

VIETNAM NATIONAL UNIVERSITY HO CHI MINH CITY  
HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY  
FACULTY OF COMPUTER SCIENCE AND ENGINEERING

- CAPSTONE PROJECT -

## Develop a web application to create exam samples and practice for examination



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H1 Đ9 ULK KHMT

ĐẠI HỌC QUỐC GIA TP.HCM  
TRƯỜNG ĐẠI HỌC BÁCH KHOA

CỘNG HÒA XÃ HỘI CHỦ NGHĨA VIỆT NAM  
Độc lập - Tự do - Hạnh phúc

KHOA: KH & KT Máy tính  
BỘ MÔN: KHMT

NHIỆM VỤ LUẬN VĂN/ ĐỒ ÁN TỐT NGHIỆP  
Chú ý: Sinh viên phải dán tờ này vào trang nhất của bản thuyết trình

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**1. Đầu đề luận văn/ đồ án tốt nghiệp:**

Develop a web application to create exam samples and practice for examination

**2. Nhiệm vụ (yêu cầu về nội dung và số liệu ban đầu):**

Phase 1

- ✓ Research for a variety of exam structure and exam pool test
- ✓ Decide suitable tech stack for building a web application
- ✓ Analyze the requirements and make a feature list
- ✓ Design the application architecture
- ✓ Make a PoC

Phase 2

- ✓ Implement the full application
- ✓ Evaluate the application
- ✓ Deploy the application

**3. Ngày giao nhiệm vụ: 30/01/2023**

**4. Ngày hoàn thành nhiệm vụ: 09/06/2023**

**5. Họ tên giảng viên hướng dẫn:**

**Phản hướng dẫn:**

- 1) Quản Thành Thơ
- 2) Mai Đức Trung

Nội dung và yêu cầu LVTN/ ĐATN đã được thông qua Bộ môn.

Ngày 20 tháng 05 năm 2023

**CHỦ NHIỆM BỘ MÔN**

(Ký và ghi rõ họ tên)

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(Ký và ghi rõ họ tên)

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Ngày bảo vệ:

Điểm tổng kết:

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TRƯỜNG ĐẠI HỌC BÁCH KHOA  
KHOA KH & KT MÁY TÍNH

CỘNG HÒA XÃ HỘI CHỦ NGHĨA VIỆT NAM  
Độc lập - Tự do - Hạnh phúc

Ngày      tháng      năm

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Họ và tên SV: Phạm Tân Phước  
MSSV: 1952406

Ngành (chuyên ngành): Khoa Học Máy Tính

2. Đề tài:

Develop a web application to create exam samples and practice for examination

3. Họ tên người hướng dẫn/phản biện: Quản Thành Thor

4. Tổng quát về bản thuyết minh:

Số trang: 138

Số chương: 6

Số bảng số liệu: 4

Số hình vẽ: 111

Số tài liệu tham khảo: 41

Phần mềm tính toán:

Hiện vật (sản phẩm)

5. Những ưu điểm chính của LV/ĐATN:

- The developed application has a note-taking function and keyword highlighting, which allows users to take notes and highlight important information while they are taking the test. These features make the studying and practicing process more efficient and effective and help users to focus on areas they want.
- The application also has a result management system that allows users to view their scores and track their progress over time. This feature is helpful for those who wish to monitor their improvement and identify areas where they need to focus their efforts.
- The application also allows users to manage other users' results. This feature is particularly useful for educators or trainers who wish to monitor their students' progress and identify areas where they need additional support.
- The application is designed in a highly customizable manner, allowing users to personalize their learning experience and tailor it to their specific needs and preferences.

6. Những thiếu sót chính của LV/ĐATN:

7. Đề nghị: Được bảo vệ       Bổ sung thêm để bảo vệ       Không được bảo vệ

8. Các câu hỏi SV phải trả lời trước Hội đồng:

a.

b.

c.

9. Đánh giá chung (bằng chữ: Xuất sắc, Giỏi, Khá, TB):      Điểm :      8.8/10

Ký tên (ghi rõ họ tên)



Quản Thành Thor

Ngày 02 tháng 06 năm 2023

**PHIẾU CHẤM BẢO VỆ LVTN**  
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1. Họ và tên SV: Trịnh Mạnh Hùng MSSV: 1952740  
Họ và tên SV: Phạm Tân Phước MSSV: 1952406  
Ngành (chuyên ngành): Khoa học Máy tính
2. Đề tài: Develop a web application to create exam samples and practice for examination
3. Họ tên người phản biện: Trương Thị Thái Minh
4. Tổng quát về bản thuyết minh:
- |                        |                     |
|------------------------|---------------------|
| Số trang:              | Số chương:          |
| Số bảng số liệu        | Số hình vẽ:         |
| Số tài liệu tham khảo: | Phần mềm tính toán: |
| Hiện vật (sản phẩm)    |                     |
5. Tổng quát về các bản vẽ:
- |                 |         |         |                          |
|-----------------|---------|---------|--------------------------|
| - Số bản vẽ:    | Bản A1: | Bản A2: | Khô khác:                |
| - Số bản vẽ tay |         |         | Số bản vẽ trên máy tính: |
6. Những ưu điểm chính của LVTN:
- Students have investigated and applied suitable technologies to implement a web application for creating exam samples and practicing examination. Their system provides various features supporting users to create different kinds of tests, conduct tests, mark tests, take note, high-light keywords, and view solutions.
7. Những thiếu sót chính của LVTN:
- The use-case diagrams still contain some mistakes that need to be revised in the thesis.
  - In your ERD, how can we know that the “test-result” belongs to which “exam-collection”?
8. Đề nghị: Được bảo vệ  Bổ sung thêm để bảo vệ  Không được bảo vệ
9. 3 câu hỏi SV phải trả lời trước Hội đồng:
- a. Which domains are suitable to apply your system in? (e.g., which kinds of subjects, which kinds of tests?)
  - b. Can your system mark the test automatically? If so, please clarify which kinds of tests could be marked automatically.
  - c. Why is there only one kind of user in your system for both creating and taking the tests? If users already know the questions and answers, why do they need to take the tests?

10. Đánh giá chung (bằng chữ: giỏi, khá, TB): Excellent

Điểm : 9.0/10

Ký tên (ghi rõ họ tên)



Trương Thị Thái Minh

# **Declaration of Authenticity**

We declare that this research and implementation is our own work, conducted under the supervision and guidance of Assoc. Prof. Dr. Quan Thanh Tho and Mr. Mai Duc Trung. The result of our research and implementation is legitimate and has not been published in any form prior to this. All materials used within this research are collected ourselves from various sources and are appropriately listed in the references section.

In addition, within this research, we also used the results of several other authors and organizations. They have all been aptly referenced.

In any case of plagiarism, we stand by our actions and will be responsible for it. University of Technology - Vietnam National University HCMC therefore are not responsible for any copyright infringements conducted within our research.

Ho Chi Minh City, June 2023

Author

Pham Tan Phuoc

Trinh Manh Hung

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Lastly, our families deserve endless gratitude for their everlasting love, sacrifice, and support keeping us motivated and confident. Our accomplishments and success are because they believed in us. There is no word that can describe our love for them.

