

**Project Proposal for:**

A Web Collaboration Tool for Students

**by**

**Colm Doggett – B00106947**

**Jakub Plich – B00098516**

**Nikita Savkovs – B00101929**

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**Declaration of Authorship**

We, Colm Doggett, Nikita Savkovs, Jakub Plich declare that this proposal titled, `A Web Collaboration Tool for Students ' and the work presented in it are our own. We confirm that:

* This work was done wholly or mainly while in candidature for a research degree at this University.
* Where any part of this proposal has previously been submitted for a degree or any other qualification at this University or any other institution, this has been clearly stated.
* Where we have consulted the published work of others, this is always clearly attributed.
* Where we have quoted from the work of others, the source is always given. With the exception of such quotations, this proposal is entirely our own work.
* We have acknowledged all main sources of help.
* Where the proposal is based on work done by us jointly with others, we have made clear exactly what was done by others and what we have contributed ourselves.

Signed: Colm Doggett, Nakita Savkovs, Jakub Plich

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**Abstract**

Online Collaboration is an area of immense importance in today’s fast paced world, with industries and educational institutes paying increasing attention to its’ merits. This project aims to investigate the potential benefits that can be gained from effective collaboration, and how they can be used to develop a Web Application to assist students in the process of learning. It will outline the Systems Development Life Cycle that will be used and explain the technologies needed to achieve this goal.

Table of Contents

[Introduction 1](#_Toc27138411)

[Aims and Objectives 2](#_Toc27138412)

[Aims 2](#_Toc27138413)

[Objectives 2](#_Toc27138414)

[Literature Review 3](#_Toc27138415)

[Introduction 3](#_Toc27138416)

[Student Collaboration and Online Collaboration Research Trends 4](#_Toc27138417)

[The Move to Online Collaboration 6](#_Toc27138418)

[Achievement gains 7](#_Toc27138419)

[Increasing Participation 8](#_Toc27138420)

[Topic Tagging 9](#_Toc27138421)

[Problem Statement 10](#_Toc27138422)

[Requirements Analysis 11](#_Toc27138423)

[Introduction 11](#_Toc27138424)

[Version Control System 11](#_Toc27138425)

[Modelling and Design 11](#_Toc27138426)

[Architecture 12](#_Toc27138427)

[Overview 12](#_Toc27138428)

[Front-end 13](#_Toc27138429)

[Back-end 14](#_Toc27138430)

[Persistent Storage 15](#_Toc27138431)

[Testing 16](#_Toc27138432)

[PDF Text Extraction 17](#_Toc27138433)

[Architecture Diagram 18](#_Toc27138434)

[Feasibility 19](#_Toc27138435)

[Methodology 20](#_Toc27138436)

[Systems Development Life Cycle Models 20](#_Toc27138437)

[Agile 21](#_Toc27138438)

[Scrum 22](#_Toc27138439)

[The Scrum Team 22](#_Toc27138440)

[Scrum Artefacts 23](#_Toc27138441)

[Scrum Events 23](#_Toc27138442)

[References 25](#_Toc27138443)

[Appendix 27](#_Toc27138444)

[Project Gantt Chart 27](#_Toc27138445)

# Introduction

Online collaboration has become a hot topic in recent years, with many companies stressing the importance of teamwork and the ability to be a team player. Any large-scale project involves many team members, some located in separate buildings or countries, and the need to effectively coordinate the communication and collaboration has led to the development of some sophisticated online tools. In academia, this has led to a greater focus on group-work and group assignments, to promote the benefits of learning from each other. While studying, and especially when preparing for exams, the lack of an effective tool aimed at student collaboration became apparent. With many students communicating using social media and instant messaging services, and others using shared documents, the need for a common resource that housed all the tools necessary to facilitate efficient collaboration arose. Research into the area of Online Collaboration has shown that the benefits of working together, and of building knowledge within the context of a group, has significant achievement and satisfaction implications for learners. With this in mind, this project proposes to develop a suitable system for students to use, while working on group assignments or preparing for exams, that will incorporate the convenience of instant messaging, the knowledge sharing capabilities of a public forum, and the practicalities offered by a shared document system.

