencies and another library's.

Unlike Angular, React requires other third party libraries to perform much of the functionality angular has out of the box.

PHP

"PHP is a popular general-purpose scripting language that is especially suited to web development. It is also described as fast, flexible and pragmatic and is widely used in many different websites which currently exist" (Php.net., 2017) PHP first came into existence back in 1995 and has since been chosen by many as the language of choice for a server side language.

PHP is often chosen due to the fact its free, simple to setup and maintain and that it can be embedded into HTML. It also fits into the LAMP stack and can be used in tandem along with other technologies such as a Linux distribution (most commonly Ubuntu), databases such as MySQL or even a web server like Apache. Whatever the reason for choosing it, PHP has quite a track record as a dependable and reliable server side technology.

Along with the above, PHP also has fantastic documentation and is widely known across the world. If you ever have a problem which is PHP related, you can generally ask a member of the rather large PHP community, or consult the many pages of documentation associated with it. PHP also tends to be very scalable, so it can be used in any situation big or small.

One of the major drawbacks with PHP however is with regards to security. There are many flaws that exists with using PHP as a server side scripting language. In some cases, hackers may be able to view PHP code if not secured properly and will be able to find weaknesses in the system.

MySQL

"MySQL is the world's most popular open source database. With its proven performance, reliability and ease-of-use, MySQL has become the leading database choice for web-based applications, used by high profile web properties including Facebook, Twitter, YouTube, Yahoo and many more". Mysql.com. (2017)

MySQL has developed quite a reputation in the world of web development. According to DevOps.com. (2017), "MySQL is globally renowned for being the most secure and reliable database management systems". MySQL also offers great on-demand scalability options, a high level of performance and round the clock up time.

On the flip side of things, MySQL is known to have some stability issues. These issues tend to arise when it comes to references, transactions or audits. Along with these stability issues, MySQL has seen little to known development progress over the last few years. Because of this, flaws may be exposed and may take some time to patch.

Mongo DB

MongoDB can be described as quite a modern and general approach to a database platform. It was designed to allow developers to utilise the full power of software and data to build very robust and advance applications. MongoDB. (2017)

MongoDB is one of the many different NoSQL databases which are currently available. Mongo uses both JSON and binary JSON (BSON) to store and access data. In contrast with standard RDBMS models, Mongo operates schema less and allows for more flexibility with regards to the data being stored. Another aspect of Mongo is that the application sending data to mongo will have to ensure that data is in the correct form / data type due to the much looser storage approach.

MongoDB like any other technology also has its disadvantages. Mongo can be very RAM intensive when performing operations due to its schema less approach. Applications may suffer long read and write times with large amount of data because of this. MongoDB also required that all data be manually updated in one way or another. This process can sometimes result in your entire database locking and requiring manual intervention to fix the problem.

Apache HTTP

The Apache HTTP Server Project is a joint effort of many developers to create a powerful, open, industry standard server version of the HTTP protocol which allows its users access to many different features. Httpd.apache.org. (2017). The project itself has been around since 1995 and is responsible for running quite a considerable percentage of websites on the web to date.

There are many reasons why you would choose Apache http over any other web server. One of the main ones being compatibility. Apache is compatible with several operating systems ranging from windows to mac and even Linux distributions. It also offers developers the option to customise the server to greatly enhance their users experience. Apache is also free of charge and has great support / documentation. Also, seen as how apache has been around more than 20 years, the community around it is vastly experienced and available to help if needs be.

One of the major flaws with apache is that it is susceptible to security issues. By allowing access to its configuration, Apache often puts itself at risk of a lack of security if not configured properly.

Python

Python is a high level, object-oriented programming language which can be easily understood by developers. It offers a wide range of functionality such as

data-structures and the ability to create dynamic variable types and binding. This often makes python the language of choice when it comes to both rapid application development and server side scripting. (Python.org., 2017).

Python has been on the rise as one of the most popular languages since its conception in 1991. There are many reasons why someone may choose python as their preferred language of choice. Firstly, it is very beginner friendly and is also extremely easy to understand. Pythons lack of semi-colons and almost English like syntax means that any developer from beginner to advanced would be able to pick it up and understand it with ease. Secondly, Python has a great level of flexibility associated with it. There are no hard and fast rules about how certain features need to be designed or implemented. This offers developers more freedom to weave their own style into their approach. Finally, the Python community continues to grow and support one and other. With one of the largest communities on stack overflow, an answer to your question is never far away.

Python does have some draw backs however. When it comes to scalability, this is one area in which python does not excel. As a python app continues to grow, errors may become a lot harder to debug and ultimately fix.

Java

"Java is a programming language and computing platform first released by Sun Microsystems in 1995. There are lots of applications and websites that will not work unless you have Java installed, and more are created every day. Java is fast, secure, and reliable. From laptops to datacenters, game consoles to scientific supercomputers, cell phones to the Internet, Java is everywhere!". (Java.com, 2017).

There are a lot of reasons why a developer might choose to use Java as their language of choice for mobile development. Google who currently owns android have all their documentation written around the Java language and is their language of choice when it comes to native android development.

Android itself needs to run on many different devices and Java offers a way to compile and optimize native code on each of these devices. There are a lot of developers who are proficient in Java due to Java having open source support and lots of libraries to use. Java also protects against many exiting problems such as memory leaks and bad pointers. It can also be used to build sandbox style applications and implement a security model which prevents a bad app from ruining an OS. (Bayt.com., 2017).

Java however can also be quite slow. Often the process of compiling and running a java application can be much slower than other languages which are like it. Java also uses more system resources due to things like the jvm and garbage collector. These make it a lot more resource hungry than say c++ for example.

Android

Android is responsible for providing functionality to millions of mobile devices all over the world. In fact, Android is the most installed of any mobile platform. This is due to its rapid usage growth which keeps on increasing day by day. Android enables developers to create and distribute mobile apps and games for Android through an open marketplace with ease on a world class platform. (Android, t., 2017).

Android itself offers developers a fantastic platform to develop native apps on. Having had a taste of mobile development for IOS using swift, I can safely say that android has its advantages over IOS in a development sense.

Android allows developers to distribute to any device running Android. It's very simple, if you develop an app for android, it can be run on any device powered by it. With IOS however, you can only run your apps on an apple brand machine. Android is also a free platform to develop for and is easily accessible to anyway. No matter who you are or what os you use, android is generally available to use. You can download android studios for windows, linux and mac and can create a developer account free of charge. A fee of $25 is required however to push your apps to the app store. Apple on the other hand requires a mac to use XCode and swift and has a yearly recurring charge of $99 for their developer account. Along with the cost of the developer account, IOS apps can take some time to publish on the app store. Some may take anywhere from several days, to several weeks to be published whereas android will generally have your app up on the store within a few hours.

Android does have some drawbacks however. Often more code is required to create an android app than say an IOS app. This results in more time being spent on developing and android app compared to its competitors. Layouts and animations are much harder to implement on Android. Androids use of xml layouts may offer more customisation however, implementing complex layouts in xml can often be quite time consuming and frustrating.

Angular-nvD3

Angular-nvD3 is "An AngularJS directive for NVD3 re-usable charting library (based on D3)". (Krispo.github.io., 2017). It "allows users to easily customise charts via JSON API". (Krispo.github.io., 2017).

This chart library allows developers to create complex charts in very simple ways. There is a good level of documentation associated with it and has quite an easy learning curve. As it is built on the ever popular D3 library, it already has a lot of functionality built in out of the box and a good level of support behind it.

As with any other framework or library however, what you see is what you get. Angular-nvD3 is no exception to this and if it doesn't have what you are looking for, you may have to look elsewhere.

AWS

Amazon Web Services (AWS) is an example of a secure cloud based platform which offers its users a multitude of different functionality such as compute power, database storage, content delivery and much more. AWS also enables businesses to grow and scale thanks to its cloud products and solutions which allow for flexibility, scalability and reliability. (Amazon Web Services, Inc., 2017).

AWS has been around for about fifteen years now and has been at the fore front of cloud hosting since it began to take off. It is one of the most preferred IaaS (Infrastructure as a Service) providers now a day also offering services such as its EC2 or Elastic Compute Service to anyone ranging from students to businesses. AWS has a lot of things going for it too. It boasts a very cost effective and scalable platform which offers a high level of security and flexibility. They also offer incentives such as a student access scheme for third level students which allows for greater availability.

Although AWS seems to quite a hot favourite when it comes to cloud hosting, it can also have its own drawbacks. The pricing model for AWS is very confusing at times and often leaves bemused as to what they are paying for. It can also become quite expensive as you scale up your operations to fit your needs. There is a steep learning curve associated with AWS also. Control panels are often difficult to navigate and it can take some time to often find what you are looking for. It can often be overkill too. Although AWS offers quite a large amount of functionality, for something as simple as hosting a basic web page, it can be very much over the top. There have also been problems in the past where AWS is in accessible due to server outages.

Digital Ocean

(DigitalOcean., 2017) describe themselves as "a cloud infrastructure provider focused on simplifying web infrastructure for software developers.". When it comes to the area of web hosting, Digital Ocean are quite a strong contender. In fact, they are currently responsible for maintaining over "50000 teams" web sites including the likes of HP, Zendesk, Docker and many more.

They also state that their main advantages are "SSD-only-cloud, Simple Control Panel, Professional hosting starting at 5$, Active Developer Community and one-click installations". What I really like about Digital Ocean is just how simple it is to use. If we come its control panel to the likes of AWS for example, its streets ahead. Digital Ocean also offer great transparency and clarity around pricing. You sign up, create your droplet and select how much you want to pay a month and it's as easy as that. Another great thing about Digital Ocean is that they offer

50$ free credit through the github education pack. This means that you can avail of a professional service without having to pay out any of your own money.

