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# FM Future Marker

Learning Management System with Automated Assessment

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## Abstract

Nowadays the world is moving towards the automation and artificial intelligence in all institutions and organizations to facilitate their work and decrease the cost, in addition to getting the highest possible accuracy, So we have decided to build Future Marker which is a smart learning management system that can automatically mark and evaluates the programming assignments and MCQ exams, it also allows the instructors to share the course materials with the students.

Future Marker web application is one of the best solutions for the educational institutions especially the ones that are related to programming, it helps them to apply the distance education magnificently as the instructor can share the materials, upload assignments, and tests his students.

This project is trying to solve various problems such as saving time and efforts for instructors who spend much time on marking and evaluating the programming assignments and multiple choices exams manually, besides the final grade, many instructors do not have the opportunity to give every student brief feedback for each one of them about their progress on the assignment submission.

We have decided to build a Java API which is responsible to assess the assignments by checking the code compilation and code indentation, feature testing, and dynamic testing, also to check if the code is illustrated by comments or not, then we have decided to connect with it our learning management system which is developed by HTML, CSS, JavaScript, and Bootstrap4 for the Front-end, And for the Back-end development we have used PHP with Laravel framework in addition to MYSQL for database, furthermore, we have used MVC design pattern during our development to get clean code that facilitated our work and help us to edit or improve the system with more features now or in the future, what's more, is that we have developed mobile application by using flutter so it can work on Android or IOS, the application is connected with the web app and our MySQL database, Future Marker mobile app allows the instructor to sign up and create courses, upload materials and assignments, publish posts, the app also allows the student to join the courses and download the material, in addition to submit the assignments and take quizzes and see grades.

The project has been tested two times with the end-users (computer science) students, the first time when we finished the main API functions as have connected it with a desktop application and use it with the students while they were submitting their java project in the course of Programming language 2, and the second time when we have finished the whole system (web and mobile application) with more features like auto marking test assessment, and adding feature and dynamic testing in the API, and the result was impressive as the user was satisfied with the system performance, functionalities, and how it can make a work that was taking a lot of time from instructors, done just in a few seconds.

So Finally we can say that Future Marker smart learning management system is the best solution for all educational institutions especially the programming departments, as it allows the instructors to communicate and share materials with the students, and create coding assignments for them as it will be marked automatically and send feedback once the student submits it, furthermore the system is helping the universities and institutions to make online exams that also marked automatically when the student finishes the exam or exceeds the allowed time.

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# Chapter 1

## Introduction and Background

### *Main points*

- Introduction
- Problem definition
- What is the importance of this problem?
- What are the current solutions?
- How will this solution solve the problem? What is new?
- Project description
- Scope
- Methodology
- Deliverables
- Summary

## **Introduction**

Computer Science degrees are very popular study programs worldwide. A core topic in computer science is to learn programming skills. Programming is also related to several fields of technology, hence many university students -in various programs- study it. Novice programming students require to practice as much as possible to enhance their problem solving and programming skills. A key tool for instructors is setting assignments for students to encourage them to practice more. However, to gain the most required result from such assignments, quick and detailed feedback is required.

## **Problem definition**

The main problem with the traditional manual assignments marking is that the instructor usually needs to spend a lot of time and efforts to check and mark every student's code and to write a report for every student on each assignment to give feedback for the submission that informs him that his submission was good enough or not, and advise students about the mistakes that they did and what points they have missed. Instructors also need to set a clear grading policy and give students a breakdown of the grading criteria [1]. The time required to achieve this would usually mean late feedback delivery to students, it may take days and sometimes weeks for a student to know his/her marks. Furthermore, the accuracy of the marking or writing feedback may decrease as the number of students increases. Also, the student can submit the assignment only once, without being able to submit it again after the feedback he receives with his grade.

## **What is the importance of this problem?**

By 2020 all the Educational sectors are working hard to improve themselves by using new tools and technologies or improving the old ones [2], Today we can see the importance of following up with the students as fast as possible by monitoring their level, as the instructors can evaluate them by giving them assignment and marking them, but if we are going to talk about the coding and computing we have to admit that evaluating the students by the instructor is not easy and it requires more efforts and time to check the coding level and give them a feedback for every single task, hence providing instructors with easy to use automated code assessment tool that can evaluate assignment in no time with minimum set

up, and giving instant feedback to student and send a report for the instructor about each student and what grade they take and what points they miss [3], This will help student to enhance their programming skills vastly through learning from their mistakes, it will also enable instructors to set more assignments without the worry of the time they need to mark it. In addition, it will save a lot of time for the instructors and professors so that they can be more creative with their teaching with the students, furthermore now all universities and schools who don't use or rely on an effective learning management system will suffer when any problem or epidemic happens because they will need to apply the distance education, and they can't do this without a learning management system allow the instructors to communicate with their students and share the course materials with them, in addition to all institutions must have another alternative way to examine the students instead of the usual written exams, so they must prepare and get an online testing system so they can evaluate the students by online tests and quizzes on what they have studied from home, we can say that it becomes obvious that any educational institution are not willing to make progress in improving its distance learning mechanisms, won't hold up in the future or when any crisis occur.

## What are the current solutions?

For many decades automatic assessment has been applied in many forms even before personal computers existed. The automatic assessment had already been suggested by Hollingsworth in 1960 [4].

In many programming courses at tertiary institutions, the use of automated assessment has been proved useful through the use of systems like:

- The Course Master Automated Assessment System (2001) [5]
- The BOSS Online Submission and Assessment System (2005) [6]
- Individualized exercises for self-assessment of programming knowledge: An evaluation of Quiz PACK (2005) [7]
- ALOHA - A Grading Tool for Semi-Automatic Assessment of Mass Programming Courses (2006) [8]
- Easy Accept: a tool to easily create, run and drive development with automated acceptance tests (2006) [9]
- PASS - Programming Assignment Assessment System (2006) [10]
- Automatic marking with Sakai (2008) [11]
- Web-CAT: Automatically Grading Programming Assignments (2008) [12]
- Programming Task Packages: Peach Exchange Format (2008) [13]

- PROGTEST: An Environment for the Submission and Evaluation of Programming Assignments based on Testing Activities (2011) [14]
- A System to Grade Computer Programming Skills using Machine Learning (2014) [15]

### **Course Master Automated Assessment System:**

This system is a desktop application that can mark several types of coursework in a non-trivial manner. That is, criteria can be set against which the work is thoroughly assessed. Specifically, the system is particularly good at marking computer programs, it can also mark diagrams and assist in the marking of essays [5].

#### **Pros:**

- Marking several programming languages.
- Assisting in marking diagrams and essays.
- High efficiency.

#### **Cons:**

- Old user interface.
- Used privately for a single organization.
- Not multi-platform.

### **How will this solution solve the problem? What is new?**

This project introduces Future Marker (Automated Task Assessment Cloud-based System). It will reduce the effort and time consumed by instructors when they assess submitted tasks from students. It will assess tasks by using logical techniques that begin with compile the code to check for runtime errors, then evaluating typographic layout which is checking for the layout and indentation, besides the identifiers' name and length and the written comments, then checking code efficiency by running multi-dynamic test cases.

Future Marker will solve many problems for students. It will allow students to submit assignments several times customized by the instructor to improve their grades and learn from their mistakes by getting instant feedback from the system.

Future Marker aims to utilize the recent technological advancement in both cloud computing and artificial intelligence to provide smart, accessible, and easy to use system for programming instructors worldwide.

## Project Description

Future Marker is a learning management system with an automated assessment for programming assignment, the system's goal is to allow students and instructors to interact online together. Future marker allows instructors to upload materials and assignments for students, the system marks the programming assignment and sends brief feedback with the marks for the student. You can access the system through the web app or mobile app (iOS & Android).

## Scope

The tools and languages used to develop the system are PHP, Java, Dart, Laravel, and Flutter.

The project aims to deliver a great online educational system that can evaluate the programming assignments and send feedback to the students easily.

## Methodology (Proposed Approach)

We will use the agile methodology with an incremental plan because it is easier to change the process to reflect changing customer requirements and the process works well when not all requirements are known.

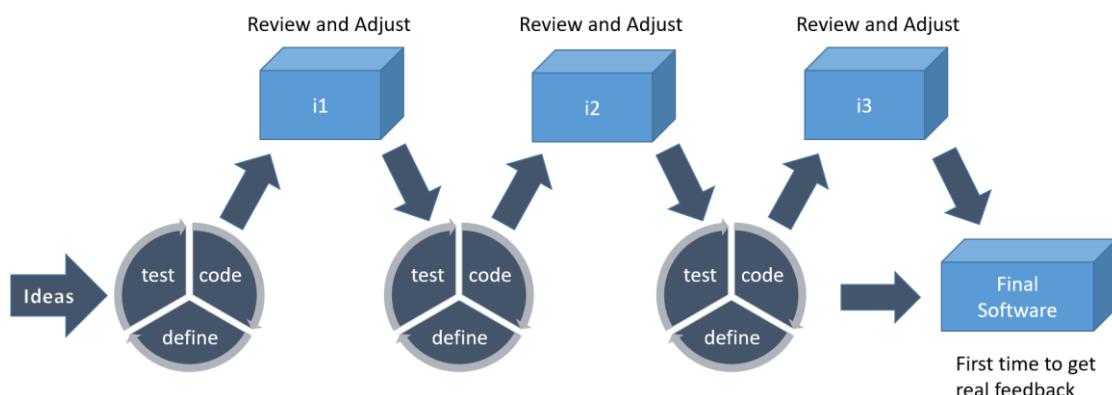


Figure 1 - Agile Methodology

We will use the scrum method because that focuses on managing iterative development, users see on-time delivery of increments and gain feedback that will help us to improve our system. We will have the flexibility to change anything while working on the system.

## Deliverables

1	Project Proposal
2	Future Marker Web application
3	Future Marker Mobile Application
4	Future Marker Documentation

## Summary

In this chapter, we have discussed the problem that we are going to solve and how we are going to solve it and how important it is, also we have introduced our project and mentioned the project description and its functionalities and what methodology we are going to use in our work, in addition to listing some of the similar examples that already exist and used to solve the same problem.

# Chapter 2

## Analysis and Design

### *Main points*

- Introduction
- User Requirements
- System Requirements
- Functional Requirements
- Non-Functional Requirements
- Stakeholders
- System Design

## **Introduction**

In this phase we are planning to design our system after gathering information and checking the current solutions for our problem, we have designed the diagrams and divide the whole system into functions to start working on it besides writing the user stories in the Product Backlog as we are using scrum method while working Agile, Furthermore, we chose our Git hosting service and Project management software that will help us in the implementation of the project and distributing tasks, Moreover, we have picked our design pattern that we are going to use during our code implementation also we have made a comparison between different web application frameworks and decided which one is going to be more suitable for our system.

## **User Requirements:**

- 1- Future Marker shall allow the instructor to create a course.
- 2- Future Marker shall allow the student to join a course.
- 3- Future Marker shall allow the instructor to upload material.
- 4- Future Marker shall allow the instructor to create assignments.
- 5- Future Marker shall allow the instructor to edit assignments.
- 6- Future Marker shall allow the student to submit assignments.
- 7- Future Marker shall automate feedback to the student instantly.
- 8- Future Marker shall allow the instructor to create quizzes.
- 9- Future Marker shall allow the student to answer quizzes.
- 10- Future Marker shall allow the student to view assignments' feedback.
- 11- Future Marker shall allow users to text each other.
- 12- Future Marker shall allow the instructor to publish posts.
- 13- Future Marker shall allow the student to interact with posts.

## **System Requirements :**

### **Functional requirements :**

- Instructors can create courses.
- Instructors can upload course material.
- Instructors can create assignments.
- Instructors can edit assignments.
- Instructors can create quizzes.
- Instructors can publish posts.
- Instructors can view students' grades.
- Instructors can limit permissible attempts for assignments or quizzes.
- Students can enroll in courses.
- Students can submit assignments.
- Students can answer quizzes.
- Students can get submitted assignment's feedback.
- Students can answer an assignment within the permissible attempts.
- Students can interact with posts.
- Users can text each other.
- The system assesses programming code by running multi-test cases.
- The system sends automated feedback to students instantly.

### **Non – functional requirements:**

#### **Security requirements:**

- Future Marker not allowing the user to enter a password less than 8 characters.
- The system encrypts the passwords in the database.
- The user can't sign in without registering on the system for one single time.
- The user can't use existed e-mail address while registering.

#### **Accessibility and Usability:**

- Future Marker user interface is simple to use for any student or instructor at any age.
- You can reach Future Marker from any device connected to the internet.

### **Performance and scalability:**

- The system functions work with high performance.
- The system marks the tasks and sends feedback in just 3 seconds.

### **Portability:**

- Future marker is a cross-platform (web and mobile application).
- Future Marker mobile app supports multiple operating systems (Android and IOS).