# Aims and Objectives

## Aims

This project aims to address the lack of student focused Online Collaboration tools and outline the features and functionality that such a tool should provide to better aid students while working on group assignments, exam preparation, and learning in the course of their studies. The core functionalities when implemented are intended to increase student participation in group work by providing a user-friendly experience with all the tools necessary for effective collaboration in one convenient web application.

## Objectives

To achieve the aims, the team will implement the following features to meet the required objectives:

* A public forum will be implemented as a central repository of information on certain user created topics of discussion or questions. This forum will be publicly available to all users, however, to contribute to or create a topic a user must be registered.
* Users will be able to register an account to avail of the additional features outside of searching and browsing the public forum.
* Registered Users can upload a PDF document, such as a past exam paper, which will be processed by the application to extract questions and create discussion topics automatically, to simplify the process.
* Registered Users can create private groups by inviting other users to collaborate on questions or topics in real time.
* Private groups will have access to a shared document, a place to upload resources such as text or links to relevant information, and a text chat feature to allow for communication between group members.
* Registered Users will be able to rate answers in the public forum based on how well they answer the question, allowing for a consensus to be reached on how helpful an answer is.
* Registered Users will be able to tag questions to assign them to the most appropriate topic.
* Registered Users will be able to rank questions according to the level of difficulty.
* Registered User will be able to take a quiz on a topic, with questions generated from a random selection from the public forum, to test their knowledge.

# Literature Review

## Introduction

The growth of the internet has led to a change in how information is accessed, and knowledge is acquired. To account for this, many different online collaboration tools for both academic and professional settings have been proposed, each offering their own advantages. Despite this diversity, they all share the same core idea that two heads learn better than one (Johnson & Johnson, 1988). The field of cooperative or collaborative learning has been studied extensively, with many scholars suggesting that a back to basics approach to group learning is needed as “The ability of all students to learn to work cooperatively with others is the keystone to building and maintaining stable marriages, families, careers, and friendships” (Johnson & Johnson, 1988). Group work and collaboration can lead to greater achievements than individuals working alone, but for the group to succeed each member must participate. This literature review will explore some of the research that has been carried out in relation to the effectiveness of online collaboration, the gains that can be achieved and some of the strategies that can be employed to encourage greater participation.

### Student Collaboration and Online Collaboration Research Trends

Collaborative learning, especially in regard to student collaboration learning, is an ambiguous concept that has not been well-defined, with the existing papers often struggling to distinguish between student collaboration and student co-operation, however, there is a consensus that collaboration is beneficial to the students, their skills and learning (Witney and Smallbone, 2011).

The reason for difficulty with the research might be lack of systematic approach and varying difficulty level. The same task imposed unto those working individually and those collaborating in their work, might either place too harsh of a burden on individuals assigned a task fit for a group or, on the other hand, giving a task too easy to accommodate individuals while rendering group work for the aforementioned task all but useless. Either of those may have resulted in obfuscation of the research, rather than clarifying the concept, leading to inconclusive and sometimes even contradictory analysis of efficiency of the collaborative learning (Kirschner, Paas and Kirschner, 2001).

It has been shown that students find collaboration useful and helpful in their endeavours, although the efficiency of collaboration may vary depending on the group organisation and group communication:

* a formal organization, with well-defined roles and structures, or an informal organisation
* a formal communication, with students documenting meetings and keeping the transcripts, as well as conducting face-to-face meeting faring better in their project tasks than those without formal communication (Strijbos et al. 2007)

With Web-based technologies becoming more ubiquitous, various online collaboration tools become essential to support online collaboration, mostly in the software engineering industry, since they ease project management, track development process etc. (Lanubile et al. 2005).

However, despite the rapid growth of the industry, there are no specialized tools for collaboration to be used by students, with the majority of undergraduates resorting to using social media platforms, such as Facebook, which, although perfectly valid for collaboration, serves as an informal learning tool (Deng, Li and Lu, 2018).