# **Abstract**

Due to the Covid-19 pandemic, people came to realize the importance of technology, especially online applications to complete their work without needing to go to the offices or schools. However, there was still a huge gap between real and virtual environments which made people feel uncomfortable when using these applications. A great example is, during the Covid-19 pandemic, HCMUT students had suffered from taking exams via BK Exam and BKeL, which was inconvenient and ineffective. We find that the diversity of exams' genres on those websites was very limited, which made both students and lecturers feel annoyed. As a result, this bad experience affected severely the learning outcomes of students. At the same time, the need of taking international exams such as IELTS or GRE has risen these days. Therefore, we come up with an idea of creating a website that can support lecturers, students and even working people to develop and practice a variety of examinations more conveniently and easily.

In this Capstone Project, we research on a diversity of exams' genres and look for a way to actualize them into a web application that helps people to have everything they need for preparing an exam in just a web application. Moreover, we also introduce several intriguing features such as a tracking result system, taking notes, and highlighting words to make the process of taking exam samples more comfortably.

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# Chapter 1

## Introduction

*The first chapter establishes the context for the remaining chapters of the thesis by offering a thorough review of the study issue and its importance. This chapter covers the objectives and contributions of the research, including how it will benefit our society, as well as the research questions or hypotheses that the study seeks to address. The chapter also describes the parameters and restrictions of the research that might have an impact on how the findings are understood. The chapter concludes by giving a general summary of the capstone project's structure.*

### 1.1 Problem Statement

While countries were at different points in their COVID-19 infection rates, worldwide there were more than 1.2 billion children in 186 countries affected by school closures due to the pandemic [14]. In such a situation, online learning and blended learning were adopted to ensure the students can gain enough knowledge at home. However, several problems occurred during online classes such as system glitches, limited interaction, audio clarity. Having experienced this hard time, we, as Ho Chi Minh City University of Technology students, also had to deal with many challenges when using online learning platforms of the university including BK Exam, BKeL, Google Meet, ... And various limitations appeared when we took the exams or tests on these platforms.

In the beginning, BKeL was the only place that we could use to study and complete

every examination. However, it did not support well for taking tests which really annoyed both students and lecturers. Witnessing this limitation, lecturers of the university successfully developed a separate application called BK Exam which would be used mainly for creating and taking exams. The new website was better. But it still lacks many features that can support users when answering questions such as taking notes, highlighting keywords, and formatting answers, which encouraged us to develop an application that can solve these drawbacks.

Along with the above problems, at the same time, the need of practicing international exams such as IELTS or GRE also rises these days, which requires an application that can support well a diversity of exam genres and allow the users to create a list of questions themselves for practicing. All of these problems and needs together have motivated us to choose “Develop a web application to create exam samples and practice for examination” as our Capstone Project.

## 1.2 Goals and Contribution

### 1.2.1 Goals

The Capstone Project is an exciting opportunity for us to create a dynamic and user-friendly web application that enables individuals to create their own exam samples and utilize these materials to prepare for upcoming exams. Our application will offer a diverse range of question types, providing users with greater flexibility in designing their test forms based on their individual preferences and requirements. In addition to the traditional multiple choice and constructive questions, we will also incorporate more innovative question formats to enhance the user experience.

To further assist users in their exam preparation, we will incorporate various helpful tools, such as a note-taking facility and keyword highlighting. These features will significantly increase the efficiency and effectiveness of the learning and practicing processes. We will also offer a function that enables users to monitor their advancement and learn from their errors for advancement. Users can then concentrate their efforts on topics they need to learn more about.

Overall, our goal is to create a comprehensive exam preparation tool that is both

user-friendly and highly effective. By incorporating a wide range of question types and features, we are confident that our application will meet the needs of a broad range of users and help them achieve their goals with greater ease and success.

### 1.2.2 Contribution

Through the implementation of this topic, our team has made an invaluable contribution to the community. Our free platform provides users with a unique opportunity to create tests in a wide variety of subjects, including math, physics, history, geography, English, IELTS, and more in the format of multiple-choice questions, constructive questions, and fill-in-blank questions. Not only can users practice the topic they have created, but they can also share it with other users, thereby expanding their knowledge and helping others in the process. Our platform is particularly useful for those who wish to review lessons and prepare for important examinations, for teachers and lecturers that need a test-taking system for their students, or for those who simply want to absorb new knowledge.

In addition to these benefits, our product boasts several outstanding features that set it apart from other websites. For example:

- Our platform has a note-taking function and keyword highlighting, which allows users to take notes and highlight important information while they are taking the test. These features make the studying and practicing process more efficient and effective, and help users to focus on areas they want.
- Our platform also offers a result management system that allows users to view their scores and track their progress over time. This feature is helpful for those who wish to monitor their improvement and identify areas where they need to focus their efforts.
- Our platform allows users to manage other users' results. This feature is particularly useful for educators or trainers who wish to monitor their students' progress and identify areas where they need additional support.
- Our platform is highly customizable, allowing users to personalize their learning experience and tailor it to their specific needs and preferences.

Finally, using our website, we were able to successfully construct example tests. The inquiries are grounded in actual data and address a range of topics, including math, IELTS, humans and environments.

## 1.3 Scope

In this Capstone Project, we are going to apply various web development technologies to design and develop a web application with full features of creating exam samples and practicing questions in multiple forms. Besides that, we will include many features which can support users to take notes, highlight keywords in questions, and keep track of their results.

## 1.4 Capstone Project Structure

There are totally six chapters in this Capstone Project. The first chapter is a brief view of the problem we are solving and our approaches to solving the proposed problem. The second chapter makes the theoretical background clearer to give an overview of the technologies that we are going to use in the Capstone Project. Then for the third chapter, we will introduce how we analyze and design our system, which describes our application's architecture and our expectations for the final result. In the last three chapters, we will demonstrate our achieved result and a promising future plan.

# Chapter 2

## Theoretical Background

*Chapter 2 goes over the underlying concepts and principles that support web development in great depth. This chapter discusses web application architecture types, front-end development, back-end development, and database management systems. It goes over the various components of a web application, such as the user interface, server-side logic, and database management system, and how they all work together to build a working and dynamic web application.*

### 2.1 Web Development

#### 2.1.1 Concept

Web development, also known as website development, refers to the tasks associated with creating, building, and maintaining websites and web applications that run online on a browser. It may, however, also include web design, web programming, and database management [15]. Web development ranges from creating plain text pages to complex web-based applications, social network applications, and electronic business applications.