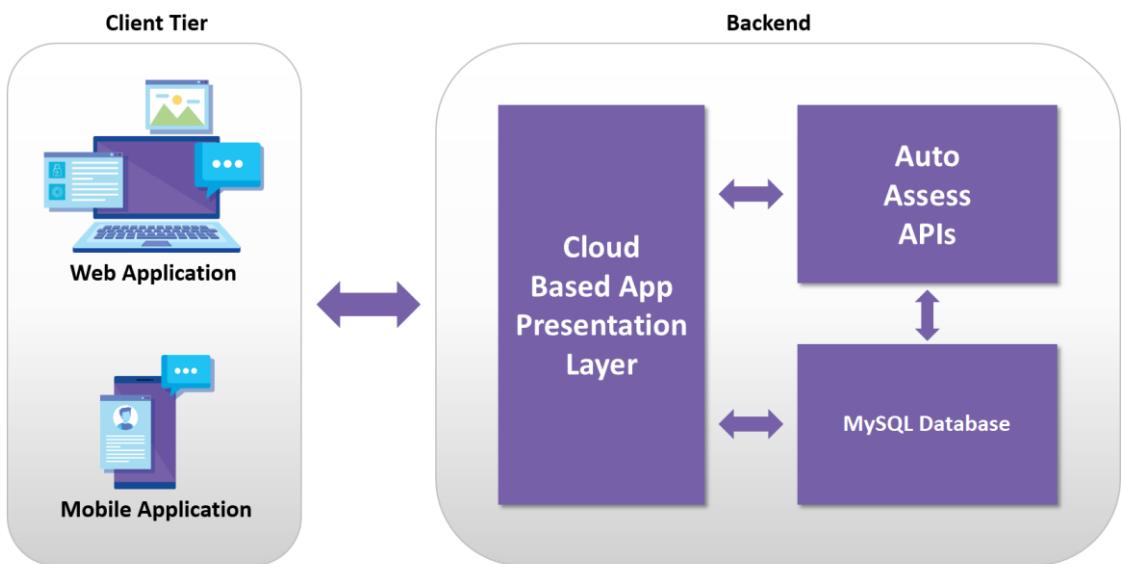
### **Stack holders**

- Universities
- Instructors
- Students

### **System Design**

Future Marker is a 3-tier application architecture that consists of a presentation tier, an application tier, and a data tier.

- Presentation tier - This tier consists of web application and mobile application. The web application will be programmed using HTML5, cascading style sheets (CSS), bootstrap 4, and JavaScript. The mobile application will be programmed using Flutter framework to provide a mobile app for android and IOS.
- Application tier - Contains the business logic of the system. It will be programmed using PHP and Java with Laravel framework, also it will be hosted on distributed servers in the cloud. Application tier communicates with the other tiers through application program interface (API) calls.
- Data-tier – In this tier, we will use MySQL as a database for the system because it's a relational database, secure, high performance, and on-demand scalability.



**Figure 2 - System Design**

## Availability

Future Marker – Smart Learning Management System is a free software for everyone and always will be, also it can be reached from any device such as computers and smartphones at any time.

## Block Diagram

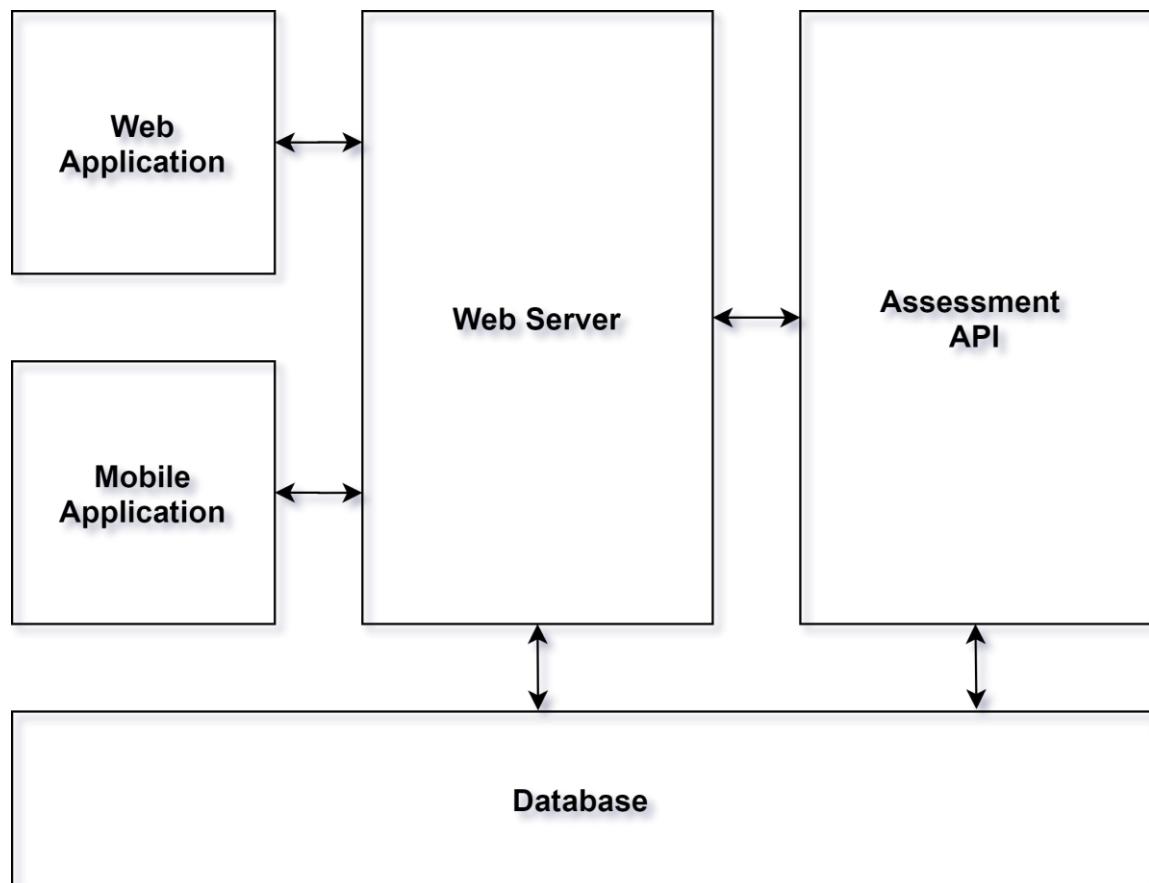


Figure 3 - Block Diagram

## Use Case Diagram

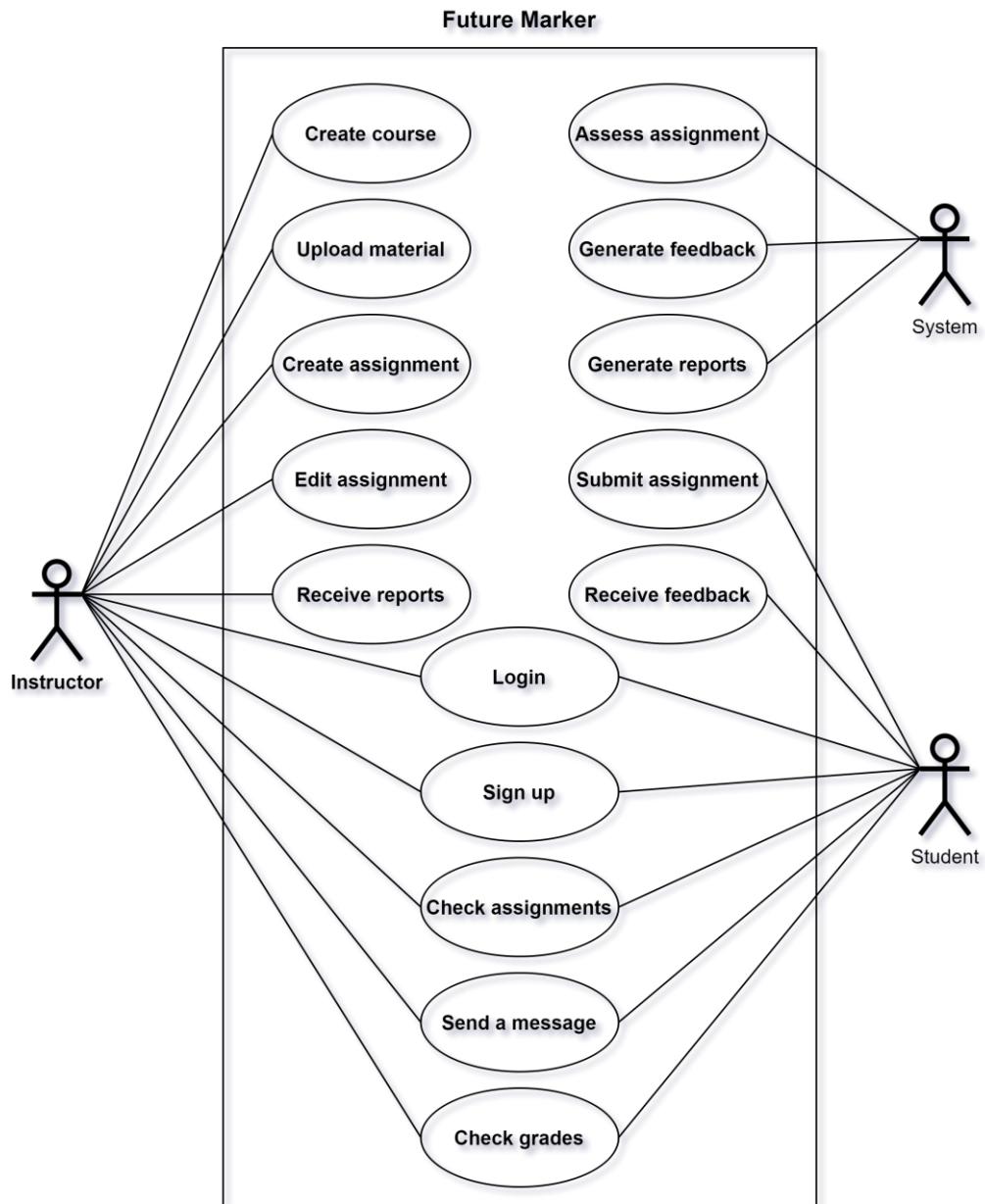


Figure 4 - Use Case Diagram

## Class Diagram

Automated assessment API class diagram

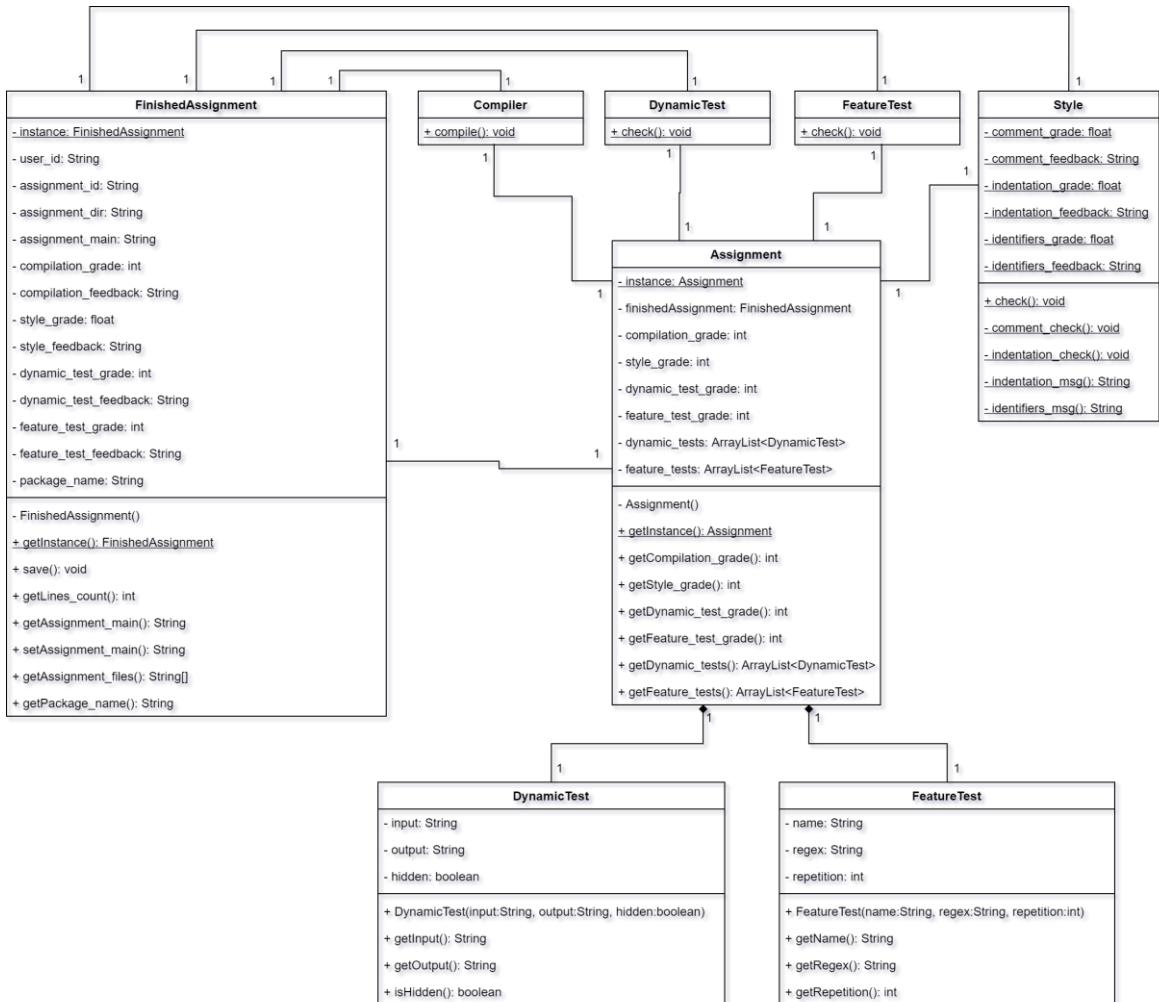


Figure 5 - Class Diagram

## Design Patterns

### 1. MVC

We are using MVC as a design pattern and we chose to work with Laravel because it is the most suitable framework that will help us using MVC.