What Kirschner, Paas and Kirschner (2001), Deng, Li and Lu (2018) and Witney and Smallbone (2011) agree on is that the research done in the sphere of student collaboration might be vague or even misleading. As per Kirschner, Paas and Kirschner (2001), this could be due to the fact that the research methods were not proper, although Strijbos et al. (2007) suggest this could be due to the fact that the field itself is quite vast, encompassing different methods of collaboration, different types of students and of diverse background. However, Strijbos et al. (2007), Witney and Smallbone (2011) and Deng, Li and Lu (2018) conclude that student collaboration is a valid, and, more importantly, a useful way of learning, held in high regard not just by the students, but by the faculty staff as well.

Strijbos et al. (2007) and Deng, Li and Lu (2018) disagree on the extent to which web collaboration is useful. Strijbos et al. (2007) suggests that face-to-face meetings will prove more fruitful than purely online communication, while Witney and Smallbone (2011) concluded that students demonstrate high performance without such meetings, communicating through online means only.

### The Move to Online Collaboration

To identify the benefits of online collaboration, from their earliest appearances after the launch of the internet to present, one should also examine the nature of collaboration and co-operation in an offline environment to see if using online tools are more effective (Hammond, 2017). In both settings, it is found that collaboration is strongly influenced by the social learning theory (Bandura, 1977), which is crucial to learning as the processes of explaining, defending, comparing, and finally agreeing on ideas creates new knowledge for all participants. In online collaboration, the technology facilitates the learning process, using various communication methods, both synchronous and asynchronous, but the underlying knowledge making and information sharing processes remain the same. The real advantage of online collaboration is allowing participants to engage in this process on their own schedule and from many remote locations, which can increase participation. Additionally, the automatic storage of interactions between participants has led to more insights into the nature of collaborative learning, highlighting some of the previously unseen and unexpected communications that happen away from the traditional sights of learning. While Hammond (2017) does accept that there are many benefits associated with online collaboration, and collaboration in general, such as increased levels of achievement and higher motivation, he cautions those who promote online collaboration as a paradigm shift in learning. Learners use collaborative tools to further their knowledge within a group context, while also expanding their knowledge on an individual level. It is only by paying attention to the needs of learners from both perspectives that successful integration of online collaboration tools can be achieved.

### Achievement gains

To measure any differences in student achievement and satisfaction when using online collaboration to complete assignments, Kurucay & Inan (2017) assessed 77 students taking part in an online course. The study was primarily concerned with measuring learner to learner interactions, to see if there was any correlation with student outcomes in terms of learning and satisfaction. It also looked at students’ perceptions of online collaboration both before and after the study. A third area of concern was with how interaction frequency, time commitment and peer evaluation related to student outcomes. Each student submitted the same individual assignment, with one control group working independently, and a second treatment group working collaboratively in groups of three, before submitting their individual assignments. The students were assigned to the two groups randomly and a survey was conducted to measure individuals’ perceptions of collaboration in online learning. The students in the treatment group were also provided with guidelines for effective collaboration. The collaborative groups members took turns at leading weekly activities and completed short surveys rating group members interactions for that activity. The final assignments were then submitted individually for grading purposes at the end of the experiment. The results showed that while the students’ perception of learning and satisfaction were higher in the control group, the actual achievement scores were significantly higher in the treatment group (almost 10%). The students’ perception of collaboration also increased for the treatment group after being involved in this study. They also reported that both peer evaluation scores and interaction frequencies relate positively to the students’ satisfaction, perception of learning, and achievement. Although the results of the study indicate that the online collaboration tool is more effective for learning, the study has two main limitations which may impact the extent of its internal or external validity: the small number of participants, and the guidelines provided to the treatment group which may have given them a small advantage. In an earlier study to understand the correlation between the frequency of online interactions and students’ final grades, Davies & Graph (2005) examined the activities of 122 undergraduate students. Although the results did not find that greater interaction led to significantly higher grades, they did reveal that students passing with medium to high grades had higher numbers of interactions than those passing with low grades. Furthermore, students who failed one or more modules had the lowest number of interactions recorded.