The web development hierarchy is as follows:

- Client-side development: sometimes referred to as front-end development, it involves the user interface with which the user interacts on the web. It is

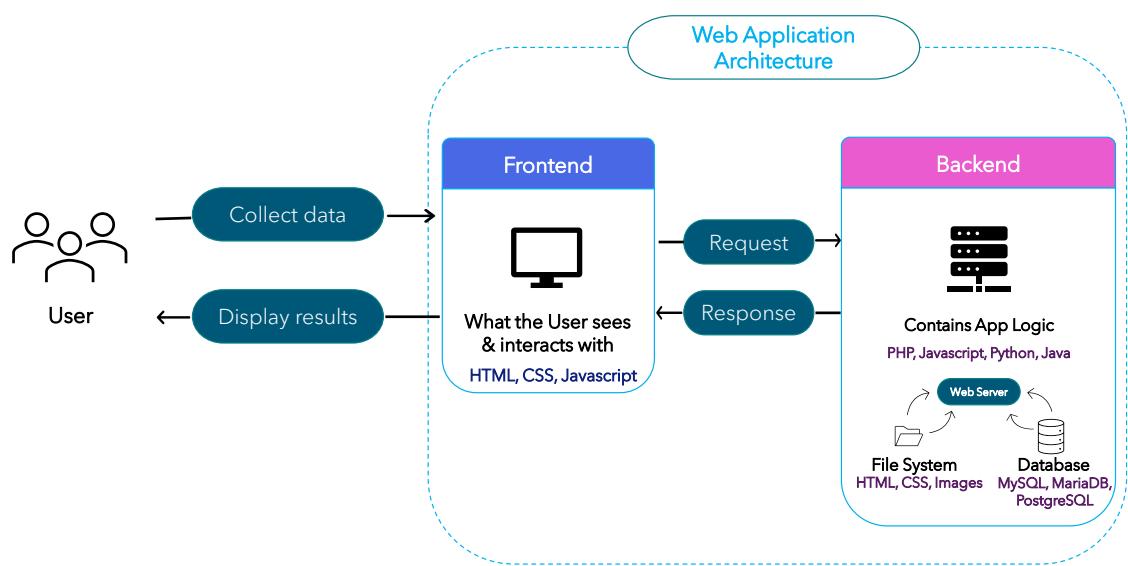
mostly a browser, in the user's machine, that runs the code and is mainly done in any scripting language like JavaScript.

- Server-side development: sometimes called back-end development, is a type of development that involves programs that run on a server. This type of programming is important because web browsers, or clients, interact with web servers to retrieve information. Users don't see this development because it happens on servers [16].
- Database development: is the process of obtaining real-world requirements, analyzing requirements, designing the database and functions of the system, and then implementing the database in a Database Management System (DBMS).

### 2.1.2 Fundamentals of Web Architecture

The architecture of an application describes how its components are interconnected and how they communicate with each other. It can also be described as the connection between the client and server that defines the connection, along with the server that handles the communication between the client and server [17].

With the above figure, we have an overview of how the website's components communicate with each other and respond to the user's interactions. To understand clearly how it works, let's take mybk.hcmut.edu.vn as an example, this website is located on the server, so when you type "mybk.hcmut.edu.vn" into the browser, your IP address will be recognized and the request will be sent to the Domain Name Server. The Domain Name Server will then send the request to the server where mybk is located, which will retrieve the requested data and display it on your screen.



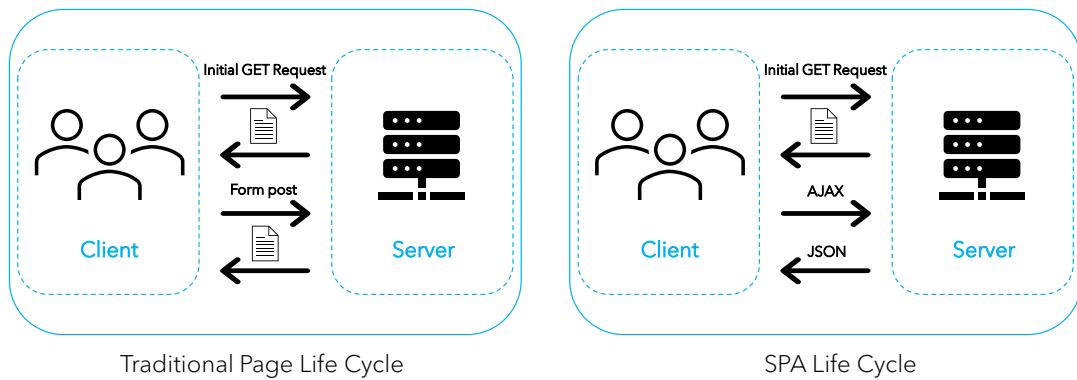
**Figure 2.1:** Basic Web Application Architecture

## 2.2 Web Application Architecture Categories

When developing an app, it is always a good idea to stick to the most appropriate architecture based on the app's logic, functionality, and so on. The correct architecture defines the objective of the entire product. Basically, there are four kinds of web applications.

### 2.2.1 Single Page Application Architecture (SPA)

SPA (Single Page Applications) seeks to overcome the classic difficulty of constructing smooth apps, in order to provide an easy-to-use, intuitive user experience. These difficulties are overcome by SPA [17].



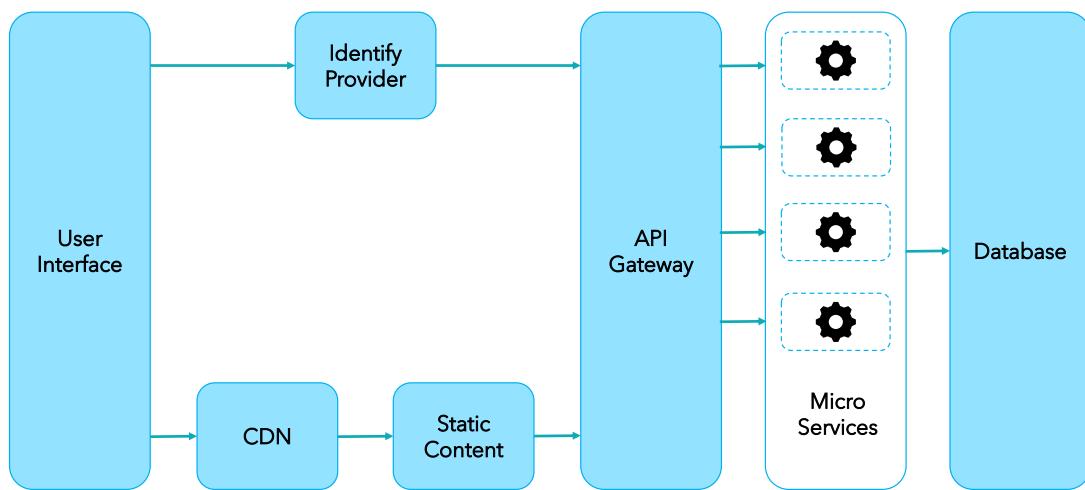
**Figure 2.2:** Single Page Application Architecture

A SPAs loads a single web page and updates the data on that page with dynamically generated content rather than loading a new page. Instead of loading a new page, SPAs load a single page and refresh the data on that page with dynamically updated content. The front end receives the same logic as the back end. JavaScript

frameworks are used to develop SPAs on the client side using client-side JavaScript frameworks.

### 2.2.2 Microservice Architecture

Monolithic architectures are now outcompeted by microservice architectures, which are built around a multitude of services that can function asynchronously to solve complicated problems. Because APIs are used to communicate between services, they are loosely associated [17].