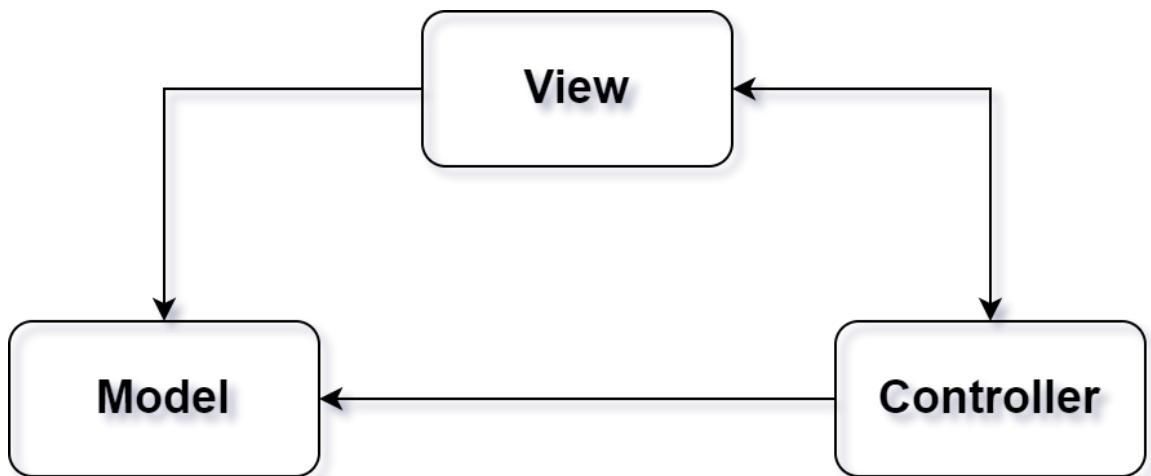


Figure 6 - MVC Design Pattern

### 2. Singleton

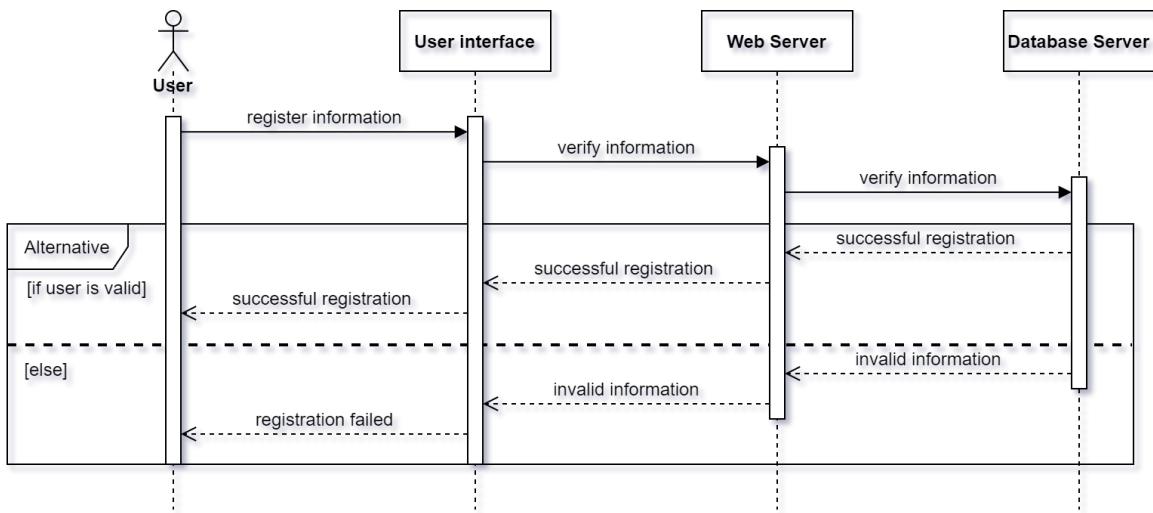
Singleton design is useful when exactly one object is needed to coordinate actions across the system, because of this we decided to use singleton design pattern in our API to restrict the instantiation of a class to one "single" instance in "Assignment" class and "FinishedAssignment" class.

FinishedAssignment	Assignment
- instance: FinishedAssignment	- instance: Assignment
- FinishedAssignment()	- Assignment()
+ getInstance(): FinishedAssignment	+ getInstance(): Assignment