### Increasing Participation

The success of any online collaboration or discussion depends largely on the engagement of participants. While many studies have focused on how to engage the learners from an instructor or tutors’ perspective, Cheung & Hew (2008) focused on student led discussions and how to encourage participation. The study was conducted by observing the online interactions of students and by examining student reflection logs. The depth of discussion threads was used as an indicator of engagement while the contents of the threads were also analysed for meaningful interactions. Each participant had an opportunity to lead a discussion thread and all students actively participated in threads. At the end of each discussion the students were required to reflect on the different facilitation techniques they used and on techniques that the observed others using. By analysing the results, the authors identified seven main techniques that were used by the students when facilitating online discussions, which were then categorized into three main sections:

* Introduction – ’Establishing ground-rules’.
* Engagement – ’Give own opinions and experiences’, ’Questioning’, ’Showing appreciation’.
* Monitoring – ’Suggesting new direction’, ’Summarizing’, ’Personally inviting contributions’.

Of these seven, the most used and productive techniques were; ‘giving own opinions and experiences’, and ‘questioning’, occurring in 32% and 38% of the threads, respectively, with a depth of 6 or more responses. Although the results of the study indicate that using the techniques described can encourage higher levels of participation in online discussions, the study has two main weaknesses that may impact on the validity of the claims; the limited number of participants (24) were all studying the same course at post-graduate level , and incentives were used to encourage participation.

### Topic Tagging

The increasing amount of digitized content available on the internet has led to a need to categorize this information to allow for easy search and retrieval. Many sites allow users to annotate content with keywords (tags), to enable simple keyword searching capabilities. While this approach can achieve remarkable results, it can also introduce a great deal of variance as individuals may choose different keywords to tag the same content. The variance can be lowered with the introduction of tag recommendation algorithms that suggest keywords that the user can choose from based on the type of content.

Krestel & Frankhauser (2012) suggest a method of personalised tag recommendation based on a probabilistic model from the content, combined with the users previous tagging preferences. The model uses Latent Dirichlet Allocation (LDA), a generative topic model first introduced by Blei et al. (2003), in combination with a Language model, to suggest keywords to the user. LDA assumes that text content consists of a set of topics, which in turn consist of a set of words, and deduces the topic of the text by assigning probabilities to the words and topics based on their frequency within the text.

By combining LDA with the Language model based on the users’ previous history of keyword choices, the authors show that their model can compete with state-of-the-art tag recommendation algorithms at significantly reduced computational expense.

# Problem Statement

The main problem that can be defined is the fact that, although there are collaboration applications and tools for professionals, such as GitHub, Atlassian’s JIRA Board or Trello and applications and tools for online learning, such as Duolingo or Udemy, the team is currently unaware of any application to be used specifically for student collaboration and learning that is freely accessible to the students. Although these tools can be used by students, the large feature sets and capabilities can be daunting and distracting, thus, the following research questions can be addressed:

* Is it possible to implement such a system as to be useful in student learning and collaboration, or whether the application will deliver all its functionality as to aid the students?
* Is the implementation of such a system within a given period feasible, and if it is, is the proposed implementation feasible?
* Is there any benefit in using such a system, rather than other already implemented collaboration tools?
* Can such a system be implemented efficiently using the technologies proposed?
* Can such a system be migrated to a cloud platform and how feasible is it to do so?

# Requirements Analysis

## Introduction

The proposed project is a web-based application. Therefore, it is possible to identify the basic components of the application, which are a front-end and a back-end. In addition to that, the project involves file processing, as well as providing an opportunity for the user to sign-up to avail of additional features, thus, there is a need to store persistent data, either on a native file system or in a database. Regarding the testing process, back-end will be tested using unit testing techniques, while the front-end will be tested using unit testing and end-to-end (E2E) testing techniques. Finally, a version control system is required, to manage team member’s work and collaboration.

## Version Control System

For the project management and version control it is the team’s intention to use Git. In addition to Git itself, a private repository will be created on GitHub. SourceTree - an application that provides a graphical user interface on top of Git, whose purpose is to ease visualisation of the workflow and management of the repository and commits, will be used as well. Git has been chosen due to its ease of use, as well as familiarity of team members with Git and GitHub. SourceTree has been chosen because of its visualization capabilities, as well as integration with GitHub. Thus, the technologies for VCS are follows:

* Git (with SourceTree)
* GitHub

## Modelling and Design

For the project design, Universal Modelling Language (UML) will be used. The key features of the UML that the team intends to employ are Use Case Diagrams and Activity Diagrams to visualize user interaction with the application. Class diagrams are used to visualize relationships between inner application components and to assist with the analysis of system modules to determine feasibility of the architecture. UML was an obvious choice for the team, since all the team members are familiar with and accustomed to UML.