Some of the disadvantages of Digital Ocean are that they don't offer and Windows based images, you are given the opportunity to make a mess of your server setup / maintenance and support isn't the best.

Recommender Systems

It is more than likely that anyone who browses the web on a day to day basis has encountered a recommender system in one form or another. A few popular examples would be the likes of Amazon, Facebook or Netflix. Recommender systems can provide recommendations to a user based on items or information analysed by the system. (Jannach, D., 2012). By using things like user preference and limitations or constraints, the system will try to recommend what it classifies as the most suitable items to the user. (Ricci, Rokach, and Shapira., 2010).

Recommender systems themselves are very popular and powerful additions to any system nowadays. They allow users to find items in a system which they may have never previously considered or may not have even known existed. They are also great for allowing the user experience to be personalised in a way that may not have been possible before their conception. They also work off real time data and decisions, so the user can always ensure that anything that is recommended to them will be of some relevance.

Recommender systems however do have their own drawbacks and down falls. They can often rely on vast amounts of data to exist in a database to make recommendations on. This can be a problem for newer systems that currently don't have the same amount of data as well established systems. On top of this, they can often at times return what users may consider 'wrong recommendations'. This can be down to the popularity of an item that has been aimlessly interacted with, users inputting false data or once again, not enough data to analyse.

Collaborative Filtering

An example of a recommender algorithm is Collaborative filtering. It uses data such as ratings, preferences and other user behaviour to make its predictions or recommendations to a user. The algorithm assumes that other user preferences can be combined to allow a prediction to be formed and provided back to the user. (Ekstrand, M., 2011). Collaborative filtering presumes that if a group of users tend to both like and dislike a set of the same two items, then that group of users will have a similar preference for a similar set of items. (Linden, G., Smith, B. and York, J., 2003).

Collaborative filtering is widely used across many different recommender systems in today's day and age. There are several reasons why this is the case. Firstly, collaborative filtering is quite a versatile algorithm to use when it comes to recommender systems. Due to the simplicity of its implementation, it can be used across many different domains with ease. Collaborative filtering also doesn't have a lot of overhead associated with it as opposed to the likes of content based filtering. A very simple implementation would require a simple two-dimensional matrix with rows and columns specifying users and items for example. In the content based model, there is often a lot of overhead associated with items that also needs to be stored to make recommendations to a user.

Although there are many advantages to collaborative filtering, there is also one major disadvantage. Collaborative filtering relies heavily on vast amounts of data already existing within a system. If there isn't enough data within a database for the system to analyse, it cannot in turn make any recommendations, ultimately rendering the system useless.

Content Based Filtering

Content based filtering is very like collaborative filtering. The main difference between the two is that content based filtering will mainly target a single user's profile and a list of items as opposed to the multi user approach of the collaborative model. A single item and user will both have a set of attributes assigned to them. The user's attributes will be updated as they interact with each item and this will ultimately update the users profile and enable the system to make future recommendations.

Nowadays user's profiles are often generated by automated systems based on analysing their actions or choices, as opposed to a user manually inputting data about themselves. (Carreira, R., Crato, J., Gon?alves, D. and Jorge, J., 2004). Allowing the system to automatically generate the users profile data has its advantages. Common errors such as lack of user input can be avoided using this automated approach. The user does not have to worry about tracking items they have an interest in, this will be taken care of by the system. The user can also focus on simply using the application itself and won't have to worry about an extra functionality.

A recommender system can use several different techniques such as relevance feedback, algorithms or Bayesian classifier to build up and learn about a user profile. (Recommender-Systems.org, 2012). All of which will allow the system to construct relevant recommendations for the for the user in question.

As with many techniques in machine learning, there are often weaknesses to it. Content based filtering and its weakness can often arise when a system solely relies on it. A study conducted on content-based filtering and the results showed that predictions could often be very in consistent based on the domain of the application. (Hurwitz, J., 2006).

Artificial Neural Networks

"Artificial neural networks (ANN) are a form of computing for predicting a set of outputs from a set of input patterns (a set of variables). This machine learning method is motivated by the functioning of biological neural networks that consist of neurons and links (nerves). The neurons serve as the processing units and links serve as the connections between neurons.". (Zhu, A., 2017).

There are a lot of reasons why a system might need to implement an artificial neural network. Neural networks have been applied in several different industries already to accommodate real world problems. They can solve very complex problems in a quicker amount of time than other algorithms or techniques may take. Neurons can be used in parallel to achieve faster computation times. They may also be able to apply human like reasoning to a given problem, find obscure patterns in data or even predict future trends with ease. (Ciobanu, D. and Maria, M., 2013). Whatever the case for choosing neutrals networks, they can be quite a powerful technique to use when it comes to data prediction or problem solving.

One of the major disadvantages with neural networks presents itself after a neural network has been trained. If we wish to add more data down the line to the neural network, we would either completely re-train it or start from scratch.

K Nearest Neighbour

K Nearest Neighbour (KNN) is a lazy learning classification algorithm which is non-parametric. What this means is that the algorithm makes no underlying assumptions on the data and that there isn't really any training phase associated with it. This results in quite a quick training phase, but because of this it is very inefficient in time and memory. (God, Your Book Is Great !!., 2017).

KNN is primarily used in situations where there is not a lot of knowledge about a dataset already. It works by firstly determining the distance of the closest K neighbours. It will then secondly classify its neighbours and will finally vote on each one of the nearest k neighbours to determine its own class. KNN is a very powerful algorithm due to its simplicity and because of its ability to produce non-linear decisions. It can really show its worth in recommender systems when analysing a whole dataset may not be an option.

One of the biggest downfalls of KNN however is when it comes choosing the value of K itself. There doesn't seem to be defined way of choosing K. It is well known nonetheless that the lower the value of K, the less noise there will be from the given data, however a value of K that is too low may result in the model itself being too easily classified.

Travis CI

"Travis CI is a hosted continuous integration platform that is free for all open source projects hosted on Github. With just a file called .travis.yml containing some information about our project, we can trigger automated builds with every change to our code base in the master branch, other branches or even a pull request". (Basu, S., 2017).

Travis CI offers many advantages over its competitors. One of the biggest ones being that it is a hosted solution. Often with CI systems such as TeamCity, a local server is required to host and run the system itself. By offering hosting as part of the package, Travis makes it easier for smaller companies to really avail of continuous integration and all the benefits it has to offer.

One of the major disadvantages of Travis however is its lack of customisation. Developers will be forced to use third party add-ons for much of the functionality that is already provided by the likes of TeamCity.

Selenium

Selenium is used to automate browsers and is primarily used for web application testing. (Seleniumhq.org., 2017). Selenium works by interacting with the DOM api via JavaScript driver. The driver can in turn be accessed using Java or C# bindings and can be used to run suites of tests for a given web application.

I have some previous experience with Selenium from my internship in the summer so I am aware of what it can and can't do, its advantages and disadvantages.

One of the major advantages of Selenium is that it is free and open source. How you choose to utilise it as a developer is completely up to you. Another advantage of Selenium is that it relies on JavaScript and DOM interaction. If a developer is familiar with either, it means that there will be a relatively low learning curve associated with Selenium.

On the opposite side of things, Selenium is often prone to unexpected crashes and strange errors. The community associated with Selenium is quite small. Because of this, questions you have may not yet have any answers. This can often result in a developer spending far too long trying to sort out issues when they could in turn be better spending their time elsewhere.

Other Relevant Research Done

Continuous Integration

Continuous Integration (CI) enables automatic building and testing of code once any given member of a team has checked code into a repository. Once code has been committed, the CI system of choice will automatically pull from the given repository, build and or test the code itself. (Guckenheimer, S., 2017).

There are many advantages to using continuous integration no matter how big or small your team is. One of the biggest advantages is that it removes the need to manually run tests or builds on your local machine. This can be great for bigger teams since each member can see both the build and test results. For both large and small teams however, it is useful for freeing up system resources. It allows means that there is no need to devote a single developer to run tests, builds and deployments also. Continues integration really shows its worth however when it comes to longer builds or test runs. These can often be run over night and can often result in developers devoting their time to other more pressing issues.

CI does have some drawbacks however. Some CI systems can be very tricky and complex to setup and may require a lot of time to the initially setup. Another issue with CI is when the CI system throws unknown errors not related to a build or test runs. Severs may fail, network connections may die, disk space issues may arise and this may lead to some frustration if tests or builds may need to be run again.

Scrum Methodology

"Scrum is a subset of Agile". It is quite a lightweight form of agile that is mainly based around processes or practices which must be closely adhered to. Scrum can be seen in environments which are related to either complex pieces of software or product development and which tend to follow iterative or incremental processes. (cPrime., 2017).
Scrum has many advantages associated with it. Because of this it is often one of the first methodologies chosen by a business to suit their needs. One of the main advantages of scrum is that it is a face paced and adaptive methodology. This means that problems or changes can be quickly overcome with little to no hassle. Scrum also ensures that sprints are kept short, lightweight and easy to maintain. Because of this, constant feedback is always provided, issues are identified well in advance and it is easier to maintain and deliver a quality project in a set period.

Scrum also has some key disadvantages however. It does not work well with single developer teams. Scrum usually dictates that there are several different roles on a Scrum based team. If a single developer was to take on these roles, they would be better off in the long run switching to a different methodology

altogether. On top of this, if a task or tasks are not very well defined within a Scum based environment, it can often lead to a lack of clarity and can often lead to extra hours worked on a project there were never needed in the first place.