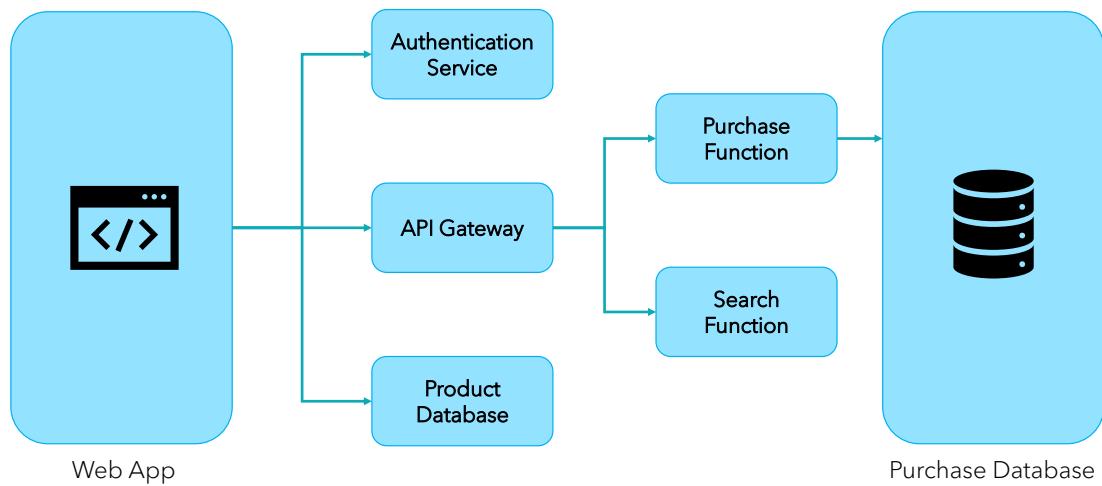


**Figure 2.3:** Microservice Architecture

Deploying web apps has been made simple because of the lack of coupled parts in microservices. Microservices have eliminated the difficulty of deploying service components in a monolithic fashion. Microservices have prevented the necessity for numerous service components to be deployed in addition to eliminating the monolithic app deployment difficulty. Amazon, Netflix, SoundCloud, Comcast, and eBay are a few of the country's most renowned technology firms that use microservices [17].

### 2.2.3 Serverless Architecture

Cloud service providers such as Amazon and Microsoft manage the servers that are used by serverless architectures, so no manual intervention is required on the server. No matter how complex your code is, cloud service providers can handle everything for you—you don't need to deploy them manually on your server. Serverless architecture is a design pattern in which applications are built and run without any human intervention on servers managed by third-party cloud service providers like Amazon and Microsoft [17].



**Figure 2.4:** Serverless Architecture

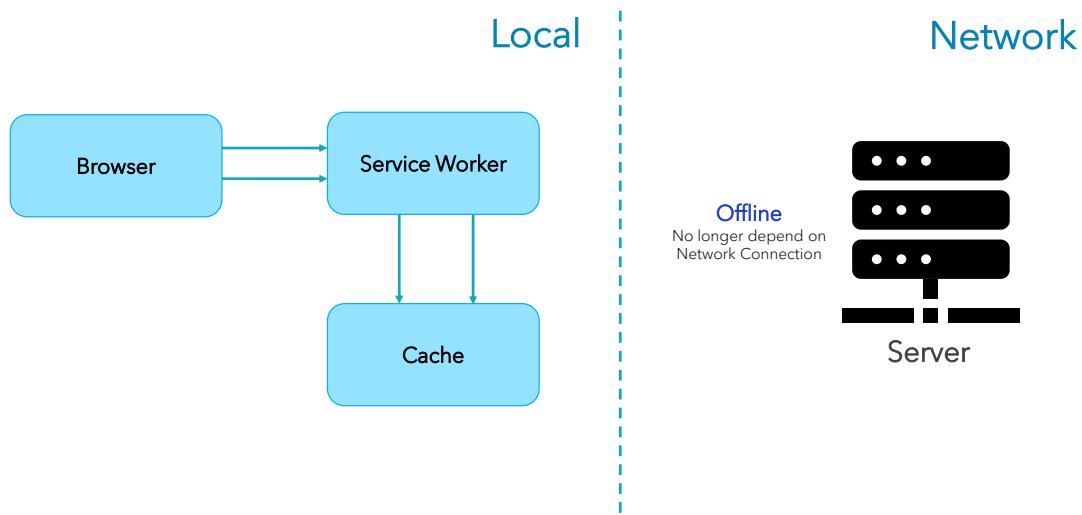
It allows you to focus on the quality of the product and the difficulty of making them highly scalable and reliable. Backend-As-A-Service (BaaS) and Function-As-A-Service (FaaS) are the two types.

Developers who use BaaS to eliminate the back-end operations can focus on building the front-end aspects of their applications without worrying about operating the back-end. Amazon Amplify, for example, is a popular BaaS product. FaaS, on the other hand, is an event-driven model that allows developers to concentrate on coding

and event triggers. The remaining work will be handled by FaaS service providers such as Amazon Lambda and Microsoft Azure.

#### 2.2.4 Progressive Web Applications

In 2015, Google created Progressive Web Apps (PWAs). To develop apps that offer rich and native functionality with enhanced capabilities, reliability, and ease of installation, PWAs were created [17].



**Figure 2.5:** Progressive Web Applications Architecture

A PWA is capable of functioning on any browser and on any device. It may be adjusted to run on a tablet and a desktop as well as on a tablet. URL instead of app stores is used to discover and share these apps. These apps can be quickly added to a device's home screen in addition to being installed quickly. Poor internet connection and offline mode are both advantages.

Several popular companies, such as Uber, Aliexpress, Alibaba, Pinterest, and Starbucks, manufacture their products by creating PWA websites.

## 2.3 Front-end development

### 2.3.1 Concept

Front-end web development is the development of the graphical user interface of a website, through the use of HTML, CSS, and JavaScript, so that users can view and interact with that website. Examples are the user interface, buttons, user-entered data, websites, and user experience (UX) features. The front end aims at meeting user requirements and delivering a positive user experience [18].

Additionally, it is essential to ensure that the front-end is compatible with all types of devices by each device while programming it. The screen size, resolution, and even the operating system vary amongst devices.

### 2.3.2 Basic knowledge

Below are the most common programming languages for developing the front end that each front-end developer should have core knowledge about.

- HyperText Markup Language(HTML)

Front-end development uses the HyperText Markup Language (HTML) scripting language, which establishes the framework and intent of web content. Browsers render webpages for users, including those with hyperlinks and links to other webpages, by displaying text or loading elements through HTML.

- Cascading style sheets (CSS)

The standard language for describing how to display HTML text, including fonts, foreground and background colors, ... is called CSS. For a variety of platforms, including PCs, tablets, and smartphones, you may need to manage the design layout and its elements with CSS. The header, body, footer, text, asides, and sections are a few examples of the components.

- JavaScript (JS)

The ability to use JavaScript (JS) is yet another crucial skill. By extending website functionality beyond HTML and CSS, JavaScript (JS) enables us to

build a variety of interactive features for the website, including: audio, video, games, scrolling, animation, and more. This is a crucial step in creating the user interface for a website.