## Architecture

### Overview

The application itself will be split into front-end, back-end and persistent data management. The front-end is concerned with user interaction and will be implemented using Angular framework. The back-end is concerned with user requests that cannot be implemented on the front-end or are unfeasible to implement on the front-end, such as database queries, and will be implemented using the Spring Boot framework. A MySQL Database and the native file system will manage the persistent data. As the development progresses, based on the time constraints, team might migrate part or the whole architecture to cloud – either Azure or AWS.

### Front-end

To develop the Front-end the team has chosen to use the Angular Framework. Angular is implemented using TypeScript, a superset of JavaScript. It uses a component-based architecture, with each element of the UI and its’ functionality encapsulated into reusable components. This allows for greater reuse of elements and makes the code more testable and maintainable. The components are written in HTML and TypeScript and then compiled to JavaScript before being interpreted by the browser. Although Angular is a relatively new framework with a steep learning curve, and despite the teams’ unfamiliarity with it, it was chosen because it allows the development of a standalone front-end, which provides more flexibility on the back-end.

Development in Angular is done using TypeScript, a superset of JavaScript, with program logic separated in modules and bound to HTML templates and CSS, thus enabling great functionality and flexibility, since both HTML and TypeScript are compiled together. Since Angular is a relatively new framework to the team, a certain timeframe will be dedicated so the team members can get familiar with it. When choosing a front-end framework, the team has faced several options – either using a stand-alone front-end framework, like Angular, or using a back-end framework that incorporates front-end capabilities with template processing, such as Laravel with its Blade Templates or Spring Boot with JSP. A stand-alone framework has been chosen as a preferable option since it is much easier to update the architecture with a stand-alone front-end framework. For example, if the team decides to migrate part of the architecture to AWS, it will be possible to host a webpage straight from the S3, without any changes to the server or to the front-end. On the other hand, it would be not possible to do the same were front-end part of a templatized back-end, since front-end would be essentially a part of the back end. Finally, a stand-alone framework, and Angular in particular, encourage decoupling and are usually more powerful than templatized back-end front-end, because it is possible to embed TypeScript (that is compiled into JavaScript) directly into the page. As a conclusion, the following technologies will be used for front-end development:

• Angular Framework:

* HTML
* CSS or SASS
* TypeScript
* Bootstrap
* Angular Material

### Back-end

To develop the Back end the team has chosen to use the Spring Boot Framework. Spring Boot is a micro-framework that allows developers to quickly create a Spring Application. It builds upon the underlying Spring framework by automatically configuring some of the dependencies needed. This auto-configuration can reduce the amount of code that needs to be written to get an application up and running. Spring Boot uses Java and provides a comprehensive set of libraries and modules in an easily configurable manner. Spring Boot was chosen because of the team’s familiarity with Java and although some initial effort will be required at the beginning, the benefits provided by the auto-configuration will allow for the core of the system to be developed quite quickly.

In addition to that, Spring Boot eases database management with automatic entity creation and update using Hibernate. Since Spring Boot is a relatively new framework to the team, a certain timeframe will be dedicated so the team members can get familiar with it. For the back end, the team faced a choice of which language to use – there are numerous for back-end development, such as Java, C#, PHP or Python. It was decided that Java-based framework would be preferential: all of team members are proficient in Java, and Java remains the predominant language for the server-side programming language (TIOBE Software BV, 2019) While C# and Python gain pace, they were not chosen due to team member’s unfamiliarity with them. PHP has been ruled out, since it has been on a nearly constant decline is popularity for the last fifteen years. When decided what language to use, there was still a choice between the various Java frameworks for back-end development. Spring Boot has been chosen due to its relatively mild learning curve (unlike its predecessor, Spring). The technologies used for back end are:

* Spring Boot:
  + Java
  + Spring Initializr
  + Spring Security and Encryption
* Hibernate with MySQL Connector

### Persistent Storage

MySQL will be used for persistent storage. It was chosen because of the simple to use interface and uncomplicated setup and for the teams’ knowledge and experience of working with it. The user information, such as login credentials and profile data will be encrypted and stored in the database.