Figure 7 - Singleton Design pattern

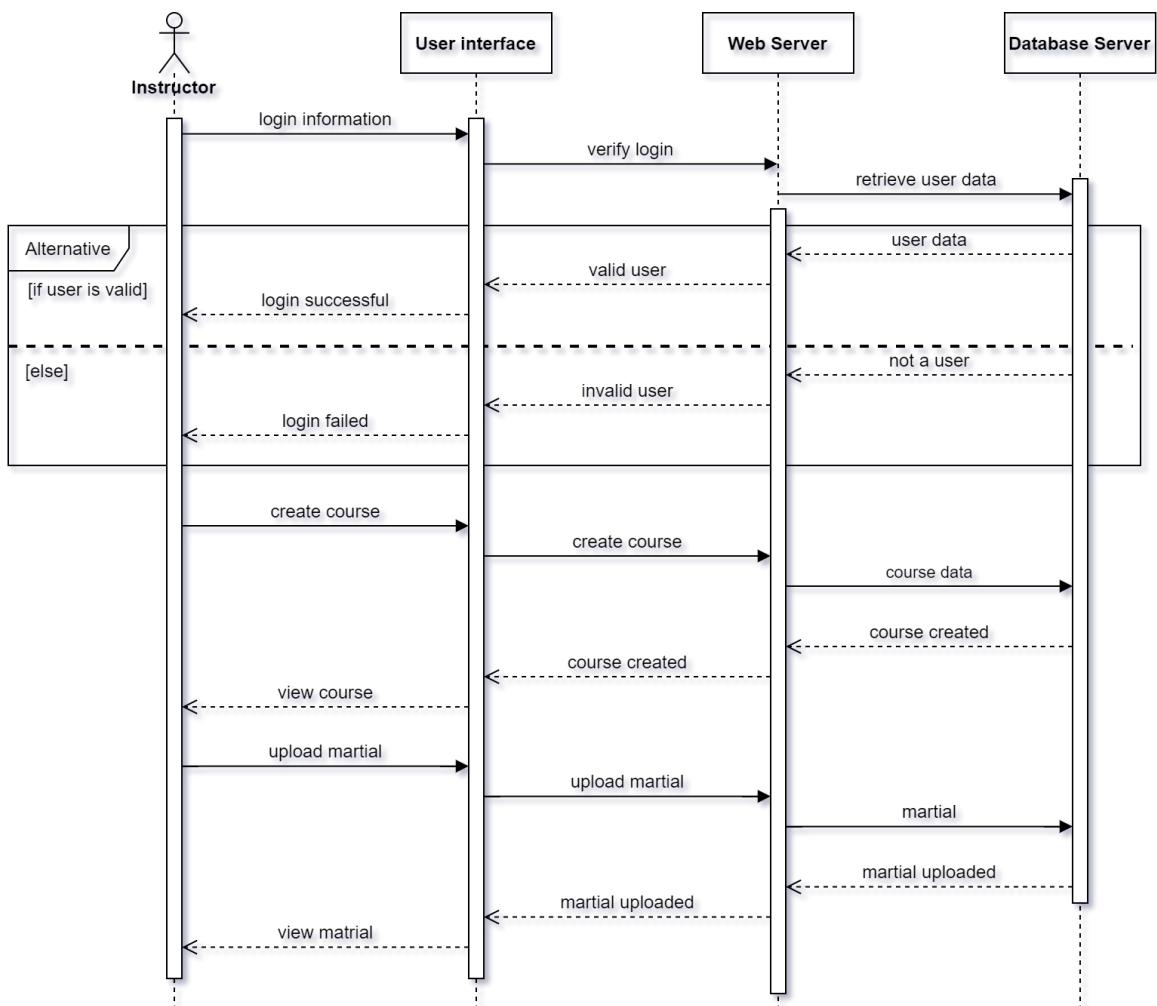
## Sequence Diagram

User registration

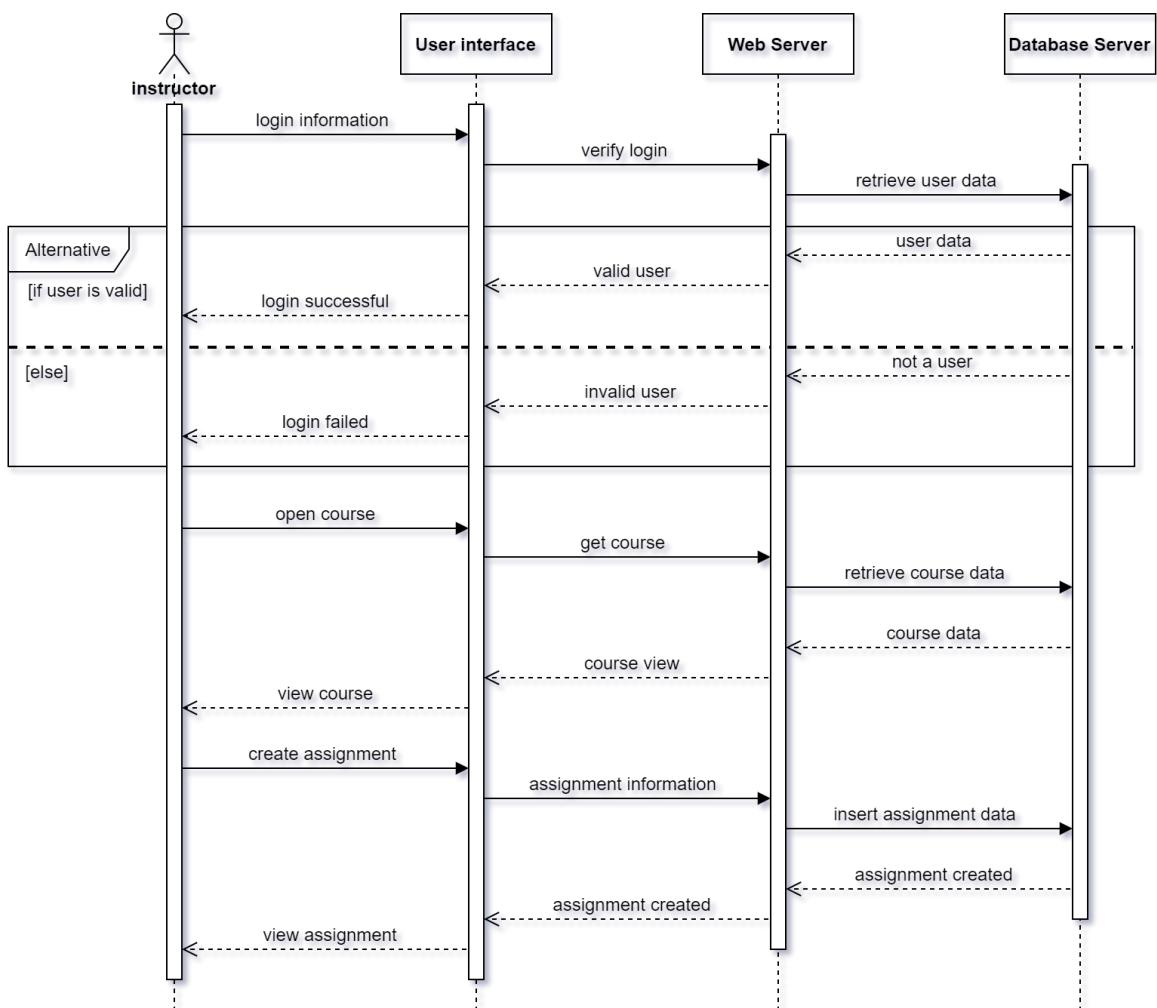


**Figure 8 - Sequence Diagram**

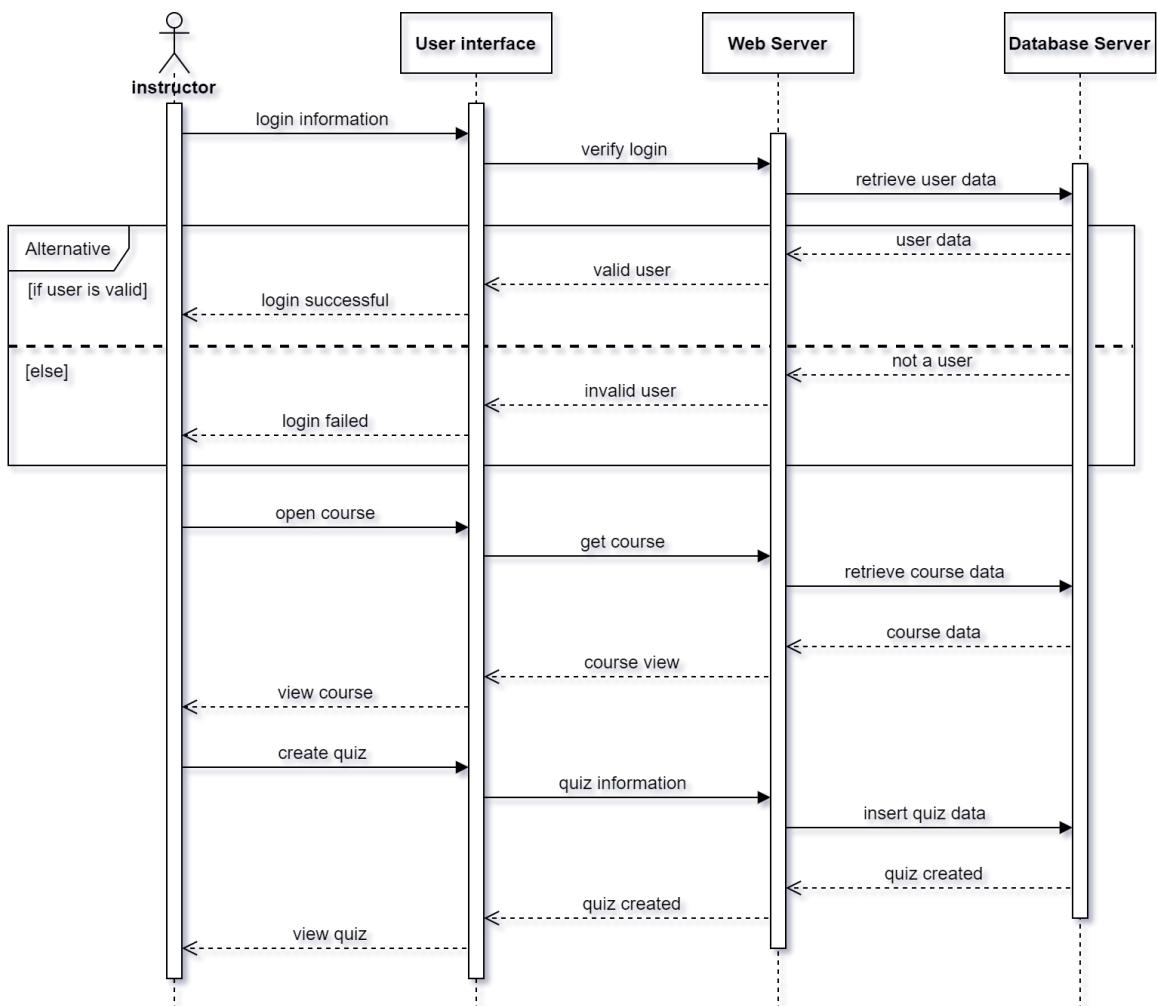
## Instructor course creation



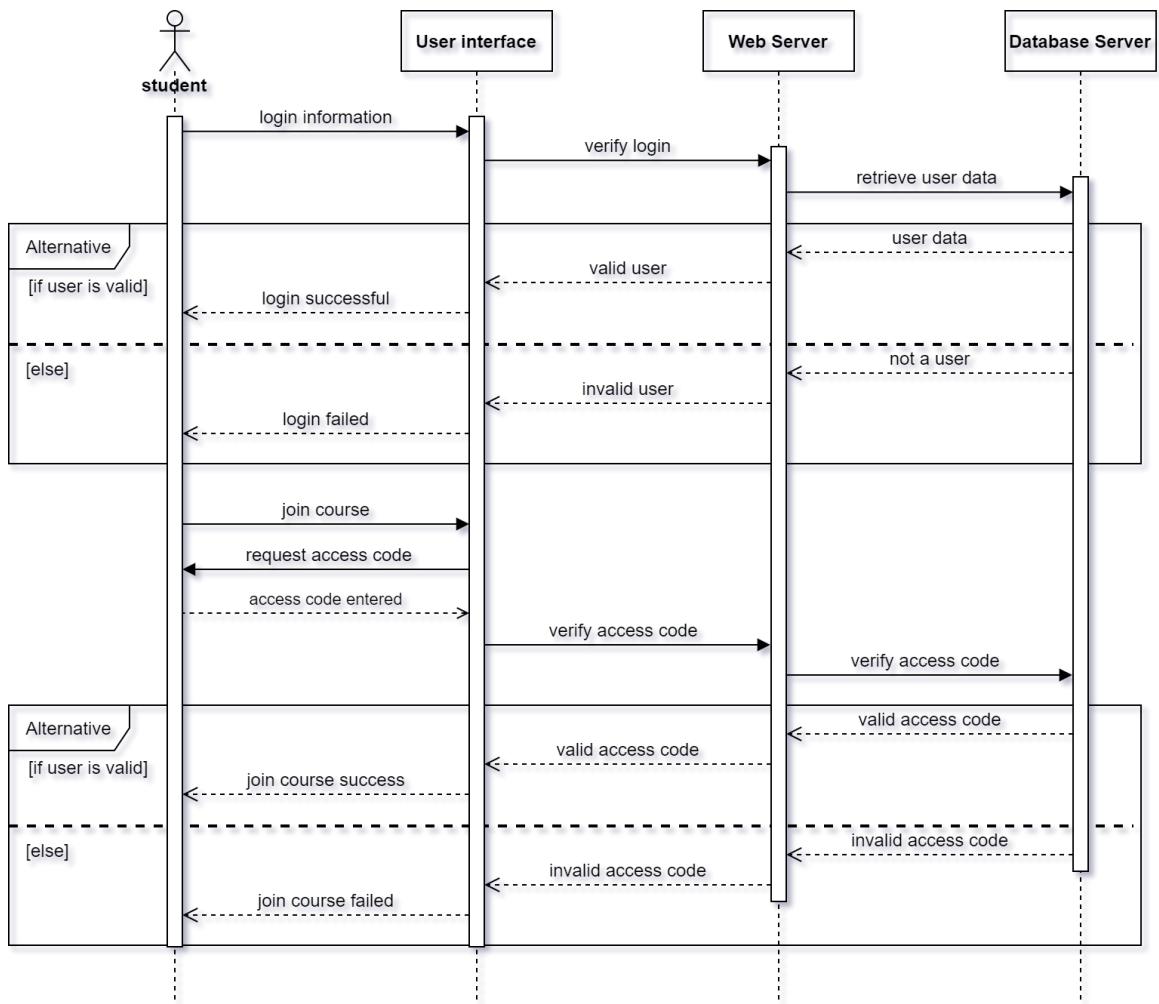
## Instructor assignment creation



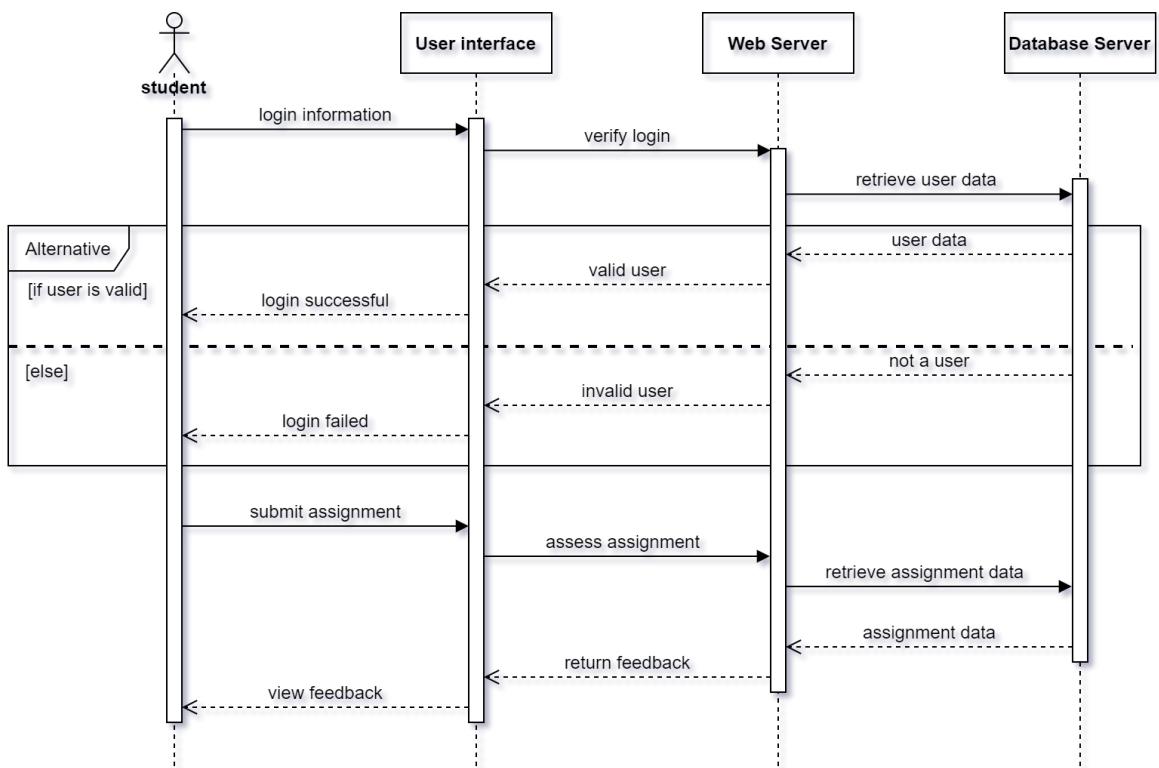
## Instructor quiz creation



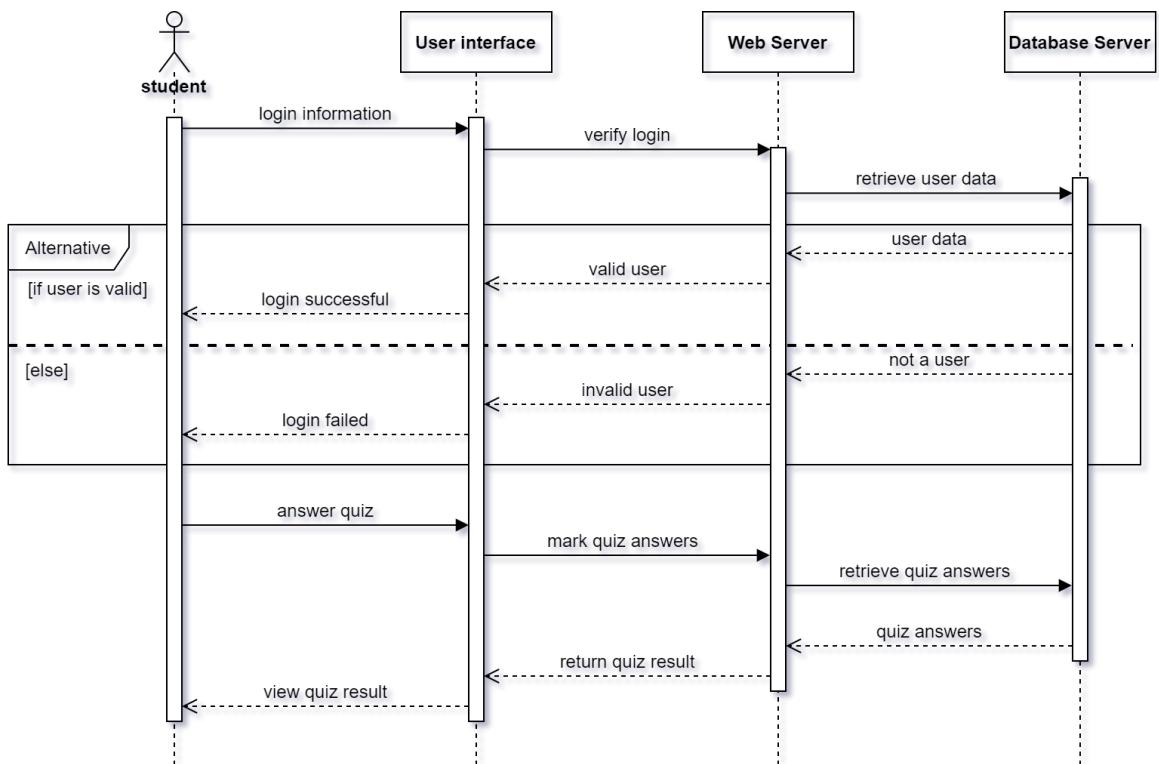
## Student joining course



## Student assignment submission



## Student quiz answering



## Database Design (ERD)

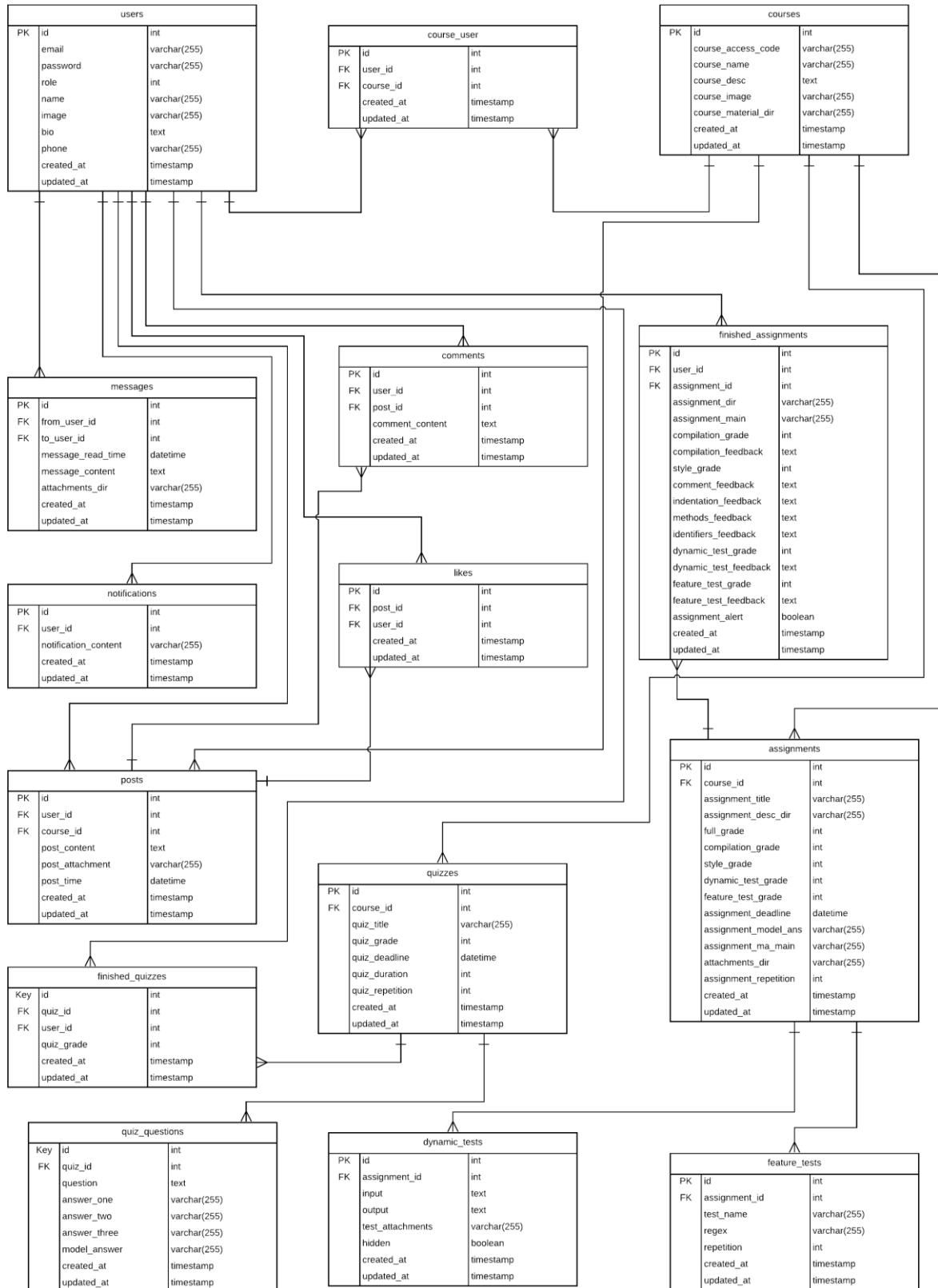


Figure 9 - Entity Relationship Diagram

## Storage Structure

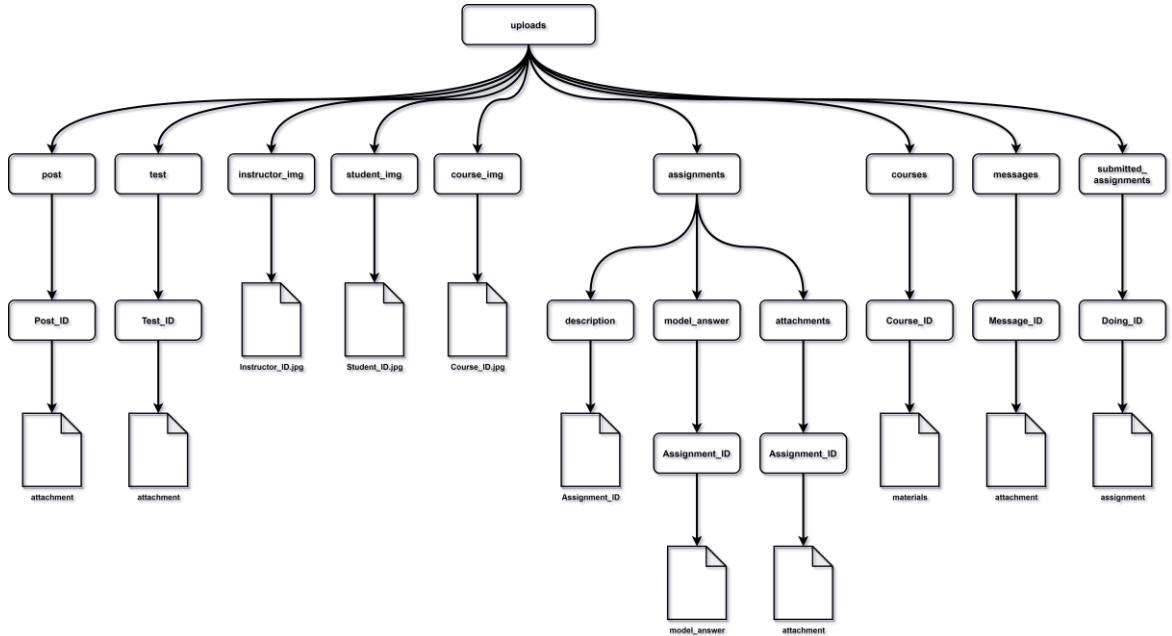


Figure 10 - Storage Structure Diagram

## Used Technologies and tools :

- HTML, CSS, JavaScript
- Bootstrap 4
- Laravel framework
- PHP
- Java
- MYSQL
- Flutter
- GitHub
- Jira
- Digital Ocean cloud

## Summary

In this chapter, we have discussed our analysis and design for the system, and the diagrams that describe it, we have discussed what tools and technologies we are using, furthermore, we illustrated the functional and non-functional requirements, besides the user and system requirements.

# Chapter 3

## Deliverables and Evaluation

### *Main points*

- Introduction
- User Manual
- Testing
- Evaluation (User Experiment)
- Summary

## Introduction

In this phase we are showing the project deliverables and how we test our product, besides we are showing the user manual easily to the user so he can use the project and know how to use its features and specification without facing any problems or constraints, Furthermore, we are representing the user experiment whether on the first demo of Future Marker or on the final output after finishing the product and discussing the result of this experiment and Feedback that we have received.

## User Manual

Here's the user guide for helping you to access and use Future Marker

Open your Brower and go to [futuremarker.com](http://futuremarker.com), then create an account by clicking on Register or Join us.

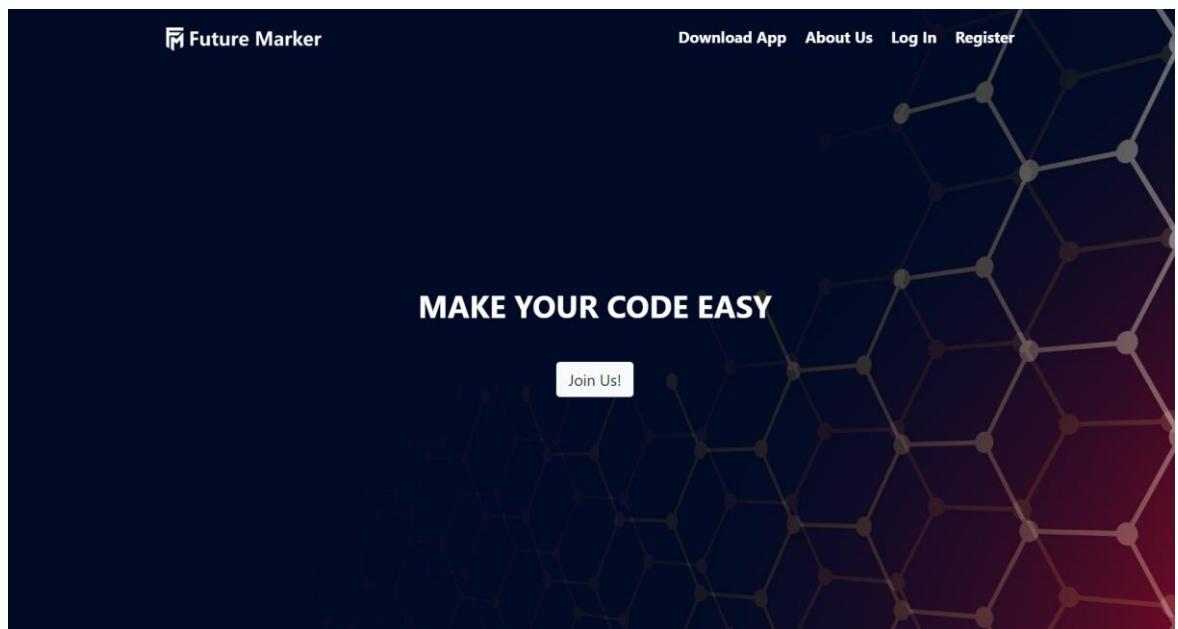


Figure 11 - User Manual

## Instructor's guide:

After login this the home page you will see your posts and courses.

The screenshot shows the Future Marker home page. At the top, there is a dark header bar with the logo "Future Marker" and the word "Courses". On the right side of the header, there are notification icons (bell, message) and a dropdown menu labeled "Instructor". Below the header, the page is divided into two main sections: "Posts" on the left and "Courses" on the right. The "Posts" section contains the text "Here you're going to see the latest course updates." and an icon of a document with a key. The "Courses" section contains the text "Here you're going to see your courses." and an icon of a person on a computer screen with a video camera above it. At the bottom of the page, there is a dark footer bar with the copyright text "© 2020 Copyright Future Marker".