- Asynchronous JavaScript and XML (AJAX)

Ajax is extremely beneficial for websites with limited bandwidth because it significantly enhances network performance and speeds up websites. Call a server in an asynchronous manner. As a result, Ajax speeds up page loading while saving consumers' time.

- CSS/JS Framework

Default CSS and HTML files make up a CSS framework. It expands a front-end developer's range of website design options. CSS frameworks not only aid in creating responsive designs but also offer distinct and symmetrical layouts, sparing developers from having to start writing code from scratch every time. They are typically thought to be an excellent option to fit a variety of platforms and screen sizes.

Many frameworks of CSS such as:

- Full featured (Bootstrap, Foundation, Semantic UI, and more).
- Aimed at Material Design: (Materialize and Material Design Lite), and.
- Lightweight (Pure).

JavaScript frameworks are complete sets of tools to form and arrange a website or web application.

Some frameworks of JavaScript such as AngularJS, VueJS, ReactJS, ... assist programmers efficiently build user-friendly interactions and save time during the programming process.

- RWD, also known as responsive design, is a web-design approach that emphasizes user experience. The goal is to guarantee consistent page rendering across a range of platforms, screens, and windows of varied sizes and shapes. Knowledge of responsive design has become important given the rise of mobile devices, with most web traffic coming from mobile-device users.

### 2.3.3 Front-End Development Frameworks

Front-end frameworks make it possible to use prewritten standard functions packaged as libraries as well as ready-made code and components. By eliminating the need to create common functionality and components from scratch, this speeds up website development. Below are some of the popular frameworks we take into account.

#### 2.3.3.1 Angular

The JavaScript ecosystem includes one of the most widely used software development tools, Angular. Angular is not to be confused with a JavaScript library, like jQuery. Angular is similar to platforms such as Polymer, Aurelia and React. This open source framework was developed by Google under the MIT License in 2010 and has since received several upgrades and facelifts to keep up with the times [19]. Users must be familiar with the fundamentals of HTML, CSS, JavaScript, TypeScript, and Document Object Model before utilizing Angular (DOM).



**Figure 2.6:** Angular framework [1]

Pros of Angular:

- With Angular, users can create custom components and transform rendering logic and functionality into reusable pieces. The same is true for web components [19].

- A wide variety of third-party integrations are available through Angular and may be quickly and easily added to the framework. This provides designers with even more resources to enhance the overall design and functionality of their creation [19].
- By utilizing the clever idea known as "ahead-of-time compiler," Angular provides faster load times and greater security. Because Angular compiles HTML and TypeScript into JavaScript during development, all of the code is compiled before the browser even loads your web app [19].
- The dependency injection capabilities of the Angular framework can be a huge advantage, which means it provides user the ability to write service modules and put them wherever they need to be. This improves the testability and reusability of the same services [19].
- Angular provides cross-platform and cross-browser compatibility. An Angular app can typically run on all browsers (Example: Chrome, Firefox) and operating systems, such as Windows, macOS, and Linux [19].

Cons of Angular:

- A major drawback of using Angular is the limited SEO options and poor accessibility for search engine crawlers [19].
- Learning the Angular framework might be challenging. Understanding Angular takes time because of the intricate web of modules, coding languages, integrations, and customization options [19].
- The documentation for Command Line Interface is currently in a state that some developers find problematic. Although Angular engineers find the command line to be quite helpful, you won't find enough information in their official documentation on GitHub, so programmer will need to spend more time browsing forums on the platform to obtain answers [19].

### 2.3.3.2 React

React was first created in 2011 by a software engineer employed at Facebook. React, an open-source JavaScript framework, was made available to the general public in 2013. Because React can be used to build strong User Interfaces that operate more quickly than other frameworks, its popularity has increased over time [20].



**Figure 2.7:** React framework [2]

Let us consider the advantages and disadvantages of React. Here are some pros of React:

- The virtual DOM is much more efficient, performs faster compared to traditional DOM, and ultimately creates a better User Interface. Since JavaScript's virtual DOM is quicker than the conventional DOM, this will enhance the performance of apps [20].
- ReactJS is easy to learn [20].
- The code for ReactJS is made up of various components. Components can be reused or even recycled in other sections of the code, which is helpful especially when working on larger projects that call for numerous scripts [20].
- With the Redux feature, the developers can manage the application state, and if it is used with other frameworks, it can become an interesting tool for creating user interfaces [20].

- React is one of the best frameworks for creating SEO-based web applications [20].
- React-native feature helps to create interactive and high-performance mobile applications. And the plus point, you don't have to learn any tool or language [20].

Cons of React:

- Since the environment changes fast and there are new updates, some developers cannot relearn the codes [20].
- Due to new releases and updates, there is no time left for the documentation. Most developers are left with limited guides and basic details of how the framework works [20].
- The mix of JSX and JavaScript makes React JS tricky to learn, which may act as a barrier due to the complexity of understanding the code [20].

Additionally, ReactJS offers a great range of libraries and frameworks that are ideal for creating our proposed features, including MathJax for mathematical expressions, React-admin for building layouts and handling common features, react-highlight for highlighting keywords, etc.

### **React-admin [3]**

React-admin is one of the best B2B frameworks which offers the best developer experience, enables developers to concentrate on business requirements, and creates delightful user interfaces. React-admin allows to bootstrap a fully working admin on top of an existing API in minutes. Developers can then spend time on customizing the user interface and adding new features by tweaking the generated code. It helps us accelerate the development of common features and have a good codebase for further building.

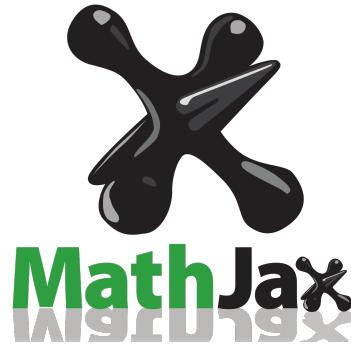
### **MathJax [21]**

With built-in support for assistive technology like screen readers, MathJax is an open-source JavaScript display engine for LaTeX, MathML, and AsciiMath notation that functions in all current browsers. MathJax allows page authors to write formulas



**Figure 2.8:** React-admin framework [3]

using TeX and LaTeX notation, MathML (a World Wide Web Consortium standard for representing mathematics in XML format), or AsciiMath notation. MathJax uses web-based fonts to produce high-quality typesetting that scales and prints at full resolution, unlike mathematics included as bitmapped images. With MathJax, mathematics is text-based rather than image-based, so it is available for search engines, meaning that your equations can be searchable, just like the text of your pages.



**Figure 2.9:** MathJax open-source display engine [4]

### React-highlight [22]

React-highlight is a ReactJS component developed by Deshayes Yann that helps you highlight ranges of text and give you callbacks to detect user text selection. We use this component to implement our proposed feature: Highlight keywords during practice tests.

### 2.3.3.3 Vue.js

Vue.js, or Vue, is a JavaScript-based framework developed by Evan You and first released in 2014. It was initially intended to serve as a framework for creating user interfaces (UI) and single-page applications (also known as SPA). Vue is considered one of the most appropriate frameworks for asynchronous server-side rendering [23].