Files that must be stored, such as PDFs and user images, will be stored in either Azure Blobs and Azure Files or AWS S3. MySQL database has been chosen due to the fact that it is easy to setup and has a simple user interface, as well as team familiarity with MySQL. Even though MySQL database will be used, little or no SQL scripting will be written, because Spring Boot Server will be managing it without the need for the team to interfere. The team has yet to review its options regarding Azure and AWS – while some team members have limited experience with AWS, pricing might be an issue; Azure, on the other hand, provides better options in term of price, while the services themselves are nearly identical to what team might need (storage being of main interest, however, additional services, such as hosting, databases and request processing are being considered as well). Also, it is worth pointing out, that native file system is likely to be used initially for testing purposes. The full list of technologies is:

* MySQL Database Server
* Azure Blobs and Azure Files OR AWS S3

## Testing

For back-end testing, JUnit will be used for unit testing; for front-end, Jasmine will be used for unit testing and Angular Protractor will be used for E2E testing. It is team’s intention to use test-driven development approach, so as to spot flaws in the system and ease debugging and tracing, thus, the application will be well-defined and tested at the end of every iteration. These technologies ship with the frameworks the team will be using. The full list of testing libraries used is:

* Back-end:
  + JUnit
* Front-end:
  + Jasmine (Unit Testing)
  + Angular Protractor (E2E Testing)

### PDF Text Extraction

Text contained in a Portable Document Format (PDF) file is represented by stream of character glyphs denoted by a String Object and the associated information used to display the text correctly on the page. This information, such as the font and location, is then used to paint the glyphs in the correct size and shape in the specified location (Adobe 2006).

To extract text from uploaded PDF files the team will use the Apache PDFBox open-source library for java. PDFBox provides many features for working with PDF documents including:

* Extracting Unicode text from PDF files
* Splitting and merging PDF files
* Saving PDF files as images

The PDF specification also allows for images to be displayed on the page. In a case where a PDF file is created by simply scanning an existing document, the document may be represented by a single image, and therefore contain no text Strings. As there is no actual text data in such a document, PDFBox will not be able to extract the text. Therefore, another approach will be needed.

Extracting text from a PDF Image

To extract text from an image, the team will use Optical Character Recognition (OCR). OCR is a widespread technology used to recognise text in an image, with many uses ranging from converting large volumes of printed material such as old newspaper articles into machine readable text, to vehicle number plate recognition.

Tess4J will be used to extract text form images in a machine-readable form. Tess4J provides a Java Native Access (JNA) wrapper for the Tesseract OCR API, which was first developed by Hewlett-Packard, and since being open sourced in 2005, is now developed by Google. The images are extracted from the PDF and then processed using OCR to output a String of machine-readable text. Tess4J can be tested using JUnit and provides support for PDF documents using PDFBox.

## Architecture Diagram

Below is a high-level overview of the project’s architecture. The front-end will be sending AJAX requests to the back-end, which will act as an intermediary between front-end and a database. As can be seen, in the initial design, front-end and back-end are completely separated, with front-end sending requests to the back-end when specific database manipulations are required.