This is the courses page, here you can see your courses and create one.

The screenshot shows the Future Marker Courses page. At the top, there is a dark header bar with the logo "Future Marker" and the word "Courses". On the right side of the header, there are notification icons (bell, message) and a dropdown menu labeled "Instructor". In the center of the page, there is a large text area with the text "Here you're going to see your courses." and an icon of a person on a computer screen with a video camera above it. To the right of this text area, there is a button labeled "Create New Course". At the bottom of the page, there is a dark footer bar with the copyright text "© 2020 Copyright Future Marker".

This is your course page, here you can add material, create assignments, create quizzes, publish posts, and monitor your students' grades.

The screenshot shows a course page for 'Data Structure'. On the left, there's a sidebar with a red header 'What is Programming?' containing a small icon of a computer screen with code. Below it are links for 'Material', 'Posts', 'Grades', and 'Members'. The main content area has a title 'Data Structure' with a detailed description of what a data structure is. It includes an 'Access Code' (4LGH-AFJO-OTSG) and a list of resources: 'Lectures' (Lecture-1.ppt, Lecture-2.ppt) and 'Sections' (Section-1.pptx, Section-2.pptx). To the right, there are sections for 'Assignments' (empty) and 'Quizzes' (empty), each with a 'Create Quiz' button. At the bottom, a footer bar says '© 2020 Copyright Future Marker'.

To create assignment you have to determine the deadline, write the assignment description, and determine the grades distribution, furthermore, you can add attachments, in addition to you can use the dynamic testing by entering the inputs and the expected output, also, you can use feature testing to look for any feature in the assignment and its repetition count.

The screenshot shows the 'Create Assignment' form. It has fields for 'Deadline' (a date input field), 'Title' (a text input field), and 'Description' (a rich text editor with a toolbar). Below the description is a 'Permissible Attempts' section with a text input field. The sidebar on the left is identical to the one in the previous screenshot, showing the 'What is Programming?' module and other course links.