Iterative Design

According to (Pidoco.com., 2017), "Iterative design is a process of designing a product in which the product is tested and evaluated repeatedly at different stages of design to eliminate usability flaws before the product is designed and launched". Iterative design can be utilised on any scale, big or small. Even if you are a solo developer, or work as part of a team, it can be quite a simplest, yet powerful methodology to follow.

By utilising the iterative design model, a step by step approach can be taken with the design and implementation of a piece of software. It allows for more thorough designs, implementations and can provide a better way of catching major defects before they manage to make their way into the system. As the system is contently built up over a phase of iterations, greater feedback can also be given on specific components of the system in question. As well as this, the iterative design model allows for more time spent on design and implementation and less time on documentation.

Some of the main drawbacks with iterative design however relate to how rigid each iteration can be. Because of this rigidity, there is often no overlap between phases. Another knock-on effect is to do with the overall system design. Since all requirements may not be gathered up front, design issues may arise due to uncertainty about the system.

Pomadoro Technique

The Pomodoro technique is a time management based approach used for organisation and completion of tasks. The idea behind the technique is to split your time into 25 minute blocks or sessions with a 5-minute break after each session. Once you have completed around 4 sessions, you are said to have completed a round of Pomodoro's. (Focusboosterapp.com., 2017).

In theory, the Pomodoro technique is a fantastic way to optimise productivity. This is mainly due to the requirement of 25 minutes of highly focused work. It also enables the user to break larger tasks into smaller more manageable tasks. This may result in a better quality of work as well as less errors overall.

In practice however, the Pomodoro technique may not be best suited to a project of this variety. This is mainly because the final year project requires only a percentage of the student's time and not all of it. Nonetheless, it would be best to try and implement the technique where possible to better manage the workload and keep the quality of work to a high standard.

Kanban Board

Kanban boards are a way of visualizing tasks which relate to your current workflow. The board uses the concept of vertical lanes or columns on the board to separate tasks. Each lane can be given a unique heading such as 'to do' or 'done' and there is no limit on the number of lanes you can have on a single board. A Kanban card or is placed on the bored and will relate to a certain task within your workflow. (LeanKit., 2017).

Being able to visualise a work load can often put things into perspective. It's very easy to plan something in your head and not truly realise the true extent or the sheer size of what's involved. I liked the idea of the Kanban board because it meant that I would be able to keep track of things, prioritise and ensure that my workload would be kept at a reasonable level throughout the project.

Although the Kanban board has its benefits, it can be quite easy to overpopulate. There is also no set template for a Kanban board as each user's requirements will differ.

Gannt Chart

"A Gantt chart, commonly used in project management, is one of the most popular and useful ways of showing activities (tasks or events) displayed against time". (Gantt.com., 2017).

Gantt charts can be quite a useful resource when it comes to project management. It enables both the person who created it and the person / people viewing it to easily keep track of what is happening within a given project. Because of this, it ensures that everyone is aware of important details such as timeframes, tasks and different requirements for each item on the chart. The Gantt chart also ensures that people can plan to prepare for items of greater complexity if required.

Some of the main disadvantages of Gantt charts lie with their complexity. As a Gantt chart can be a collection of many different items or tasks relating to many individuals or projects, its complexity can be quite overwhelming. This in turn can have knock on effects if, for example a deadline was extended. Because of this, the Gantt chart would have to be re drawn to facilitate new deadlines. Also, lines on a Gantt chart do not represent how much work may be involved in a certain set of tasks. It is merely an indicated of how long a given task may take to complete.

Requirements Testing

"Requirements-based testing is a testing approach in which test cases, conditions and data are derived from requirements. It includes functional tests and non-functional attributes such as performance, reliability or usability". (www.tutorialspoint.com., 2017).

Requirements testing is a great way to determine whether a piece of software is functioning properly or not. Anyone from a developer to even a business analyst could write a very basic requirements tests to prove a system is working as intended. Nonetheless, there are a lot of things requirements testing cannot tell about a system.

To begin with, requirements testing in not concerned with how a piece of software functionally goes about implementing a requirement. Once the requirement is met, the test is considered passed. This can be quite a dangerous way to test a system if used on its own as there is potential for underlying bugs, flaws or weaknesses in the system they may go uncaught. Requirements may not also be written correctly. Because of this, the outcome of the test may through a false result while still functionally working as intended. Requirements also tend to change quite frequently within a system. Tests may have to be re-written for this reason and can have a knock on down the line.

Unit Testing

Unit testing allows developers to test the smallest components of a piece of software. A single unit test will focus on the "internal process logic and data structures within the boundaries of a component ". (Pressman, R., 2005).

Unit testing itself offers quite a lot of benefits. Problems with a single piece of code can often be uncovered quite quickly and early because of unit testing. Because of this, integration testing is often a lot quicker and easier. Unit testing can also enable developers to produce very accurate test coverage reports on their code. Finally, unit testing will also be able to verify whether the design of a piece of software is valid or whether there are problems with it.

On the flip side of things, unit testing also has some drawbacks. Unit testing itself can often be a very time consuming process. On top of writing the unction code for the application itself, specific test cases will have to be created and implemented on top of this. Integration errors and system errors are very rarely caught also seen as how only the functionality of the code itself is tested. Finally, the accuracy of these tests may be sometimes called into question. Initial requirements for a specific test case may not have been setup correctly and could give a false result in the test.

Regression Testing

Regression testing is a means to ensure that errors have not made their way into a piece of software throughout the testing process. (Agarwal, B., Tayal, S. and Gupta, M., 2010).

Regression testing is vitally important in any operation to ensure no new bugs are introduced and that current functionality remains the same when new features are introduced. A big advantage of regression testing is that it can be automated also. Frameworks like selenium can be used to mimic the same user

input on a web application repeatedly to ensure results stay the same. Regression testing also ensures that any issues which have previously been flagged and fixed are no longer a problem. Regression testing also can be used during integration testing to ensure components continue to work properly together when changes have been made.

One of the major drawbacks with regression testing however is that it can be timely. If a problem is detected during regression testing and the fault is quite a big one, it can often result in the entire suit of tests being re-run again. This may be very time consuming if entire suites can take several hours to run.

System Testing

System testing is a way of determining whether a system meets both the functional and non-functional requirements. Usually the entire system is tested and system testing itself can be sub-divided into three sub categories. (Britton, C. and Doake, J., 2006). These three sub categories are Alpha, Beta and Acceptance testing and each have their own advantages and disadvantages.

Alpha testing is normally conducted by a test team or by the developer if there is no test team. Beta testing involves a group of individuals who volunteer to test the software having no prior exposure to it. Acceptance testing is performed by the users of the final production version of the software.

One of the main advantages of system testing is that you as a developer can receive feedback from a multitude of different users. It also allows the software to be tested by users who have had little to know exposure with them system itself. This can often result in errors arising that may have been previously missed by another individual. It also enables developers to receive realistic feedback about how the system performs overall and what they can do better.

The main disadvantage of system testing is that it can often be hard to source users to beta test. Alternatively, if your software isn't very popular by some chance, feedback on the production version of your software may be limited.

Resultant Findings and Requirements

Findings

After conducting a lot research on technologies, methodologies and techniques, I was able to produce the following findings:

Researched Technologies

- Angular:
    - Advantages: Has lots of built in functionality, does not require third party libraries to perform for common functionality and can be very rewarding to use.
    - Disadvantages: Has a steep learning curve and is subject to versioning.
- React:
    - Advantages: Easy to learn, simple to use and is very popular.
    - Disadvantages: May require third party libraries to perform basic functionality.
- PHP:
    - Advantages: Free to use, easy to setup, works well as part of a LAMP stack, great documentation and community and is very scalable.
    - Disadvantages: Security can be an issue if not done right.
- MySql:
    - Advantages: Very secure and reliable, highly scalable, offers a good level of performance and round the clock up time.
    - Disadvantages: Has stability issues and development has ceased to exist on MySQL.
- MongoDB:
    - Advantages: Flexible data storage and high data availability
    - Disadvantages: Very ram intensive. High amounts of data can cause deadlock on the database.
- Apache HTTP:
    - Advantages: High level of compatibility with operating systems, customisable, free to use and offers great support and documentation.
    - Disadvantages: Security issues relating to customisation.
- Python:
    - Advantages: Easy to use and understand, very flexible and a great community and support associated with it.
    - Disadvantages: Doesn't tend to scale well.
- Java:
    - Advantages: Offers solutions to optimise native code, open source support and prevents against things like memory leaks.
    - Disadvantages: Can be very resource intensive / hungry.
- Android:
    - Advantages: Can run on many devices, free to use and very good documentation.

    - Disadvantages: Can often require more code to develop apps than other native solutions.
- Angular-nvD3:
    - Advantages: Easy to use and well documented.
    - Disadvantages: Functionality is limited.
- AWS:
    - Advantages: Very cost effective and scalable, offers a high level of security and flexibility.
    - Disadvantages: Can be quite confusing to use, offer more functionality than you may need and pricing model can be ambiguous.
- Digital Ocean:
    - Advantages: Simple to use, lots of customisation, very clear price plan and free credit through GitHub education pack.
    - Disadvantages: No windows machines, customisation can result in destroying a virtual machine.
- Recommender Systems:
    - Advantages: Very powerful and useful, can take away a lot of un needed data processing and can be tailored to a specific user.
    - Disadvantages: May need a vast amount of data to function well and may provide in correct recommendations.
- Collaborative Filtering:
    - Advantages: Very versatile, not a lot of overhead associated with it and easy to implement.
    - Disadvantages: May require vast amount of data to function well.
- Content Based Filtering:
    - Advantages: Can create customised user profile automatically and eliminates user input errors.
    - Disadvantages: System can fall over when relying solely on Content Based Filtering.
- Artificial Neural Networks:
    - Advantages: Can be used in several areas to solve many problems, can solve problems much quicker than standard algorithms and can also apply human like reasoning.
    - Disadvantages: System must be re-trained if data changes.
- K Nearest Neighbour:
    - Advantages: Extremely simple to use and implement.
    - Disadvantages: Can have problems if not implemented correctly.
- Travis CI:
    - Advantages: Hosted solution offered as part of GitHub education pack.