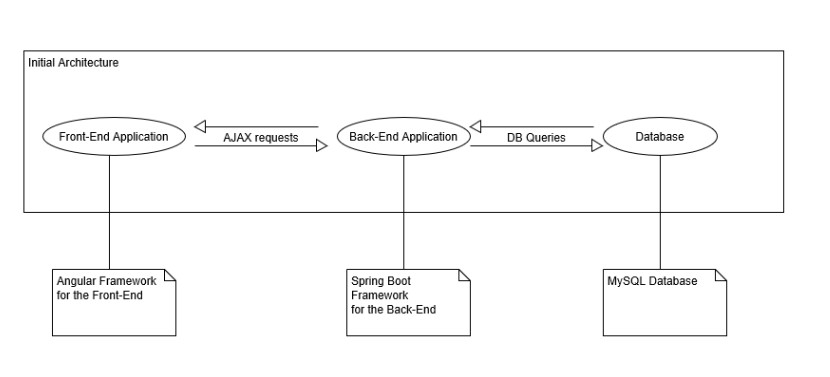


Figure . Initial Architecture Diagram

## Feasibility

Based on the proposed architecture, as well as requirements analysis, the team has concluded that even though not all of the team members are familiar with the technologies to be used, the project implementation is feasible within the given time period.

The application follows a well-recognised pattern for web application development. All the technologies needed to develop this system are well documented and supported with a large community of active developers. The only impediment to the team will be the initial learning curve of some of the frameworks, which will be taken into consideration when planning each sprint to allow the team time to learn the tools. As the team are well-motivated and willing to learn, the benefits of using these frameworks, reducing the amount of code needed to get the application to a working condition, will soon out-way the drawbacks of the initial time investment of learning them.

# Methodology

## Systems Development Life Cycle Models

The development of a software system and the processes that are involved in creating it are referred to as the Systems Development Life Cycle (SDLC). Many SDLC’s exist and each have their own strengths and weaknesses depending on what type of system is under development. However, they all share some common stages and the differences lie in how each of these stages are approached and how they relate to each other. No matter the size or complexity of the system the essential stages are:

* Planning – A feasibility study, estimation of resources, and project planning are carried out.
* Analysis – Requirements Analysis to gather information on how best to solve the problem at hand.
* Design – A detailed solution proposal based on the requirements, is used to guide the developers.
* Development – The system is developed and tested to ensure it meets the requirements.
* Deployment – The system is released for users to work with.
* Maintenance – The system is supported and/or improved over its’ lifetime.

Many SDLC’s lend themselves more suitably to different systems depending on a number of key factors, such as the size and complexity of the project, the size and experience of the development team, the understanding of the technologies involved, the flexibility of the customers’ requirements and the time allocated for the system development. Classic Models, such as the Waterfall, Spiral, and Incremental Models are particularly suited to systems where the requirements are fully known and do not change over the course of development. Others, such as the Rapid Application Development (RAD), Extreme Programming (XP), and Agile Models can be particularly well suited when the requirements are not fully known or are prone to change and provide more feedback to stakeholders with frequent working demonstrations. Many comparisons have been made of different SDLC Models and while some are more rigid, the advantages of flexibility and scalability afforded by Agile make it one of the most popular methodologies in today’s fast paced world (Ally & Ning, 2015).

## Agile

For the project and workflow management (System Development Life-Cycle or SDLC) the Agile method will be used. As reflected in Agile Manifesto (Agile Alliance, 2019), Agile method is, in essence, an iterative approach, that focuses on user’s needs and feedback, with frequent communication between user and the development team. The teams itself are self-organizing, bound by a small number of rules and necessary formalities, a fact that eases and speeds up the development process. In addition to the Agile method itself, Scrum framework and Kanban board will be used for task management. Although not a methodology, Scrum encompasses aspects of development and tackles issues of communication and provides an easier way to manage projects by decomposing complexity into manageable parts, with enforced team a cooperation being a major benefit (Scrum.org, 2019). While Scrum is concerned by how is it done, a way of assigning the actual task is needed, e.g. what is done and by whom is it done (Atlassian, 2019); for this purpose, a Kanban board shall be used – a complex problem discussed during a Scrum stand-up, with a plan of action devised, will be actually split into the tasks to be done by individual team members for the current sprint, all under aegis of Agile method.