#### Compilation Mark

10

#### Style Mark

20

#### Dynamic Testing Mark

40

#### Feature Testing Mark

30

#### Upload Attachment

No file chosen

#### Upload Model Answer

No file chosen

### Dynamic Testing

#### Input

Enter your inputs separated by space

#### Output

Enter your output

Hide Input & Output



### Feature Testing

#### Choose Type

Select the feature

#### Repetition Count

1

#### Regular Expressions



Create

## Student's guide

After login this the home page you will see your instructor's posts and upcoming assignments and quizzes.

The screenshot shows the student dashboard of the Future Marker platform. At the top, there is a dark header bar with the Future Marker logo, navigation links for Courses and Grades, and a notification bell icon showing 0 notifications. On the right, it says "Student". Below the header, the main content area is divided into several sections:

- Posts:** A section titled "Posts" with the sub-section "Recent". It contains the message: "Here you're going to see the latest course updates." and a large icon of a clipboard with a key.
- Upcoming:** A section titled "Upcoming" with the sub-section "Assignments". It displays the message: "There are no Assignments".
- Upcoming:** A section titled "Upcoming" with the sub-section "Quizzes". It displays the message: "There are no Quizzes".

At the bottom of the dashboard, there is a footer bar with the copyright notice: "© 2020 Copyright Future Marker".

This is the courses page, here you can see your courses and join one.

The screenshot shows the courses page of the Future Marker platform. At the top, there is a dark header bar with the Future Marker logo, navigation links for Courses and Grades, and a notification bell icon showing 0 notifications. On the right, it says "Student". Below the header, the main content area has the following elements:

- A "Join Course" button.
- A message: "Here you're going to see your courses."
- A large icon of a computer monitor displaying a video call interface with a person and a chart.

At the bottom of the page, there is a footer bar with the copyright notice: "© 2020 Copyright Future Marker".

This is your course page, here you can download material, submit assignments, answer quizzes, see your grades, and know your classmates.

The screenshot shows a course page for "Data Structure". At the top, there's a navigation bar with "Future Marker", "Courses", "Grades", and a student dropdown. Below the navigation is a sidebar with a red header "What is Programming?" containing a small icon of a computer monitor. The sidebar has four sections: "Material", "Posts", "Grades", and "Members". The main content area starts with a section titled "Data Structure" which defines it as a data organization, management, and storage format. It includes an access code "4LGH-AFJO-OTSG" and a list of resources: Lectures (Lecture-1.ppt, Lecture-2.ppt) and Sections (Section-1.pptx, Section-2.pptx). To the right, there's a "Upcoming" section with "Assignments" and "Quizzes", both of which are currently empty. At the bottom of the page is a footer with "© 2020 Copyright Future Marker".

### Mobile App Screens

The three screenshots show the mobile application interface. The first screenshot is the registration screen with fields for Name, Email, Password, and Confirm Password, and a "Register Now" button. The second screenshot is the login screen with fields for Email and Password, and a "log in" button. The third screenshot is the user dashboard for an instructor named "instructor@gmail.com", showing options for Home, My profile, Courses, Notifications (with 1+), Settings, and Log out.

**Create Course**

**Enter The Course Information**

Course Name

Course Description

Create

**Home**

Instructor ► Data Structures  
Posted in 2020-07-25T21:26:27.000000Z

Welcome to Data Structures! My hope is that by the end of this course you have a new appreciation for the subject matter and will continue your education in the subject.

0

Instructor ► Data Structures  
Posted in 2020-07-25T21:26:27.000000Z

The Access Code is HPNO-KL48-YBH4

0

**Data Structures**

Lectures

Sections

Material

Assignments

Quizzes

Updates

+

**Data Structures**

add two numbers  
Due 2020-07-31 16:45:00

Quiz one  
Due 2020-08-04 23:45:00

Instructor  
2020-07-25 21:26:27

The Access Code is HPNO-KL48-YBH4

0

Instructor  
2020-07-25T21:26:27.000000Z

Welcome to Data Structures! My hope is that by the end of this course you have a new appreciation for the subject matter and will continue your education in the subject.

0

Assignments

Quizzes

Updates

+

## Testing

After finishing implementation of the project we have moved to the testing phases which are two phases before making the user experiment, the first phase is testing the project by our self and make sure that everything in the system and our functions and the API are working correctly, and the result is that we have found some issues and bugs, and this is normal as we were just done the developing stage and this why the testing stage is important, so we have fixed all the issues and bugs ourselves and tested one more time to make sure that everything is working accurately, and to prove the success of this phase we have decided to move to the second phase which is sending test scenarios with the project running on cloud to another team to test it, and as we expected all the test scenarios succeeded.

### **Quality assurance will consist of several stages:**

- Review of requirements
- Test planning/writing test cases
- Unit testing
- Integration testing
- System testing
- Performance testing
- Security testing
- Cross-browser testing / cross-platform testing
- Updating test cases
- Regression testing

### **Test Scenario 1: Check register functionality**

Open the website, then click on the register button, register form will appear then start to enter the credentials.

Test Case	Test Data	Expected result	Actual Result	Status
<b>Ignore selecting role</b>	Name: name Email:user@gmail.com Password: Password Confirm password: Password	An error message should appear, and should not register.	An error message should appear, and should not register.	success
<b>Enter the wrong format of the email.</b>	Name: name Email:user.com Password: Password Confirm password: Password	An error message should appear, and should not register.	An error message should appear, and should not register.	success
<b>Enter the wrong format of the password.</b>	Name: name Email:user@gmail.com Password: 123 Confirm password: 123	An error message should appear, and should not register.	An error message should appear, and should not register.	success
<b>Enter empty email.</b>	Name: name Email: Password: Password Confirm password: Password	An error message should appear, and should not register.	An error message should appear, and should not register.	success
<b>Enter an empty name.</b>	Name: Email: user@gmail.com Password: Password Confirm password: Password	An error message should appear, and should not register.	An error message should appear, and should not register.	success
<b>Enter an empty password.</b>	Name: name Email: user@gmail.com Password: Confirm password: Password	An error message should appear, and should not register.	An error message should appear, and should not register.	success
<b>Enter an empty confirm password.</b>	Name: name Email: user@gmail.com Password: Password Confirm password:	An error message should appear, and should not register.	An error message should appear, and should not register.	success

### **Test Scenario 2: Check login functionality**

Open the website, then click on the login button, the login form will appear then start to enter the credentials.

Test Case	Test Data	Expected result	Actual Result	Status
<b>Enter the wrong format of the email.</b>	Email:user@gmail.com Password: Password	An error message should appear, and should not log in.	An error message should appear, and should not log in.	success
<b>Enter a non-existing email and the right password.</b>	Email:user@gmail.com Password: Password	An error message should appear, and should not log in.	An error message should appear, and should not log in.	success
<b>Enter the wrong format of the password.</b>	Email: user@gmail.com Password: 123	An error message should appear, and should not log in.	An error message should appear, and should not log in.	success
<b>Enter a non-existing email and the wrong password in the database.</b>	Email: undefined_user@gmail.com Password: Wrong password	An error message should appear, and should not log in	An error message should appear, and should not log in.	success
<b>Enter existing email and non-existing password in the database.</b>	Email: user@gmail.com Password: Wrong password	An error message should appear, and should not log in	An error message should appear, and should not log in.	success
<b>Enter empty email.</b>	Email: Password: password	An error message should appear, and should not log in	An error message should appear, and should not log in.	success
<b>Enter both fields empty.</b>	Email: Password:	An error message should appear, and should not log in	An error message should appear, and should not log in.	success

**Test Scenario 3:** Check edit profile functionality as an instructor.

Login to the website, then go to profile, then start to edit profile.

Test Case	Test Data	Expected result	Actual Result	Status
<b>Upload profile image</b>	Image.png/jpg Image size < 10 MB	It should edit the profile image.	It should edit the profile image.	success
<b>Upload profile image with a big size.</b>	Image size > 10 MB	An error message should appear, and should not edit profile image.	An error message should appear, and should not edit profile image.	success
<b>Enter empty Bio.</b>	Bio: phone:01234567899	It should edit other fields.	It should edit other fields.	success
<b>Enter an empty phone.</b>	Bio: this is bio text phone:	It should edit other fields.	It should edit other fields.	success
<b>Ignore selecting a profile image.</b>	Bio: this is bio text phone:01234567899	It should edit other fields.	It should edit other fields.	success
<b>Enter wrong format of the phone.</b>	Bio: this is bio text phone: phone	Error message\ should appear, and should not edit the phone.	Error message\ should appear, and should not edit the phone.	success

**Test Scenario 4:** Check edit profile functionality as a student.  
 Login to the website, then go to profile, then start to edit profile.

Test Case	Test Data	Expected result	Actual Result	Status
<b>Upload profile image</b>	Image.png/jpg Image size < 10 MB	It should edit the profile image.	It should edit the profile image.	success
<b>Upload profile image with a big size.</b>	Image size > 10 MB	An error message should appear, and should not edit profile image.	An error message should appear, and should not edit profile image.	success
<b>Enter empty Bio.</b>	Bio: phone:01234567899	It should edit other fields.	It should edit other fields.	success
<b>Enter an empty phone.</b>	Bio: this is bio text phone:	It should edit other fields.	It should edit other fields.	success
<b>Ignore selecting a profile image.</b>	Bio: this is bio text phone:01234567899	It should edit other fields.	It should edit other fields.	success
<b>Enter wrong format of the phone.</b>	Bio: this is bio text phone: phone	An error message should appear, and should not edit the phone.	An error message should appear, and should not edit the phone.	success

**Test Scenario 5:** Check the course creation functionality as an instructor.  
 Login to the website then courses page, then click on create course button.

Test Case	Test Data	Expected result	Actual Result	Status
<b>Enter empty Course Name</b>	Course Name: Course Description: that described the course Course Image: image.jpg	An error message should appear, and should not create	An error message should appear, and should not create	success
<b>Enter empty Course Description</b>	Course Name: course name Course Description: Course Image: image.jpg	An error message should appear, and should not create	An error message should appear, and should not create	success
<b>Enter empty image</b>	Course Name: course name Course Description: that described the course Course Image:	An error message should appear, and should not create	An error message should appear, and should not create	success
<b>Enter valid data</b>	Course Name: course name Course Description: that described the course Course Image: image.jpg/png	It should create a course	It should create a course	success

**Test Scenario 6:** Check to join course functionality as a student.  
 Login to the website then courses page, then click on join course button.

Test Case	Test Data	Expected result	Actual Result	Status
<b>Enter empty Access Code</b>	Access Code :	An error message should appear, and should not join	An error message should appear, and should not join	success
<b>Enter invalid Access Code</b>	Access Code: invalid Access code	An error message should appear, and should not join	An error message should appear, and should not join	success
<b>Enter valid Access Code</b>	Access Code : Valid access code (Ex: xxxx-xxxx-xxxx)	It should join the course	It should join the course	success

**Test Scenario 7:** Check to create folder functionality as an instructor.

Login to the website, then create a course, then click on create folder button from three points.

Test Case	Test Data	Expected result	Actual Result	Status
<b>Enter empty Folder name</b>	Folder Name: Choose File: image.jpg	An error message should appear, and should not create	An error message should appear, and should not create	success
<b>Enter existing Folder name</b>	Folder Name: existing name Choose File: file.pdf	It should upload a file for an existing folder and should not create another one	It should upload a file for an existing folder and should not create another one	success
<b>Enter empty upload file</b>	Folder Name: folder name Choose File:	It should create an empty folder	It should create an empty folder	success
<b>Upload file into a new folder</b>	Folder Name: folder name Choose File: file.pdf	It should create a folder and upload a file into it	It should create a folder and upload a file into it	success

**Test Scenario 8:** Check upload folder functionality as an instructor.

Login to the website, then create a course, then create a folder, then click on “upload file” from three points.

Test Case	Test Data	Expected result	Actual Result	Status
No select folder	Select Folder : - Select Folder – Choose File: file.pdf	An error message should appear, and should you select folder	An error message should appear, and should you select folder	success
Enter empty data	Folder Name: Choose File:	An error message should appear, and should not upload file	An error message should appear, and should not upload file	success
Enter empty upload file	Folder Name: folder name Choose File:	An error message should appear, and should not upload file	An error message should appear, and should not upload file	success
Upload file into a folder	Folder Name: folder name Choose File:file.pdf File size < 40 MB	It should upload a file into selection folder	It should upload a file into selection folder	success
Upload file with a big size.	Folder Name:folder name Choose File:file.pdf File size > 40 MB	An error message should appear, and should not upload file	An error message should appear, and should not upload file	success

**Test Scenario 9:** Check post functionality as an instructor.  
Login to the website, then create a course, then click on posts.

Test Case	Test Data	Expected result	Actual Result	Status
<b>Empty post</b>	Description: Upload Attachment:	It should not post	It should not post	success
<b>Enter empty description</b>	Description: Upload Attachment: image.jpg/png	An error message should appear, and should not post	An error message should appear, and should not post	success
<b>Enter empty upload attachment</b>	Description: type description here Upload Attachment:	It should post without file	It should post without file	success
<b>Upload attachment</b>	Folder Name:folder name Choose File:file.pdf File size < 40 MB	It should post and upload an attachment with post	It should post and upload an attachment with post	success
<b>Upload file with a big size.</b>	Folder Name:folder name Choose File:file.pdf File size > 40 MB	An error message should appear, and should not post and not upload attachment into it	An error message should appear, and should not post and not upload attachment into it	success

**Test Scenario 10:** Check post functionality as a student.  
Login to the website, then join the course, then click on posts.