    - Disadvantages: Lack of customisation.
- Selenium:
    - Advantages: Open source and can be utilised in several ways.
    - Disadvantages: Prone to unknown errors.

Chosen Technologies

Technology	Reason for choosing it
Angular	Wanted to challenge myself (lack of experience) and good level of functionality offered.
Angular-nvD3	Best library available for angular graphing.
Android	Previous experience with it and it is free to use.
Java	Highly experienced in java and is android's language of choice.
PHP	Fits well into my chosen LAMP stack and previous experience with it.
Apache HTTP	Previous experience with it and it is free to use. Fits well in my chosen LAMP stack.
MySQL	Previous experience with it and it is free to use. Fits well in my chosen LAMP stack.
MongoDB	Will work well with machine learning aspect of project.
Digital Ocean	Very simple to use and credit offered as part of GitHub education pack.
Recommender System	Seemed to fit project better than artificial neural networks.
K Nearest Neighbour	Best algorithm to use out of the three due to a lack of data in the system.
Travis CI	Offered as part of GitHub Education pack. Will allow me to run unit tests on a hosted machine.
Selenium	Free to use and can automate requirements tests for repeated runs.

Other Findings

Findings in the area of methodologies are discussed in section three and findings with regards to testing are discussed in section six.

Requirements

Below is a set of tables which outlines my set of requirements for both my mobile and web application. Each requirement is designated a phase, number or id, name, description and priority. The phase will relate to when the requirement will be implemented in the development cycle. The priority implies how important it is to the overall project.

Web Application

Phase	Requirement Number	Name	Description	Priority
1	1	User Login	Enable both athletes and coaches to login	HIGH
1	2	User Logout	Enable both athletes and coaches to logout	HIGH
1	3	User Sign Up	Enable both athletes and coaches to signup	HIGH
1	4	User Update Profile	Enable both athletes and coaches to update their profiles	HIGH
3	5	Athlete Create Training Log	Athlete can create a new entry on a given day of their training log	HIGH
3	6	Athlete Update Training Log	Athlete can update an entry on a given day of their training log	HIGH
3	7	Athlete Delete Training log	Athlete can delete a single training log if they wish to	HIGH
3	8	Athlete View Training Log	Athlete can create a new entry on a given day of their training log	HIGH
3	9	Coach Create / Update / Delete Training Program Templates	Coaches can create / update / delete training templates that can be used when filling out training logs	HIGH
6	10	Athlete Find a Coach	Athlete can search for and filter coaches and choose one to coach them	MEDIUM
6	11	Athlete Manage and Share Training Logs	Athletes can pick and choose what coaches to share their data with and what permissions they have	MEDIUM
6	12	Coach View List of Athletes	Coach can view all athletes which they are currently coaching.	MEDIUM
6	13	Coach Update Athlete Training Logs	Coaches can update athletes training logs given that they have permission to and that they coach them.	MEDIUM
6	14	Athlete set training targets	Athlete can set their given targets over a	MEDIUM

			period. Can be seen by coaches and acted upon	
7	15	Coach Schedule One to One Consultations and Webinars	Coach can setup one to one consultations with clients via google hangouts or live webinars via YouTube	LOW
7	16	Athlete Participate in One to One Consolations and Webinars	Athletes can participate in either one to one consolations with a coach via google hangouts or in live webinars with their coach and other athletes via YouTube / Twitch.	LOW
8	17	Athlete Recommendations by the System	The application will analyse previous user data and will recommend training plans based on this.	LOW

Mobile Application

Phase	Requirement Number	Name	Description	Priority
2	1	User Login	Enable both athletes and coaches to login	HIGH
2	2	User Logout	Enable both athletes and coaches to logout	HIGH
2	3	User Sign Up	Enable both athletes and coaches to sign up	HIGH
2	4	User Update Profile	Enable both athletes and coaches to update their profiles	HIGH
4	5	Athlete Create Training Log	Athlete can create a new entry on a given day of their training log	HIGH
4	6	Athlete Delete Training log	Athlete can delete a single training log if they wish to	
4	7	Athlete Update Training Log	Athlete can update a new entry on a given day of their training log	HIGH
4	8	Athlete View Training Log	Athlete can create a new entry on a given	HIGH

			day of their training log	
5	9	Allow for Offline Usage	Data must be able to be cached locally and used offline by users	MEDIUM

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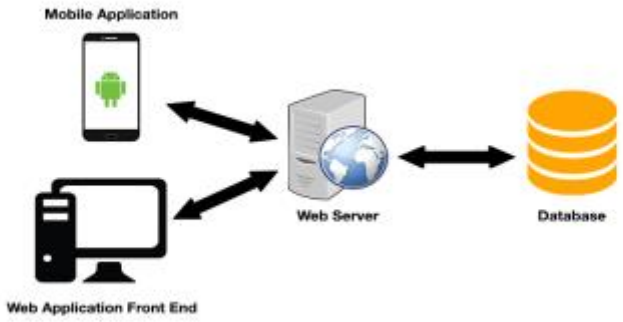
3. Approach and Methodology



The above image shows my proposed architectural approach for the project. It consists of a basic three tier model with the first tier separated into two separate components.

Iterative design was chosen over scrum as my methodology of choice. I felt as though it was better suited to a one-person team and was ultimately why I ended up choosing it. By using iterative design, I will be able to break my requirements into different phases or iterations. Within each iteration, I will be able to deal with the design, implementation and testing of each specific phase. By doing this I will be able to easily monitor progress and stick to a schedule (outlined in section eight). By doing this I will be easily able to monitor and manage the project.

A Kanban board will also be used to keep track of tasks for a given week / phase. By doing this I will enable myself to visualise my workload at any given time. It is vitally important throughout the course of this project that I keep on top of all my requirements and tasks. By doing this I will be able to ensure that deadlines are not missed and that my workload at a given time is evenly distributed. The Kanban board will enable me to do this and will ultimately play a very impotent role in the area task management.

To manage my time efficiently, I have opted to use the Pomodoro technique where possible. Although it may not be possible to devote full days to work on my project, I think it is important to ensure the quality of work produced is to a high standard. By utilising the Pomodoro technique where possible, I can ensure two things. Firstly, that any time devoted to working on my project will be well

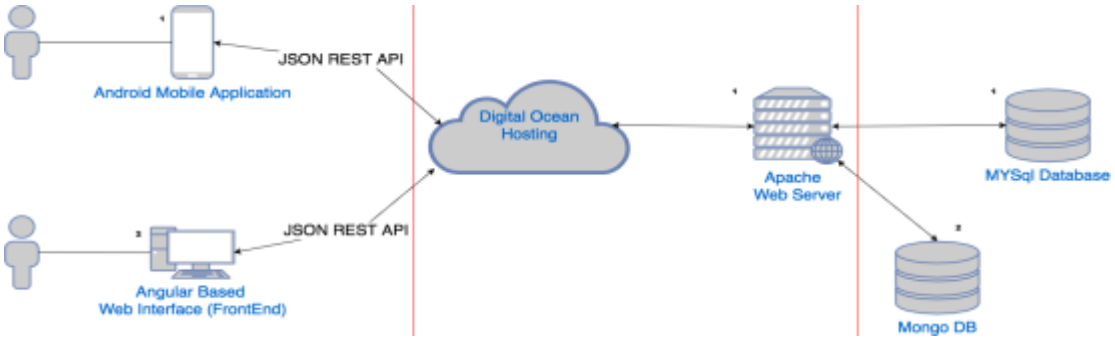
used. Secondly, that the quality of work produced in this time is of a good standard. A good standard of work will be vitally important to ensuring the project is a success.

A Gantt chart (included in section eight) will also be used to assist with time management and to ensure that the project stays on track. It will be used to plan remaining time and to make sure that other modules receive proper attention also. The chart will include time off at Christmas, for exams and will also incorporate time near the end of the project for documentation and testing. Although the Gantt chart is a good indicator of how long a certain phase may take, it may be by no means completely accurate. However, it will be useful as a guide to stick to so that I can ensure all work is completed in a reasonable timeframe. This will again allow me to better manage my time on both the project and other modules.