In comparison to Angular and ReactJS, one of the most cutting-edge technologies is Vue.js. Because of the ideas it employs, including directives and components for organizing and rendering the user interfaces, Vue.js is actually somewhat a hybrid of Angular and ReactJS. Vue.js has the capability to manage HTML that has previously been rendered by the server, in contrast to ReactJS.



**Figure 2.10:** Vue.JS framework [5]

Advantages of Vue.js:

- Vue is convenient to use for developing projects of various complexity - both small personal projects and multifunctional applications [23].
- Beginner-friendly: Even for a beginner programmer, learning Vue.js is simple, especially if he or she is experienced in JavaScript. Programming styles and templates comparable to those available in other JavaScript frameworks are included in the Vue framework, which can speed up learning [23].

- Ease of use: Vue.js's single-file components can have all the necessary codes (JavaScript, CSS, HTML) in one file [23].
- Virtual DOM: Similar to React, Vue.js renders a view using a fictitious DOM (Document Object Model) [23].
- Compatibility: Vue is a flexible framework since it lets you create templates using HTML, JSX, or JS at your choosing. The framework is comparable to React and Angular in terms of structure [23].

Disadvantages of Vue.js:

- Lack of scalability: Vue.js has a narrow community with a relatively small group of developers. It is not scalable and therefore not suitable for large-scale projects [23].
- Lack of plugins: Vue.js has much less plugins compared to Angular or React. This aspect is important to consider as developers can not fully rely on Vue because of the lack of commonly used plugins [23].
- Difficulties with mobile support: The transition from Vue to mobile application development will be more challenging than the React transition [23].
- Excessive code flexibility: Flexibility might increase inconsistency and programming faults. Most of the delays in code are caused by excessive flexibility, when several different programming approaches can be applied simultaneously within the same team [23].

#### **2.3.4 Conclusion**

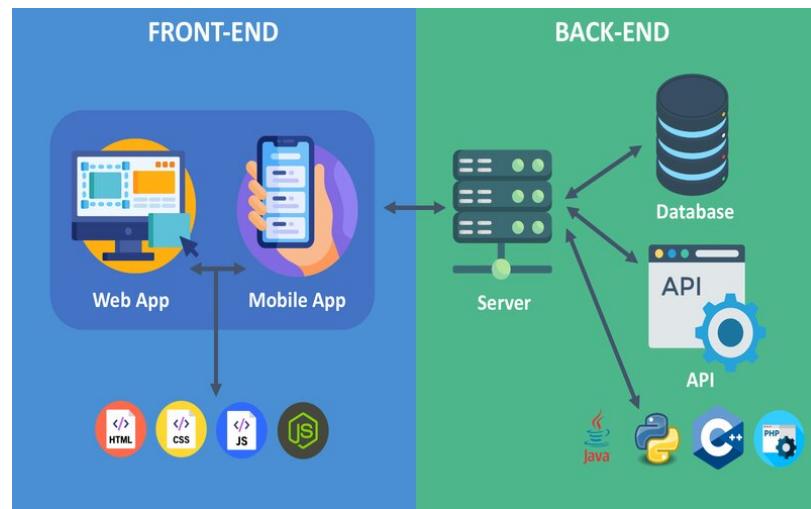
Based on the above pros and cons, our team has chosen React for front-end programming on this specific project because it is an accessible framework that is simple for most people to understand. Additionally, it has been and will continue to be a very powerful development trend. The largest of the three frameworks, React, Vue.js, and Angular, has a sizable community as well. As a result, answering queries and resolving issues during the implementation process will be done so more swiftly and easily.

## 2.4 Back-end Development

### 2.4.1 Concept

The “server side” of a website, which is invisible to users, is the subject of back-end development. An interactive website depends on it. The storage hub is a database, and some of the most popular databases, including Oracle, SQL Server, and MySQL, are operated from servers, which are essentially remote computers. This database and the website’s data stored inside will be managed with the aid of a back-end developer [16]. By doing this, it is made possible for front-end components on social media websites to continue operating normally as users view uploaded content and other user profiles.

Back-end development deals with storing and arranging data while also ensuring the front end is functioning well. Back-end web developers work on tasks like: building code, troubleshooting and debugging web applications, database management, framework utilization.



**Figure 2.11:** An illustration of how front-end and back-end interact [6]

## 2.4.2 Basic knowledge

In order to be able to do a good job on the Back-end development, we need to have fundamental knowledge of development languages, databases and caches, API (REST & SOAP), and data structure and algorithms.

- Server-side programming languages and their framework.

Good programming skills in languages like C#, Java, Python, Ruby, PHP, Golang, and Node.js are required. These are the languages that aid with server-side programming, making it possible to create programs, instructions, and webpages for operating software, apps, and websites.

The core advantages of using a framework for development are, time-saving, scalability, robustness, security, integrations. On top of that, most of the frameworks are open-source. Keep reading to learn about the best web development backend frameworks.

Of course, knowledge of the web frameworks that come with these languages: ASP.NET, Spring, Django, Rails, etc. is also important.

- Database Management System.

A database management system (DBMS) is system software for creating and managing databases. The DBMS, which is the most common type of data management platform, primarily acts as an interface between databases and users or application programs, ensuring that data is consistently organized and remains easily accessible.

DBMS allows users the following tasks:

- Data Definition: It is used to create, modify, and remove definitions that specify how data is organized in a database.
- Data Updation: It is used to add, edit, and remove the database's real data.
- Data Retrieval: It is used to retrieve data from the database that applications may use in a variety of ways.

- User Administration: It is utilized for user registration and monitoring, data integrity maintenance, data security enforcement, concurrency control management, performance monitoring, and information recovery from data that has been compromised by unexpected failure.

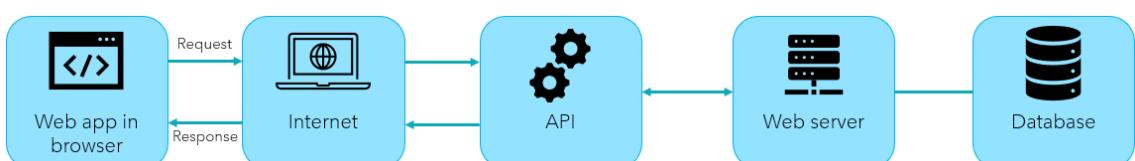
- Knowledge of server.

It is vital to have knowledge of the server since the application created by the backend developers will run there. In addition, knowledge of computer networks and the ability to create services and install programs on servers are required. There are a lot of ways to simplify this at the moment. The majority of the labor-intensive activity is virtualized via cloud services. Currently, some popular web server are Nginx, Internet Information Services (IIS), Apache HTTP server, Apache Tomcat.

- Application Programming Interface (API).

API stands for Application Programming Interface. In the context of APIs, the word Application refers to any software with a distinct function. Interface can be thought of as a contract of service between two applications. This contract defines how the two communicate with each other using requests and responses. Their API documentation contains information on how developers are to structure those requests and responses [24].