The reason Agile has been chosen as the methodology is the fact that the project proposed lends itself to it:

* Primarily, the project can be separated into three different modules – front-end, back-end and persistent data management; furthermore, these modules can themselves be split into even simpler parts, for example, a login subsystem or PDF processing subsystem. It is one of Agile method’s main objectives to deliver working software at the end of each sprint, and with problem decomposition the team will be able to continuously deliver a working piece of software. Moreover, if, for any reason, the team will be unable to finish some of the features in a given timeframe, those features can be pushed onto the next sprint. As a result, there will be less pressure on the individual team members, and the development process will not go astray.
* The aim of Agile is to avoid unnecessary documentation and over-modelling to enable iterative development. As development process goes on, the team will decide whether certain features should be added, for example, whether part of the architecture should be migrated onto a cloud platform, such as Azure or AWS. Since not bound by constraints of the existing modules, it will be easier to revise the architecture when using Agile.
* Using Scrum, a proper communication between team members will be ensured. Also, since Scrum separates development team member’s into separate roles, it will be possible for one or more team members assume managerial positions, while avoiding unnecessary formalities
* Since the project will be split into different tasks and sub-tasks to be done by team members, it is essential for the team to use a tool to organize these tasks; Kanban board will serve this purpose, enabling to track tasks that are finished and that are in progress. Moreover, with the tasks laid out in an orderly manner and difficulty assigned to them, it will be possible to:
  + Track team’s average progress per month, based on the number of tasks completed or based on the scoring system assigned to the task (e.g. a Fibonacci sequence, with easiest task having a score of one, a more complicated task having a number three and up to number thirteen). This will assist in overall planning and will help to determine what additional features are feasible to implement
  + Assign priority to the tasks, with less-important tasks being pushed onto next sprint
* Agile focuses on user experience, thus, the team is in a unique position to implement this project, because the proposed project is a collaboration tool designed to help student and the team members themselves are students. This will give an opportunity to test the project both from developer and user perspective, as well as survey team’s fellow students about features they would possibly want, thus enriching the user stories for the project.

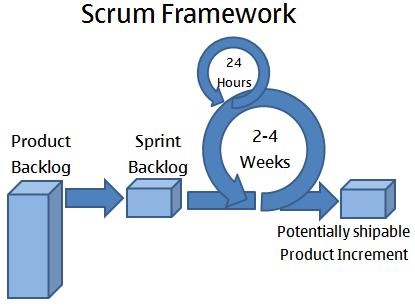


Figure . Scrum Framework Diagram

## Scrum

Of the many frameworks that use the Agile methodology, Scrum is probably the best known. Scrum has three main components; The Scrum Team, Scrum Events and Scrum Artefacts.

### The Scrum Team

The Scrum Team is made up of the Product Owner, who is responsible for maximizing the value of the product, The Development Team who develop the product, and the Scrum Master, who is responsible for helping everyone comprehend the theory, practices, rules and values of Scrum.

### Scrum Artefacts

**Product Backlog**

The Product Backlog is a list of everything that the team has identified as being needed in the product. It is the definitive source of requirements and any changes that need to be made to the product. It changes dynamically as the teams understanding of the product and its’ features evolve.

**Sprint Backlog**

The Sprint Backlog is a subset of the product backlog items that are to be implemented in a sprint. It identifies all the work that is needed to achieve the sprint goal.

**Increment**

The Increment is a sum of completed items from the product backlog of the current sprint and all previous Increments. Each item must meet the teams’ definition of done and must be in a useable condition.

### Scrum Events

There are five Scrum events used to create regularity and avoid unnecessary meetings. Each event is an opportunity to analyse and improve the process.

**The Sprint**

The Scrum framework divides the development process into a set of time periods in which useable and potentially shippable products are delivered, known as sprints. The products’ features are broken down into separate tasks and added to the Product Backlog. The team decide what tasks are to be added to each sprint.

**Sprint Planning**

A sprint begins by planning the work to be done and setting up goals. A detailed list of tasks is created and added to the Sprint Backlog.

**Daily Scrum**

Daily Scrum meetings are held to assess the progress of the team towards the sprint goals and to increase collaboration and performance.

**Sprint Review**

At the end of each sprint, a Sprint Review is held to gain feedback on what was achieved and to revise the Product Backlog.

**Sprint Retrospective**

A Sprint Retrospective is also held to enable the team to analyse their progress and suggest improvements that can be applied to the next sprint.

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# Appendix

## Project Gantt Chart

A screenshot of a cell phone

Description automatically generated

Figure Proposed timeline for Project