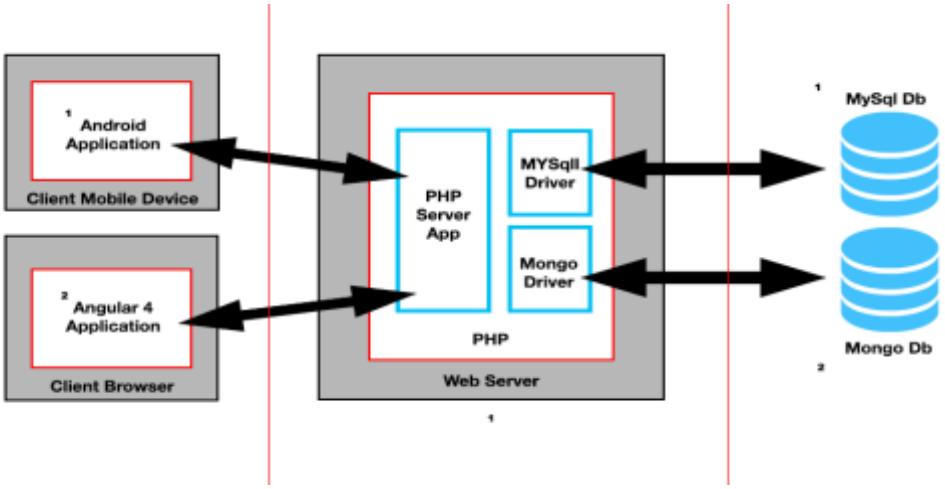
4. Design

Technical Architecture Diagram

Both the Android and Angular apps will implement a Model View Controller (MVC) approach. The android app will use Java for functionality and xml for screen layouts. The angular app will use typescript for the functionality (this will be trans piled into JavaScript) and will use both html and css for screen layouts. Both apps will use HTTP requests to communicate with the PHP REST API running on an apache http server. The web server will be stored on a digital ocean virtual machine along with the MySQL and Mongo databases.



For the PHP REST API to communicate with both the databases, it will need to use drivers such as mysqli and mongo.



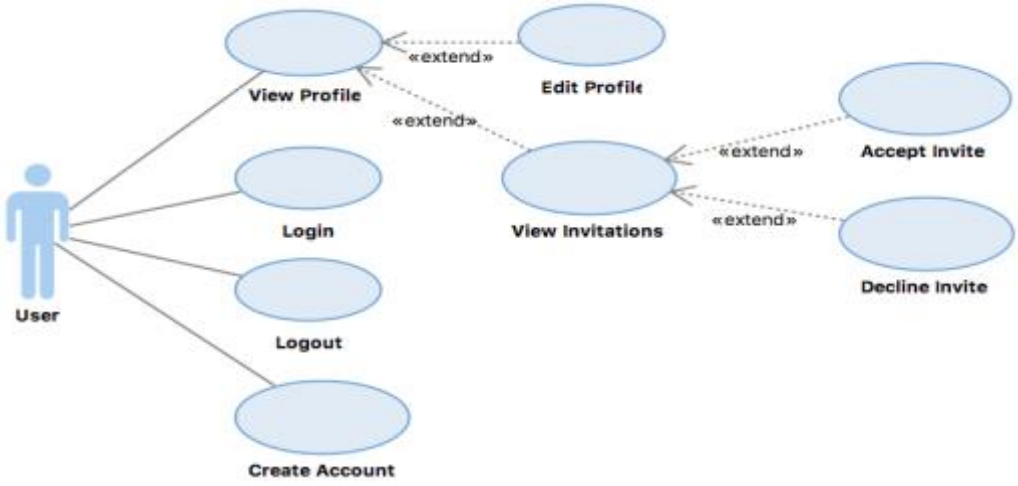
Other Design Documents

Use Cases

Within the application itself, there will be pieces of functionality that will be able to be accessed by both athletes and coaches, by only athletes and by only coaches. In the use case diagrams below I have outlined the major use cases which correspond to a type of user. The use cases were created for mainly the web application; however, all uses cases for the mobile application are contained within them also.

User

Below are the use cases that will be shared by both types of user (coach and athlete).

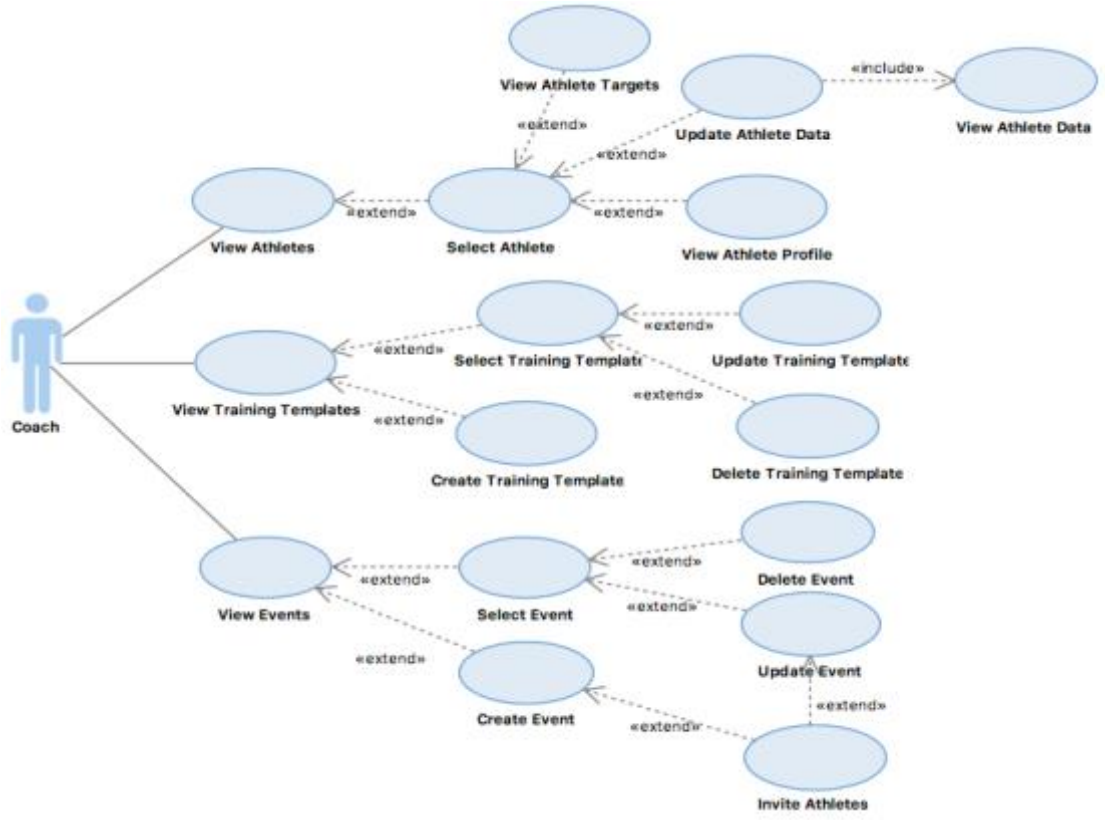


Both types of user will be able to avail of basic functionality such as logging in and out, creating an account as well as viewing their profile to either edit it or view a list of invitations. These uses cases (except invitations) will be accessible on either front end component (angular or android). The front-end component

will make a request to the REST API, which will in turn retrieve data from the MySQL database return it to the calling component to fulfil the request.

Coach

Below are the use cases that will be only accessible to the coach.



This use case diagram is divided into three sub categories. They are athletes, templates and events. The base use case for these categories is to view them. These base use cases will require the front-end component (only angular component for coaches) to make a request to the REST API, which will in turn retrieve data from the MySQL database and return it to the calling component to fulfil the request.

The angular front end will allow coaches to perform an array of tasks. One of the most important pieces of functionality for a coach will be the ability to interact with their athletes. They may do this in several different ways. If they wish to have no contact with their athlete, they may view an athletes training logs and update them accordingly for the coming week (If they have been granted access by the athlete). They may also view training targets set by athlete to better plan future sessions for them. If on the other hand a coach wishes to contact an athlete to discuss sessions, they may schedule a one to one consultations through the events page or they could view their profile to get their mobile number or e-mail address.

Another key piece of functionality for a coach may be to store training templates to use in the future. If a coach has specific session templates that they like to stick to or recommend to athletes, they can input them into the application and store them for later use. Alternatively, they will be able to use these templates when updating or creating training logs for their athletes

Athlete

Below are the use cases that will be only accessible to the athletes.

This use case diagram is divided into five sub categories. They are training logs, coaches, data access, targets and events. The base use case for these categories is to view them. These base use cases will require the front-end component (only angular component for the coach, data access, targets and events categories) to make a request to the REST API, which will in turn retrieve data from the MySQL database and return it to the calling component to fulfil the request. For the 'Get Recommendation' use case however (exclusive to angular app also), the REST API will interact with a 'machine learning' component on the server and will retrieve the data from mongo instead of MySQL.

For the athlete, the most important piece of functionality will be storing their data. They will be able to achieve this from either the mobile app or the angular app. The will be able to perform basic functionality such as creating, updating and deleting of training logs and will also be able to view logs in a given period which will be defined by the user.