To be clearer, APIs are mechanisms that enable two software components to communicate with each other using a set of definitions and protocols. For example, the weather bureau's software system contains daily weather data. The weather app on your phone "talks" to this system via APIs and shows you daily weather updates on your phone.



**Figure 2.12:** API mechanism

**SOAP APIs:** These APIs use Simple Object Access Protocol. Client and server exchange messages using XML. This is a less flexible API that was more popular in the past [24].

**REST APIs:** These are the most popular and flexible APIs found on the web today. The client sends requests to the server as data. The server uses this client input to start internal functions and returns output data back to the client [24].

### 2.4.3 Back-end Programming Language

Back-end developers work in languages like PHP, C++, Java, Ruby, Python, JavaScript, and Node.js. And Back-end frameworks include: Express, Django, Rails, Laravel, Spring. We will have a quick view about 3 languages (including Golang, NodeJs, and Python), as well as their strengths and weaknesses to be able to choose one language for this project.

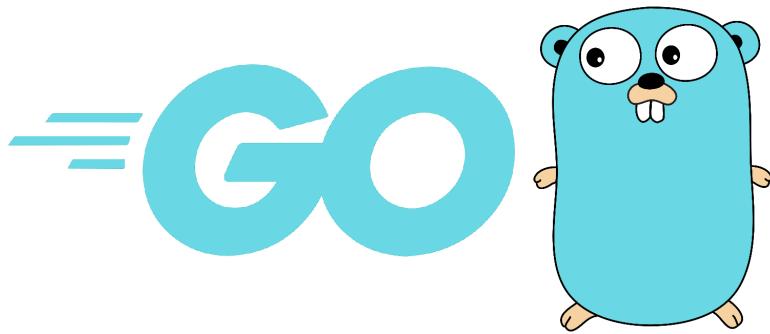
#### 2.4.3.1 Golang

An all-purpose language called Go was created with systems programming in mind. It was first created by Robert Griesemer, Rob Pike, and Ken Thompson in 2007 at Google. Concurrent programming is supported, garbage collection is built-in, and it is strongly and statically typed [25].

Packages are used in the construction of programs to handle dependencies effectively. Go programming implementations create executable binaries using the conventional compile and link model. Some of Google's production systems employ the Go programming language, which was introduced in November 2009.

Key features of Go Programming:

- Support for environment adopting patterns similar to dynamic languages.
- Compilation time is fast.
- Lightweight processes (through Go routines), channels, and the choose statement provide built-in concurrency support.



**Figure 2.13:** Golang Programming Language [7]

- Go programs are simple, concise, and safe.
- Support for Interfaces and Type embedding.
- Production of statically linked native binaries without external dependencies.

Advantages of Golang:

- Golang is capable of compiling directly to machine code without using an interpreter, which results in accelerating the development [25].
- Golang is easy to master. Go is simple for software developers, especially those who already have a solid understanding of C and Java [25].
- Golang has the capacity to support concurrent programming. Go language has Goroutines, which are functions that can run simultaneously and independently [25].
- Go includes comprehensive tools that make coding simple for developers. Go has IDEs like Visual Studio Code and others often used for programming [25].
- Companies are becoming aware of the advantages Golang could be for their business, and developers are brushing their Golang skills in large numbers [25].

Disadvantages of Golang:

- A young language, so it is still developing [26]. Because the language is so new, it could be challenging for developers to utilize the libraries to their full potential.
- Absence of manual memory management [26]. The absence of manual memory management might result in expensive garbage collection, problems like pauses, and eventually system programming.
- Given that Python is a language that is exclusively written, Golang isn't quite as detailed as Python. For the same purpose, a programmer might need to write hundreds of lines of code, while Python only needs a handful. This causes time-consuming for programmer.
- Error handling isn't perfect [26]. Because error handling is not perfect in Go, the imperfectness of it could get you.

#### 2.4.3.2 Node.JS

Node.js is a server-side platform built on Google Chrome's JavaScript Engine (V8 Engine). Node.js was developed by Ryan Dahl in 2009 [27].

An open source, cross-platform runtime environment called Node.js is used to create networking and server-side applications. Applications for Node.js may be created in JavaScript and run on Linux, OS X, and Microsoft Windows using the Node.js runtime.

Additionally, Node.js offers a comprehensive library of different JavaScript modules, greatly simplifying the creation of web applications utilizing Node.js.

Features of Node.js:

- Asynchronous and event driven.
- Very Fast: Being built on Google Chrome's V8 JavaScript Engine, Node.js library is very fast in code execution.



**Figure 2.14:** Node Programming Language [8]

- Single threaded but highly scalable. Node.js uses a single threaded model with event looping. In contrast to traditional servers, which produce a limited number of threads to process requests, event mechanism enables the server to reply in a non-blocking manner and increases the server's scalability.
- No Buffering. Node.js applications never buffer any data. These applications simply output the data in chunks.
- Node.js is released under the MIT license.

Node.js Advantages:

- High-performance for Real-time Applications.
- Easy Scalability for Modern Applications.
- Cost-effective with Fullstack JS.
- Community Support to Simplify Development.
- Easy to Learn and Quick to Adapt.
- Helps in building Cross-functional Teams.
- Improves App Response Time and Boosts Performance.

- Reduces Time-to-Market of your applications.
- Extensibility to Meet Customized Requirements.
- Reduces Loading Time by Quick Caching.
- Helps in Building Cross-Platform Applications.

Node.js Disadvantages:

- When handling heavy computing tasks, performance is decreased.
- One of the most significant drawbacks reported by Node.js users is the frequent API changes, which are generally backward-incompatible.
- Node.js Asynchronous Programming Model makes it difficult to maintain code.
- Numerous NPM registries and libraries are of low quality, inadequate, and lack proper documentation.

#### 2.4.3.3 Python

Python is a powerful, interactive, object-oriented, and interpreted scripting language. Python has been created to be very readable. It has fewer syntactical structures than other languages and typically employs English keywords rather than punctuation [28].



**Figure 2.15:** Python Programming Language [9]

Features and Advantages of python:

- Easy to learn, read, maintain: Python has a concise syntax, straightforward structure, and minimal keywords. The student can quickly study the language thanks to this. Also, Python code is more clearly defined and visible to the eyes.
- A broad standard library: The majority of the Python library runs well on UNIX, Windows, and Macintosh and is fairly portable.
- Interactive Mode: Python has support for an interactive mode which allows interactive testing and debugging of snippets of code.
- Portable: Python has the same interface across all hardware platforms and can be executed on a variety of them.
- Databases: Python provides interfaces to all major commercial databases.
- GUI Programming: Python supports Graphical User Interface (GUI) applications that can be created and ported to many system calls, libraries and windows systems, such as Windows MFC, Macintosh, and the X Window system of Unix.
- Scalable: Python provides a better structure and support for large programs than shell scripting.

Disadvantages of Python:

- Slow Speed: Because it has to perform additional work while running code, Python's dynamic nature is also to blame for its poor speed. Therefore, Python is not used for projects where speed is a crucial component.
- Not Memory Efficient: Python is a memory-intensive programming language. When developing apps, this may be a drawback if memory optimization is preferred.
- Database Access: Python's database access layer is primitive and underdeveloped in comparison to popular technologies like JDBC and ODBC.