Test Case	Test Data	Expected result	Actual Result	Status
<b>Check posts</b>	None	It should view the posts from the instructor	It should view the posts from the instructor	success
<b>Download attachments</b>	Click on attachment in a post	It should download automatically	It should download automatically	success

**Test Scenario 11:** Check comment functionality as an instructor.

Login to the website, then create a course, then create a post, then type comment.

Test Case	Test Data	Expected result	Actual Result	Status
Enter empty comment	comment:	An error message should appear, and should not post the comment	An error message should appear, and should not post the comment	success
Enter comment	Comment: comment on a post	It should post the comment	It should post the comment	success

**Test Scenario 12:** Check comment functionality as a student.

Login to the website, then join a course, then type comment.

Test Case	Test Data	Expected result	Actual Result	Status
Enter empty comment	comment:	An error message should appear, and should not post the comment	An error message should appear, and should not post the comment	success
Enter comment	Comment: comment on a post	It should post the comment	It should post the comment	success

**Test Scenario 13:** Check quiz functionality as an instructor.

Login to the website, then create a course, then click on create quiz button

Test Case	Test Data	Expected result	Actual Result	Status
<b>Enter empty data in any field</b>	Deadline: Title: Duration in minutes: Permissible Attempts: Question: Answer1: Answer2: Answer3: Answer4: Correct answer:	An error message should appear, and should not create a quiz	An error message should appear, and should not create a quiz	success
<b>Enter valid data</b>	Deadline:25/10/2020 Title: quiz Duration in minutes: 5 Permissible Attempts: 4 Question:there is a question Answer1:answer1 Answer2:answer2 Answer3:answer3 Answer4:answer4 Correct answer: Answer 1,2,3,4	It should create a quiz	It should create a quiz	success
<b>Enter negative number in Duration</b>	Deadline:25/10/2020 Title: quiz Duration in minutes: -5 Permissible Attempts: 4 Question:there is a question Answer1:answer1 Answer2:answer2 Answer3:answer3 Answer4:answer4 Correct answer: Answer 1,2,3,4	An error message should appear, and should not create a quiz	An error message should appear, and should not create a quiz	success
<b>Enter negative number in Permissible Attempts</b>	Deadline:25/10/2020 Title: quiz Duration in minutes: 5 Permissible Attempts: -4 Question:there is a question Answer1:answer1 Answer2:answer2 Answer3:answer3 Answer4:answer4 Correct answer: Answer 1,2,3,4	An error message should appear, and should not create a quiz	An error message should appear, and should not create a quiz	success

**Test Scenario 14:** Check quiz functionality as a student.

Login to the website, then join a course, then go to a quiz, then click on start quiz.

Test Case	Test Data	Expected result	Actual Result	Status
<b>Not answer for any question</b>	No select any answers	It should deduct the degree of the question	It should deduct the degree of the question	success
<b>Submit with the right answer</b>	Select correct answer	It should put give the full grade of these question	It should put give the full grade of these question	success
<b>Submit with wrong answer</b>	Select wrong answer	It should put give 0 grade of these question	It should put give 0 grade of these question	success
<b>Submit more than permissible attempts</b>	Number of submissions > permissible attempts	It should disable start quiz button after permissible attempts	It should disable start quiz button after permissible attempts	success
<b>Don't submit before the timeout</b>	Wait for remaining time:0h 0m 0s	It should submit the answers automatically	It should submit the answers automatically	success

**Test Scenario 15:** Check assignment functionality as an instructor.

Login to the website, then create a course, then click on create an assignment.

Test Case	Test Data	Expected result	Actual Result	Status
<b>Enter a negative number in Permissible Attempts</b>	Permissible Attempts: -5 (And fill all valid data)	An error message should appear, and should not create an assignment	An error message should appear, and should not create an assignment	success
<b>Enter grades percentage &lt;&gt; 100%</b>	Compilation + Style + Dynamic test + feature test <> 100% (And fill all valid data)	An error message should appear, and should not create an assignment	An error message should appear, and should not create an assignment	success
<b>Upload file with a big size.</b>	Upload attachment:file.pdf File size > 40 MB (And fill all valid data)	An error message should appear, and should not create an assignment	An error message should appear, and should not create an assignment	success
<b>Enter a dynamic test with empty data</b>	Dynamic test Input : Output: (And fill all valid data)	An error message should appear, and should not create an assignment	An error message should appear, and should not create an assignment	success
<b>Enter negative repetition count in feature testing</b>	Feature Testing Repetition count: -5 (And fill all valid data)	An error message should appear, and should not create an assignment	An error message should appear, and should not create an assignment	success
<b>Enter valid data for create assignment</b>	fill all fields with valid data	It should create an assignment and push back to the course page with a success message	It should create an assignment and push back to the course page with a success message	success

**Test Scenario 16:** Check assignment functionality as a student.

Login to the website, then join a course, then click on an assignment.

Test Case	Test Data	Expected result	Actual Result	Status
<b>Submit file with a wrong extension</b>	Assignments files: fille.pdf	An error message should appear, and should not submit an assignment	An error message should appear, and should not submit an assignment	success
<b>Submit java file</b>	Assignments files: main.java	It should submit and mark	It should submit and mark	success
<b>Submit multiple java files</b>	Assignments Files: "code 1.java" "code 2.java" "main.java" (3 files )	It should submit and mark	It should submit and mark	success
<b>Upload file with a big size.</b>	Assignments file: main.java File size > 40 MB	An error message should appear, and should not submit an assignment	An error message should appear, and should not submit an assignment	success
<b>Submit more than permissible attempts</b>	Number of submissions > permissible attempts	It should disable submit assignment automatically after permissible attempts number	It should disable submit assignment automatically after permissible attempts number	success

## Evaluation (User experiments)

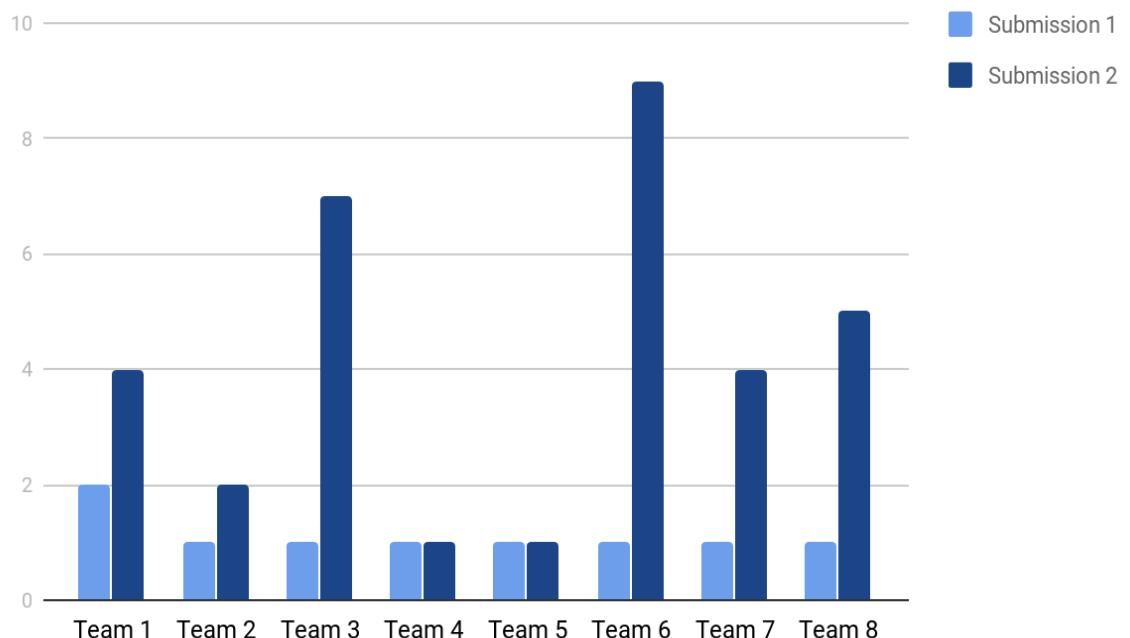
### First Experiment

After finishing three main functions from our project which are checking comments in the code, Code indentation, and identifiers name and length, we had decided that we have to test it with second-year computer science students at Future Academy in a specific programming course which is CSC211 - Programming Language (2).

This experiment consisted of two submissions, after the first submission we provide them with grade report showing them how the program evaluates their comments, indentation, identifiers, and after the students see their grade report for each java class, they try to modify and edit their code again for the second submission.

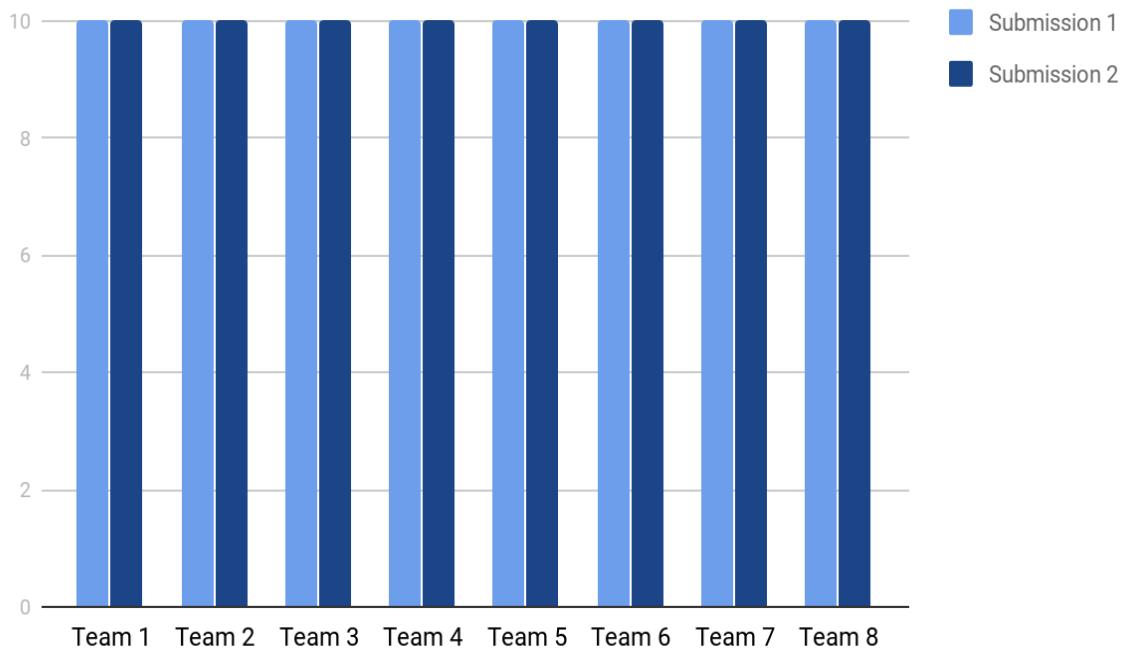
The following graphs show the improvements in grades for some teams in each section (Comments, Indentation, and Identifiers) in the first and the second submission.

### Comments Assessment

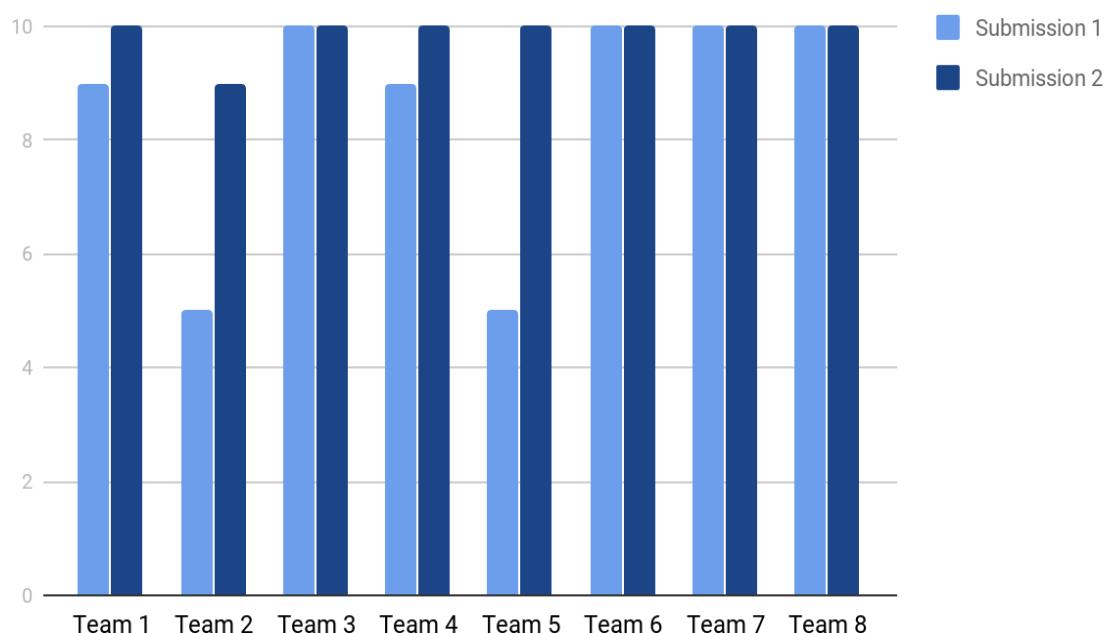


**Figure 12 - Experiment One**

## Identifiers Assessment



## Indentation Assessment



In addition to, we asked them to fill online survey we have created it to see if they are satisfied with this experiment and what is their opinion about our project, and the feedback was positive and encouraging.