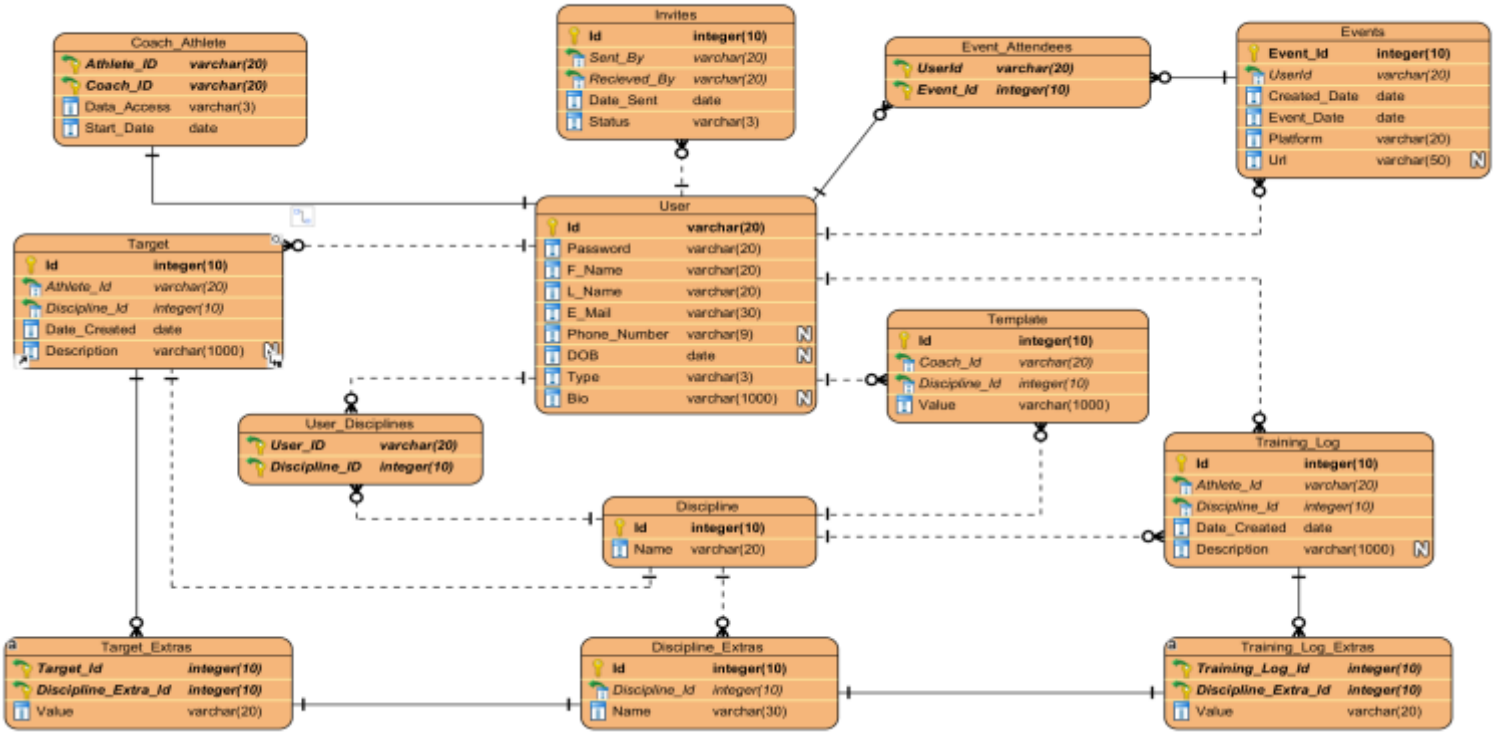
Another key piece of functionality the user may wish to avail of is training targets. An athlete will be able to indirectly communicate with a coach by creating and maintain training targets. They will show the coach what an athlete wants to achieve over several sessions and will be able to show the athlete whether they have achieved their original goals or not.

If an athlete does not already have a coach, they can search for one in the database and invite them to manage their data. Because of this, the coach will now be able to view targets and logs of the athlete in question. If an athlete no longer wants a coach to have access to their data, they may simply revoke their access.

Finally, if an athlete wishes to participate in events that they have been invited to by their coach, they may access this from an events page once they have accepted the invite. They will be able to participate in things like webinars or one to one consolations with their coach and fellow athletes.

Entity Relationship Diagrams

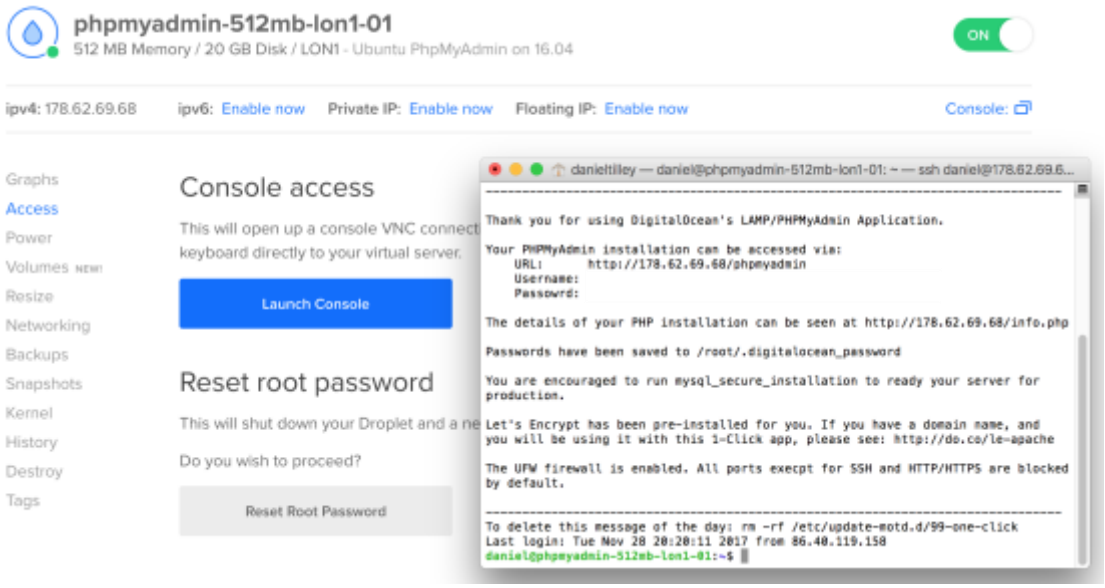
The following diagram is an entity relationship diagram for the Training Pal app. It shows a model of types of data that will be stored in the MySQL database.



5. Prototyping and Development

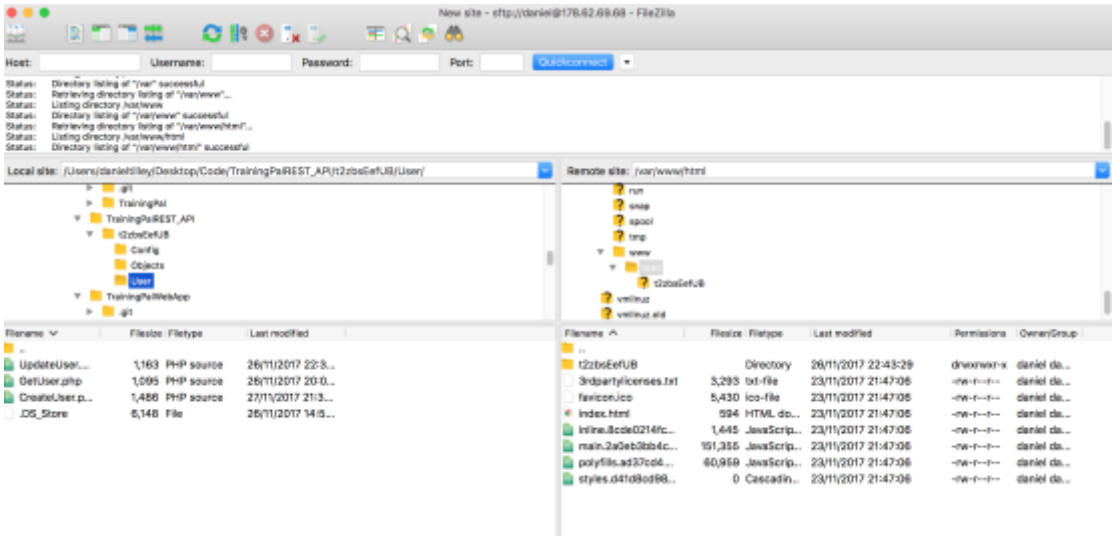
Environment setup

Digital Ocean is used to host the Angular web app, the PHP REST API and the MySQL and Mongo databases. Digital ocean offers users the ability to create and customise "one click droplets" with ease. I chose to create a "phpmyadmin" droplet which came pre-loaded with Ubuntu, PHP, MySQL and Apache HTTP Server. Once I had created the droplet I was able to access the server via the control panel or via shh command (see image below).



Before connecting to the server however, I had to setup and RSA key to ensure that I was the only person that could connect to my server. I followed their getting started guide and was completely up and running in about five to ten minutes. I also followed a similar guide to implement necessary security measures on the server. These included: changing the default user name and password and changing the url for PHP My Admin as well as disabling password access to the server and blocking all ports other than those which were necessary.

The final three steps for me were installing MongoDB, connecting an ftp client such as FileZilla (see image below) and rerouting my domain (traingpal.me) to the server. Again, there were simple to follow guides on their community forums and I had all tasks completed in twenty to thirty minutes.



Development and Prototype

The three main areas of development are:

- Angular Web App
- Android Mobile App
- PHP REST API

Each component required different ide's and dependencies to create and run them. My approach is as follows:

Component	IDE	Dependencies	Deployment Location
Angular Web App	Jet Brains Web Storm	Node, NPM and Agular CLI	Locally: Run in local folder using CLI ('ng serve' command). Accessible at http://localhost:4200 Server: Code was trans piled to JavaScript ('ng build –prod' command) and was placed in the apache web server folder. Accessible at http://trainingpal.me
Android Mobile App	Android Studios	JDK and Android Emulator	Compiled, built and run on local machine hosting android emulator.
PHP REST API	ATOM Text Editor	Zend and PHP 7.0 on target machine.	Locally: Code was placed in XAMPP web folder. Accessible at http://localhost/t2zbsEefUB Server: Code was placed in the apache web server folder. Accessible at http://trainingpal.me/t2zbsEefUB

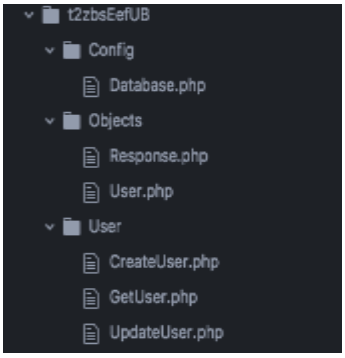
For both the Android Mobile App and the Angular Web Application I have implemented phase one and two of my development cycle (see section eight for more details.) The user will be able to login, logout, create an account and view their profile within either application. On the web app, they will be able to edit their profile. I had intended to add update profile functionality, but was a bit behind schedule.

Web App

The image below lays out the file structure of the web application. Within the app folder there are several sub folders. Directives are used to handles the likes of success or error alerts. Guards are used to protect against unauthorised access to certain URL's. Models represent data structures. Services are used to implement functionality like getting user details from db. The remaining folders map to different views in the application.

REST API

The image below lays out the file structure of the REST API. The parent folder is the endpoint the api is accessed from. It is a random string of characters to try and hide it from users. The config folder contains all db login information (These have all been removed for the interim submission). The objects folder is used to store objects that will be return to calling clients. The user folder is used as an endpoint for calling clients. If they wish to get a user for example, they would call the "GetUser.php" file and post data to it.



Mobile App

The image below lays out the file structure of the mobile app. The DAO folder is used to store classes that will retrieve data from either a local db or the REST API. The interfaces folder is used to store call-back interfaces that are used when querying the API. The model folder is used store data objects that will be used throughout the application. The utilities folder is used to store helper classes that will assist other glasses with functionality that it out of their scope. Both the activity classes and activity xml files are also show below. They will be responsible for manipulating the views on screen.

6. Testing

Requirements Testing

My most basic form of testing that I will be performing is requirements testing. Below are two tables which lists all the test cases for both the web and mobile app.

Web Application

Phase – Test Case	Feature	Test Action	Expected Result	Result
1-1	Open Webpage	Open webpage by typing url in browser	Webpage opens and login page is displayed	
1-2	User Login with valid details	Enter valid login details	Home page is displayed	
1-3	User login with invalid details	Enter invalid login details	Error is displayed	
1-4	Register New User	Click register on login screen	New user is created and taken to the login screen	
1-5	User logout	User clicks the logout button	User is logged out and re directed to the home screen	
1-6	User View Profile	User Clicks on their name on home screen	User is taken to a view profile screen	
1-7	User Edit Profile	User edits their profile after viewing it and clicks save	Users profile is updated and saved to the database	
3-1	User View Homepage	User logs in or user clicks the homepage button	Correct user homepage is displayed (coach or athlete)	
3-2	Athlete View Training Logs	Athlete navigates to home page	A list of training logs can be seen on the homepage for the current user	
3-3	Athlete View Training log	Athlete navigates to homepage and clicks a single training log	All info relating to that log is displayed on screen	

3-4	Athlete create training log	Athlete navigates to home page and clicks create training log, enters details and clicks save.	A new log entry is created and saved in the database. It should now be displayed on screen on the list.	
3-5	Athlete update training log	Athlete navigates to home page and clicks a training log to view it. Athlete then clicks update button, updates log and clicks save.	Training log is updated, saved to the database and the updated log displays properly on the list.	
3-6	Athlete delete training log	Athlete navigates to home page and clicks a training log to view it. Athlete then clicks delete button.	Training log is deleted from the database and the updated log is removed from the list.	
3-7	Coach View Training Program Templates	Coach navigates to home page	A list of program templates can be seen on the homepage for the current user	
3-7	Coach View Training Program Template	Coach navigates to homepage and clicks a single program template	All info relating to that template is displayed on screen	
3-8	Coach Create Training Program Template	Coach navigates to home page and clicks create program template, enters details and clicks save.	A new template is created and saved in the database. It should now be displayed on screen on the list.	
3-9	Coach Update Training Program Template	Coach navigates to home page and clicks a program template to view it. Athlete then clicks update button, updates log and clicks save.	Training log is updated, saved to the database and the updated log displays properly on the list.	
3-10	Coach Delete Training Program Template	Coach navigates to home page and clicks a program template to view it. Athlete then clicks delete button.	Training log is deleted from the database and the updated log is removed from the list.	
6-1	Athlete Search for Coach	Athlete navigates to find a coach screen and searches for a coach using one of	A list of coaches should be displayed on the screen	

		filters		
6-2	Athlete view coaches profile	After searching for a coach, the athlete clicks on the coach's name	Coaches profile is displayed on screen	
6-3	Athlete invite coach to view their data	After searching for a coach and clicking on their profile, the athlete can select what data to share and can click "invite to share"	Coach will receive an invitation and athlete will see the pending invite beside the coach's name	
6-4	Athlete manage data access	Athlete navigates to manage my data page, clicks on a coach, updates their privileges and clicks save	All privileges should be updated and correctly reflected on screen.	
6-5	Coach View List of Athletes	Coach navigates to home page	A list of athletes whose data they currently manage will show up on the screen	
6-6	Coach View Athlete Profile	Coach navigates to home page and clicks on "view profile" beside one of the athletes	Athletes profile will be displayed on screen	
6-7	Coach View Athlete Data	Coach navigates to home page and clicks on "view logs" beside one of the athletes	List of athlete's logs should appear on screen	
6-8	Coach Edit Athlete Data	Coach first views athlete's data, picks a log to alter and clicks the edit button beside the log name.	Coach should be able to edit the given log and changes should be saved to the database.	
6-9	Coach View Athlete Targets	Coach navigates to home page and clicks on view targets beside one of the athletes	The athlete's targets show now be displayed on screen	
6-10	Athlete View Targets	Athlete navigates to my targets page	A list of athlete's targets appears	
6-11	Athlete Create Target	Athlete navigates to my targets page and selects create target, fills in information and clicks save	A new target will be created and saved to the database	

6-12	Athlete Update Targets	Athlete navigates to my targets page, clicks on a target, updates it and clicks save	Target should be updated and saved to the database	
6-13	Athlete Delete Targets	Athlete navigates to my targets page clicks on a target and clicks delete target	Target should now be deleted from the database	
7-1	Coach Schedule One to One or Webinar	Coach navigate to events page and clicks new event. They choose the participant and fill in relevant information and click “schedule”	Event should be scheduled to take place and should be shown in a list. All athletes should have an invite sent to them.	
7-2	Athlete participate in One to One or Webinars	Athlete navigates to inbox, clicks relevant invite and clicks accept. Once event has started, athlete navigates to events page and selects the event to participate in.	Invite should be able to be accepted or declined. Once invite is accepted, event should appear in events page. Athlete should be able to participate in event once started.	
8-1	System makes Recommendations to Athlete	Athlete creates new training log.	System should be recommending data based on previous user input	

Mobile Application

Phase – Test Case	Feature	Test Action	Expected Result	Result
2-1	Open Application	Open application by selecting the icon	Application opens on login screen	
2-2	User Login with valid details	Enter valid login details	Home page is displayed	
2-3	User login with invalid details	Enter invalid login details	Error is displayed	
2-4	Register New User	Click register on login screen	New user is created and taken to the login screen	
2-5	User logout	User clicks the	User is logged out	

		logout button	and re directed to the home screen	
4-1	Athlete View Training log	Athlete navigates to view logs page and taps a single training log	All info relating to that log is displayed on screen	
4-2	Athlete create training log	Athlete navigates to view logs page and taps create training log, enters details and clicks save.	A new log entry is created and saved in the database. It should now be displayed on screen on the list.	
4-3	Athlete update training log	Athlete navigates to view logs page taps a training log to view it. Athlete then taps update button, updates log and clicks save.	Training log is updated, saved to the database and the updated log displays properly on the list.	
4-4	Athlete delete training log	Athlete navigates to view logs page and taps a training log to view it. Athlete then taps delete button.	Training log is deleted from the database and the updated log is removed from the list.	
5-1	Offline Usage	When user is offline, all functionality should still work.	Once user is re-connected, data should sync with online database.	

Unit Testing

Both angular and android have built in functionality and documentation about developing and running unit tests. I aim to implement a set of unit tests per development phase to test a certain piece of code. For both the first and second phase, I aim to implement unit tests after the interim submission. This is so I can setup my Continuous Integration environment (Travis) to automatically run unit tests. I also aim to use postman to perform unit tests on the REST API.

Regression Testing

Regression testing will be performed at the end of each phase. I aim to use Selenium and Travis CI (if possible) to run a set of application tests. The application tests can be taken directly from the requirements tests and coded to run automatically to save me time in the long run.

System Testing

Once all the development work has been completed, I intend to facilitate some form of system testing on the application. The may either be beta testing or system testing (depending on when the testing period is and how much development work has been completed). Users will include my father (a coach) and several of his athletes and will be contact in advance of the testing period. I will ask the users for feedback in order to determine whether or not the application will be a success.

7. Issues and Risks

There are many issues and risks associated with this project in both a technical and non-technical aspect. I have summarised the main issues / risks in the table below, but go into more detail below the table.

Issue / Risk	Proposed Solution	Is Outstanding
Time Management	Stick to schedule / gantt chart and monitor progress by means of phases / versions (included in section eight)	YES
Lack of experience with chosen technologies	Upskill on angular, recommender systems and neural networks using udemy.com and upskill on digital ocean using tutorials / faq's on their forums	NO
Angular Versioning	Check next major release date for angular cli and potentially accommodate time to refactor code for changes	NO

For me personally I think one of the biggest risks relating to the project is that of time management. It is vitally important that I stick to a schedule that I created for myself to ensure that everything is delivered on time. By doing this I will also be eliminating the risk of adding un necessary stress to myself throughout the course of the project. To manage my time efficiently I plan to stick to my GANTT chart (included in section eight) as well as my own personal timetable (see below) quite rigorously. It will also be important throughout the course of the year and the project that I incorporate some "me time" into my schedule. This will enable me to unwind and keep my stress levels to a minimum, which will ultimately allow me to contribute a better standard of work to both my final year and my project. As well as sticking to a schedule, it will also be vitally important that I constantly monitor the progress of my project to asses where I am at. This will be accomplished by ensuring that versions are released on time and that phases are completed on or near a given deadline (see section eight).