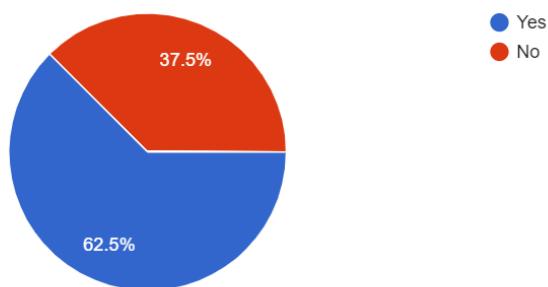
## Second Experiment

Here in this experiment we have finished the developing and testing stages of the system and it became already free and available for everyone as you can reach it on [futuremarker.com](http://futuremarker.com), so we have decided to test it with the end-users as we have created an instructor account and choose a random sample of computer science students different levels of education, we have created a course and uploaded material in it, besides, we have created two java assignments, and we have also created an online quiz, and finally we gave them the course's access code and asked them to sign up as a student and join the course to navigate the web application and try to solve the assignments and upload it to receive the grades and feedbacks, furthermore, solving the online quiz to get its mark.

As project owners, we have created a user satisfaction questionnaire for the students who tested the web application to ask them several questions that will get us to know their opinion on the whole system after they got interact with it and used its functions.

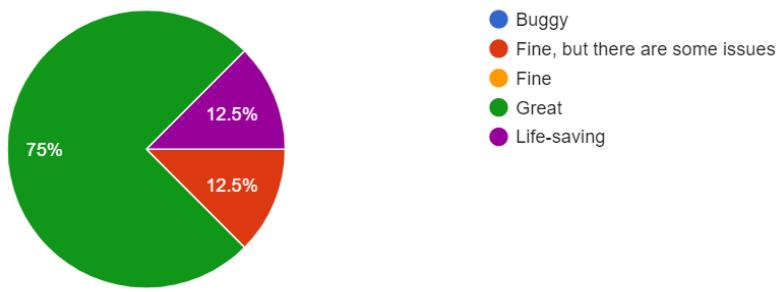
And here's the questionnaire result:

Have you ever heard about automated assessment for programming before?

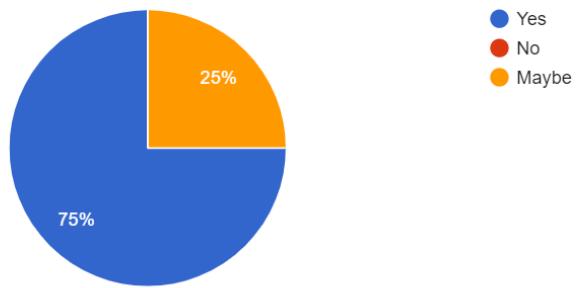


**Figure 13 - Experiment Two**

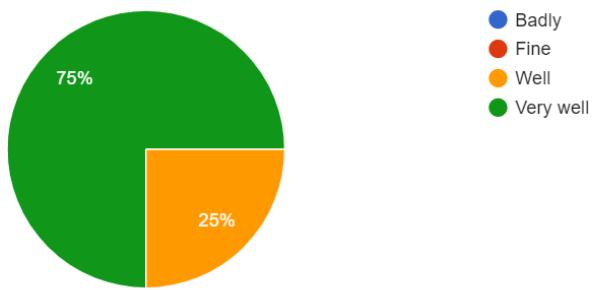
Which of the following words would you use to describe our software product?



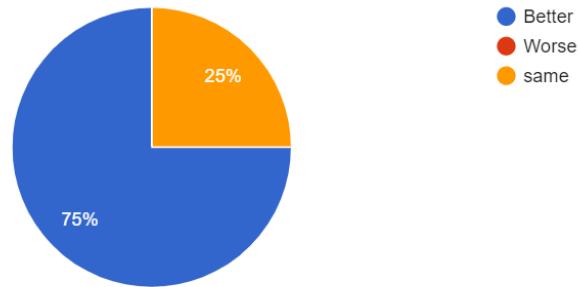
Do you see that FutureMarker can help in improving the student's coding skills?



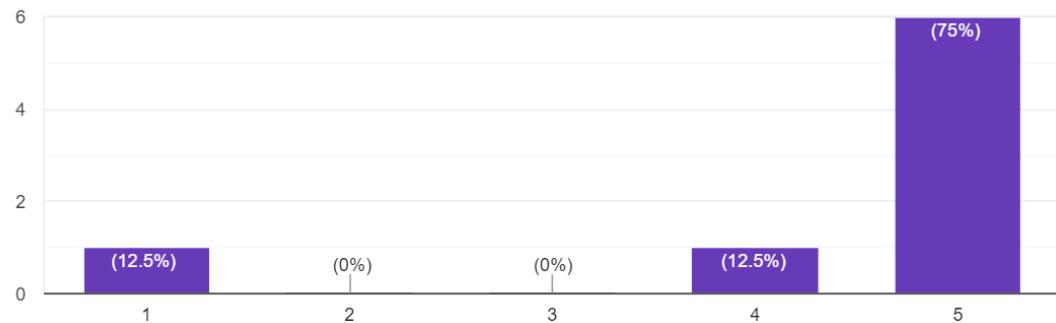
How well does our product meet educational institutions' needs?



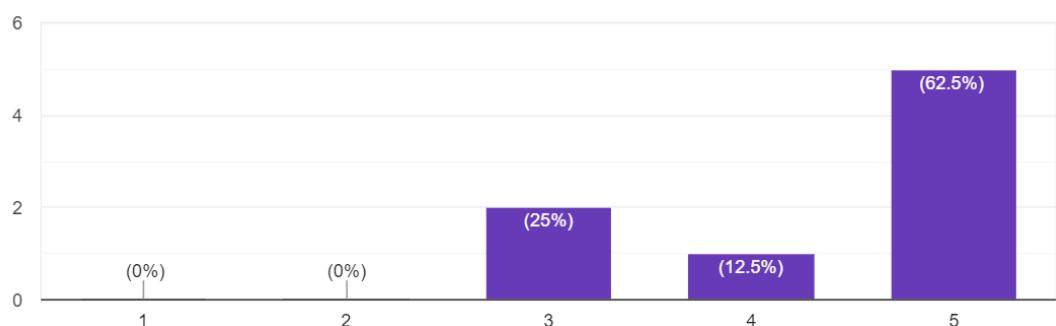
Compared to our Learning management system competitors, is our product quality better, worse, or about the same?



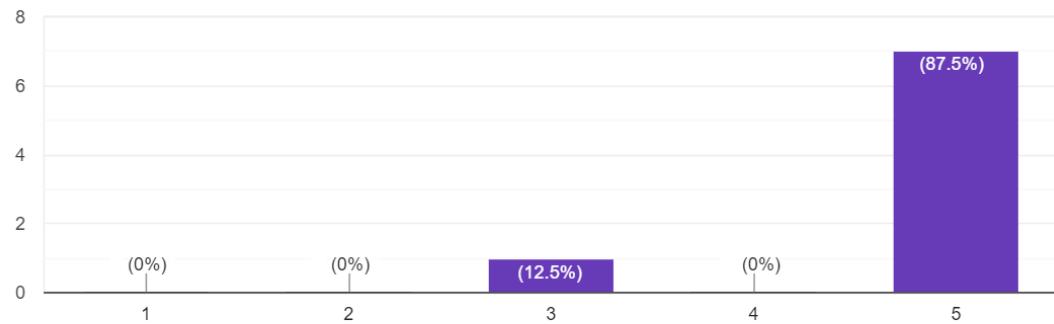
How easy is it to navigate our Web Application?



On a scale from 1 to 5 how you see your feedback is accurate?



On a scale from 1 to 5, how likely are you to recommend Future Marker to your instructors or colleague?



## Summary

In this part we have discussed how we tested our projects and what are the results of this testing and how the received feedback from the users helped us to maintain and fix the bugs, In addition to we are showing the User Manual for Future Marker that shows the user how to use it as a student or instructor, Furthermore, we have discussed our evaluation for the user experiments.

# Chapter 4

## Discussion and Conclusion

### ***Main points***

- Introduction
- Main findings
- Why is this project important?
- Practical implementation
- Future Recommendation
- Conclusion Summary

## **Introduction**

Here in this chapter, we have reached the last phase of the project after we have finished the previous phases as we have discussed in them the main problem that we are solving it and how we have solved it and what methodology we have followed, and what tools we have used, besides the deliverables of the project, also we have explained the functional and non-functional requirements, besides the user requirements, furthermore, we have shown the diagrams that clarify our system, we have also presented our testing and user experiment, and finally, here we are going to discuss the main findings that we have found and reached and why our project is very important for the educational schools and universities and what is we are planning to do regards the future improvements and recommendations for Future Marker.

## **Main Findings**

Before beginning in our project we made a lot for researches to see the current solutions that available to solve the problem, and we have discovered that almost all the learning management systems don't have an automated assessment for programming assignments, the available code judge tools are single programs for only evaluating code, one of the most well known learning management system that used is "Schoology" this system allows the instructors for communicating with their students and share material and receive assignments from them, furthermore we have discovered that the instructors spend a lot of times to evaluate the programming assignment, and they don't get the chance to give their students brief feedback to inform them about their progress, besides, most of computer science students in the early years, don't follow the standards of clean coding, and this affects them badly in the future as they will work in a team and write project together, so we have figured that if we could develop a learning management system that help the institution especially that current life demands that every school or institution must be ready for apply distance education, besides saving the time for instructors as they just create the assignments and quizzes and the system will mark and evaluate them instantly, finally every student submit assignment will get his mark at the same moment with a brief feedback that will help him to improve his coding skills.

## Why is this project important?

There is no doubt that the automation and artificial intelligence are making our life easier and saving our valuable time, all universities and schools today are willing to have a Learning management system not just for facilitating their work and deliver the material and lessons for the students easily, also it becomes necessary for them today to use it as we have seen in the lockdown that we faced because of the epidemic of Coronavirus (COVID-19), so **Future Marker** allows the instructors to communicate with students and deliver the course materials for them in addition to providing them with an automation assessments system that automatically marks the programming assignments that submitted by the students and giving them a grading report, furthermore **Future Marker** provides online quiz system so the universities and schools can easily examine their students online from home.

## Practical Implementations

We will discuss who will use our application from the user perspective, we will be having two main users who are instructor and student.

First the instructor, The instructor will be using the application because of its advantages that will help him innovate a new way of learning and connecting with his students, first of all, he will be able to have social experience through making posts which the student who enrolls in his course or follows him can interact with, also he can create courses, upload material, assign grades, create assignments, create quizzes, and with the integration of the auto marking in the system the students can get their grades immediately after uploading their answers which saves afford and time.

Second, the Student which will benefit from the software which collects all the courses material, assignments, grades in one place which he can access from anywhere, and with the instant feedback on the assignments, they will have a whole new experience because they can learn more from their mistakes from the detailed report of the assignment grading.

## **Future Recommendation**

We have made a great work in this project, as we have spent too much time and made a great effort to build this smart learning management system, we still have more goals to improve it in the future first of all we going to contract with a specialized marketing agency to help us in marketing and spreading Future Marker to the educational organizations, this is for the marketing plans, on the other hand, we have also a development plan as we can add more features in the system such as making the automated assessment works on more programming languages such as Python, C++, JavaScript, and C#, furthermore, it will be very useful to provide the system with one of the most important features nowadays in the distance education, which is the option of online meetings, also we are going to add more features for the mobile application that make the user more satisfied, moreover, we are aspiring to make Future Marker able to mark and evaluate the essay assignments besides the software diagrams, Finally it will be useful to create admin dashboard which makes the admins able to check and monitorize the system performance and how it is doing statistically.

## **Conclusion Summary**

Our conclusion during our journey in this project, that there is no learning management system is for the school of programming to help them in evaluating the coding assignments, and if it exists, it is not available for everyone, as we have seen universities made tools for evaluating but they use it for private use only, Future Marker is one of the best solutions for every educational institution especially the computer and programming departments as it is a free online web application, can be reached easily and upon our user experiments, the users' feedback showed us how our system is easy to navigate and have a great performance and high accuracy.

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