	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
9am – 10am	Database Lab KA – 1016			Dist Syst Lec KA - 3015	Forensics Lab AU – 1005		
10am – 11am	Database Lab KA – 1016	FYP Work	FYP Work	Dist Syst Lec KA - 3015	Forensics Lab AU – 1005	Forensics Study	Dist Syst Study
11am – 12pm	Database Lec KE - B016	FYP Work	FYP Work	Dist Syst Lab KA - 3008	Forensics Lec KA - 3015	Forensics Study	Dist Syst Study
12pm – 1pm	Database Lec KE - B016			Dist Syst Lab KA - 3008	Forensics Lec KA - 3023		
1pm – 2pm	FYP Lecture KE - 2008				FYP 30Min Meet K3 G026A		
2pm – 3pm		FYP Work	FYP Work	Rich Web Lab AU – 1005			Rich Web Study
3pm – 4pm		FYP Work	FYP Work	Rich Web Lab AU – 1005			Rich Web Study
4pm – 5pm	Database Study	FYP Work	FYP Work	Rich Web Lec KE – B034			
5pm – 6pm	Database Study	FYP Work	FYP Work	Rich Web Lec KE – B034			
6pm – 7pm							
7pm – 8pm							
8pm – 9pm							
9pm – 10 pm							

From a technical point of view there are several areas of concern which I have pinpointed. An area of major concern for me was my lack of experience with some of my chosen technologies. I have had a small amount of exposure with Angular and typescript in the past, but have never have I implemented a front-end application of the same scale as my final year project using Angular or Typescript.

As well as Angular, I didn't have much experience using either digital ocean hosting, recommender systems or neural networks. Many of the web projects I had worked on before were either hosted in a local environment using technologies such as XAMPP or on a remote web server or AWS. Alack of know-how with regards to digital ocean or Angular may become an issue in the future if any major problems arise. With regards to the machine learning aspect of the project, my knowledge in this area is little to none. I had never heard of a recommender system before and was un sure about how I would go around implementing it or a neural network or even which one would better suit my project. This for me was pin pointed as an area of concern earlier on in the project however.

In order to deal with a lack of experience using the given technologies, I was quite obviously going to have to get some experience using the technologies in question. For angular, recommender systems and neural networks, my go to area of expertise was udemy.com. Udmey offers its users the ability to sign up for courses provided by fully qualified instructors in any discipline or area of that discipline. By watching videos and following along with examples (how I best learn myself), I was able to develop a better understanding of the technologies and also add them to my current skill set to take forward with me into the future.

Udemy also offers its users the ability to ask questions about any given course. Your questions can be answered by either the instructor, fellow participants or by people with a level of expertise in the area. If I ever run into any problems with any given technology I could just post a question within the course and have it answered by someone else. Alternatively, I could turn to a similar community based answer page like stack overflow. As for digital ocean, they offer a wide range of tutorials and FAQ's on their website. No matter who big or small of a problem you have, it's probably already been answered in one way or another on their page.

One final area of concern which I came across around late October was that of angular versioning. Often with frameworks there are scheduled releases which can often impose breaking changes to an application implementing it. I had been enrolled on an Angular 4 course on Udemy at the time when the update was released, but thankfully there were no major changes to the framework itself. Luckily, the next scheduled major release for angular wasn't until March / April of 2018, so I wouldn't have to worry about having to make any changes mid development cycle. To ensure however that nothing breaks within my angular frontend, I will refrain from updating the CLI (command line interface) to any new major versions until after the final submission and demo.

8. Plan and Future Work

Estimated Effort

The two tables below outline the time frame given to each requirement within both the web and mobile applications. I have factored in time for exams and study, time off for Christmas, both reports and presentations and the uncertainty in both the semester 2 and exam timetable with regards to days off.

Web Application

Version	Requirement Number	Name	Time Frame	Estimated Completion Date
1.0	1	User Login	1 day	7/11/17
1.1	2	User Logout	1 day	8/11/17
1.2	3	User Sign Up	1 day	14/11/17
1.3	4	User Update Profile	1 day	15/11/17
2.0	5	Athlete Create Training Log	3 days	16/12/17
2.1	6	Athlete Update Training Log	1/2 day	17/12/17
2.2	7	Athlete Delete Training Log	1/2 day	17/12/17

2.3	8	Athlete View Training Log	3 days	20/12/17
2.4	9	Coach Create / Update / Delete Training Program Templates	2 days	23/12/17
3.0	10	Athlete Find a Coach	1 day	16/1/18
3.1	11	Athlete Manage and Share Training Logs	3 days	21/1/18
3.2	12	Coach View List of Athletes	2 days	24/1/18
3.3	13	Coach Update Athlete Training Logs	4 days	30/1/18
3.4	14	Athlete set training targets	3 days	4/2/18
4.0	15	Coach Schedule One to One Consultations and Webinars	4 days	11/2/18
4.1	16	Athlete Participate in One to One Consolations and Webinars	1 day	13/2/18
5.0	17	Athlete Recommendations by the System	5 days	27/2/18
		Total Days:	**36 days**	

Mobile Application

Version	Requirement Number	Name	Time Frame	Estimated Completion Date
1.0	1	User Login	1 day	21/11/17
1.1	2	User Logout	1 day	22/11/17
1.2	3	User Sign Up	1 day	25/11/17
1.3	4	User Update Profile	1 day	26/11/17
2.0	5	Athlete Create Training Log	2 days	31/12/17
2.1	6	Athlete Delete Training Log	1 day	3/1/18
2.2	7	Athlete Update	1 day	3/1/18

		Training Log		
2.3	8	Athlete View Training Log	2 days	10/1/18
3.0	9	Allow for Offline Usage	2 days	12/1/18
		Total Days:	**12 days**	

Version Release Dates

I aim to have the first version of both the mobile and web application ready for the interim submission. These can be used as a working prototype and can be built upon in the demonstration to show how I intend to proceed. The expected completion dates for the full versions are as follows:

Web Application

- **Version 1.3** – 15/11/17
- **Version 2.4** – 23/12/17
- **Version 3.4** – 04/02/18
- **Version 4.1** – 13/02/18
- **Version 5.0** – 27/02/18

Mobile Application

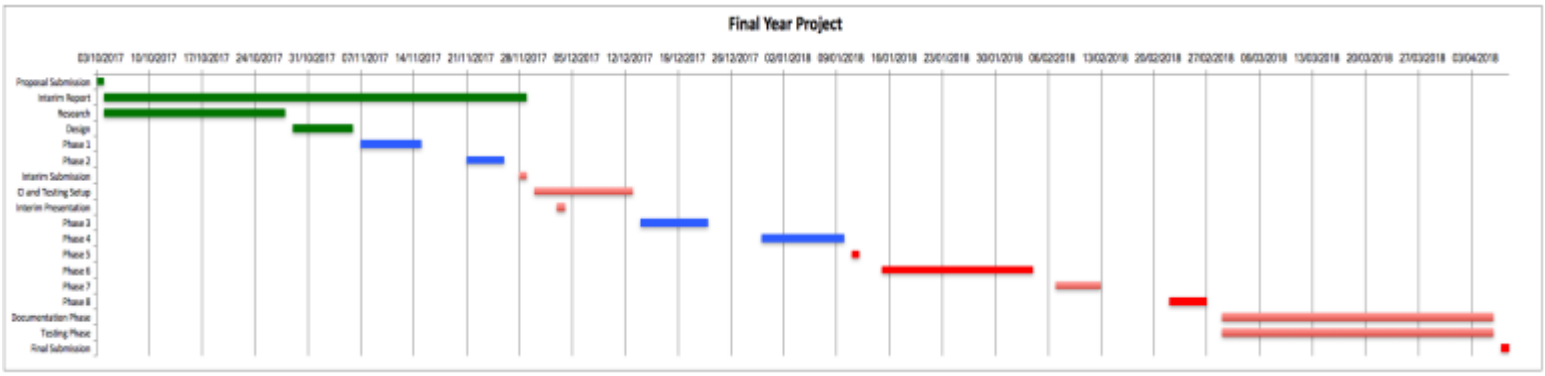
- **Version 1.3** – 26/11/17
- **Version 2.3** – 10/01/18
- **Version 3.0** – 12/01/18

Gantt Chart

Below is the Gantt chart I created to outline the prosed timeline for my project. While it is a good outline to follow, it may be by no means 100% accurate and is simply just a rough guideline for me to follow.

The implementation phases will take place from early November right through to late February. This will allow for other modules, exams and for holidays such as Christmas to be accounted for without taking too much time away from the project.

I have also allocated quite a large amount of time towards testing and documentation (Most of March) due to the unknown date of the final submission. I will be able to cut these periods short if needs be once the submission date has been revealed.


Final Year Project
Proposal Submission
Interim Report
Research
Design
Phase 1
Phase 2
Interim Submission
CI and Testing Setup
Interim Presentation
Phase 3
Phase 4
Phase 5
Phase 6
Phase 7
Phase 8
Documentation Phase
Testing Phase
Final Submission