- Runtime Errors: The data type of a variable may change at any time because Python is a dynamically typed language. Runtime errors may occur if a variable holding an integer number later changes to a string.

## Django framework

Django, a high-level Python web framework, enables the quick creation of secure and reliable websites. Because of its computation capabilities, Django today stands as one of the most used web development frameworks. First released in 2005, Django is a free and open-source web framework that takes care of much of the hassle of web development, allowing programmer to concentrate on developing your app without having to invent the wheel. It is open source and free, has a strong community, excellent documentation, and a variety of free and paid support options [29].



**Figure 2.16:** Django Framework [10]

Pros of Django framework:

- “Batteries included” framework: This framework has a ton of resources right out of the gate. Therefore, to add functionality, programmers don’t need to write their own code, just import the packages.

This not only gives the developers a lot of time back but also enables them to concentrate on including cutting-edge features. Furthermore, because it is open-source, anyone can use the packages created by the community’s top talent. The packages are easily imported, and developers can quickly begin creating apps.

- Fast Processing: Because the resources may be placed on a CDN, Django’s usage of the MTV architecture simplifies and speeds up the entire process of

broadcasting over the Internet. Django server maintains speed while handling things rather well.

- Rapid development: This feature of Django makes a great difference from other frameworks and currently, Django is the best for rapid development in industry.
- Scalable: Due to its loosely linked architecture, Django has the ability to add hardware at any point of the components as long as they can handle the change. In contrast to previous frameworks, this one will have little to no impact on other components.
- Security: Django framework is made by world's best web-developers who have a great experience and knowledge. This eliminates all but a very slim chance that Django's user authentication scheme contains security flaws.

Cons of Django framework:

- Django is Monolithic: For some programmers, Django's monolithic structure may be a benefit, but for the majority, it is a disadvantage. Programmers must become familiar with a specific collection of files and preset variables in Django before starting any project. The framework has a specific method for carrying out activities.
- Not Suitable For Smaller Projects: There is a lot of code in the Django web framework that uses the server's processing power and time. On low-end, low-bandwidth websites, this can have a negative impact.
- Inability To Simultaneously Handle Multiple Requests: Django is unable to allow individual processes to handle numerous requests at once, in contrast to many contemporary web frameworks. Developers are under pressure to find effective techniques to enable individual processes to handle many requests as a result.
- Difficult To Learn: The steep learning curve of Django is one of its main drawbacks. It has several aspects that are difficult for developers to comprehend.

#### **2.4.4 Conclusion**

We do not need to put too much emphasis on optimization because our group project is not very large. Additionally, after using Python and Java for different projects, we made the decision to choose Python and the Django framework for back-end programming due to its simplicity, use, and development. Additionally, Django offers the jobs we require to finish a normal project requirement, such as the automatic development of SQL tables.

### **2.5 Database Management System**

#### **2.5.1 Database Management System MySQL**

MySQL is an open-source relational database management system (RDBMS). It is the most often used database type for PHP. Oracle Corporation creates, distributes, and supports MySQL [30].



**Figure 2.17:** MySQL Database Management System [11]

MySQL is becoming so popular because of many good reasons:

- MySQL is an open-source DBMS product which is license-free for most database applications. Therefore, using it is free of charge.
- Up to 50 million rows can be contained in a table with MySQL. The maximum file size for a table is 4 GB by default, but if the operating system supports it, users can expand this to a theoretical maximum of 8 million gigabytes.
- Even with massive data volumes, MySQL operates quickly and effectively.
- MySQL works on many operating systems and with many languages including PHP, PERL, C, C++, JAVA, etc.
- MySQL uses a standard form of the well-known SQL data language.
- MySQL can be customized. The MySQL software can be altered by programmers to match their particular environments thanks to the open-source GPL license.

But MySQL also has some drawbacks:

- MySQL is not very efficient in handling very large databases.
- Compared to commercial databases, MySQL doesn't have as good of a developing and debugging tool.
- Due to its ineffective transaction management, MySQL is vulnerable to data corruption.
- MySQL does not support SQL check constraints.

### **2.5.2 Database Management System PostgreSQL**

With many capabilities that safely store and scale the most complex data workloads, PostgreSQL, also known as Postgres, is a robust, open source object-relational database system that uses and extends the SQL language [31]. It supports a variety of SQL features, including foreign keys, subqueries, triggers, and other user-defined types and functions. For relational and non-relational queries to be expandable and

SQL compliant, it supports both SQL and JSON. PostgreSQL assistance supports sophisticated data types and performance enhancement tools that are only found in costly commercial databases like Oracle and SQL Server.



**Figure 2.18:** PostgreSQL Database Management System [12]

Currently, PostgreSQL is the second-most used database, only falling behind MySQL. There are a few key features of the PostgreSQL database that makes it unique and widely favored when compared to other databases:

- PostgreSQL runs on all major operating systems, including Linux, UNIX, and Windows.
- PostgreSQL supports text, images, sounds, and video, and includes programming interfaces for C / C++, Java, Perl, Python, Ruby, Tcl and Open Database Connectivity (ODBC).
- A significant portion of the SQL standard is supported by PostgreSQL, which also has many contemporary features.
- JSON is supported by PostgreSQL, enabling connections to other data stores like NoSQL.

- Support for multi-version concurrency control.
- Object-oriented and ANSI-SQL2008 compatible.
- Full support for client-server network architecture.
- It offers a most sophisticated locking mechanism.
- Standby server and high availability.
- Log-based and trigger-based replication SSL.

So, why should we use PostgreSQL and what are the advantages of PostgreSQL?

Here are the main benefits of PostgreSQL:

- As a LAMP stack option, PostgreSQL can operate dynamic webpages and online applications.
- Under an open source license, PostgreSQL's source code is accessible for free. Because of this, it is free to use, alter, and use as business requires.
- Geographic objects are supported by PostgreSQL, allowing user to utilize it for location-based services and geographic information systems.
- Write-ahead logging in PostgreSQL makes it a very fault-tolerant database.
- PostgreSQL is easy to use and it has low maintenance and administration for both embedded and enterprise usage.

Disadvantages of PostgreSQL:

- There are numerous organizations who own Postgres. As a result, despite having a full set of features and being comparable to other DBMS systems, it has had trouble building a solid reputation.
- Compared to MySQL, PostgreSQL requires more work to make changes for speed enhancement because it prioritizes compatibility.
- Many open source applications may support MySQL but not PostgreSQL.
- PostgreSQL is slower than MySQL in terms of performance measures.

### 2.5.3 Database Management System Oracle

Oracle database is a relational database management system (RDBMS). It is also called OracleDB, or simply Oracle. It is produced and marketed by Oracle Corporation. It was created in 1977 by Lawrence Ellison and other engineers [32]. It is one of the most popular relational database engines in the IT market for storing, organizing, and retrieving data. Oracle tutorial provides basic and advanced concepts of Oracle. It is widely used in enterprise applications.



**Figure 2.19:** Oracle Database Management System [13]

The following are some advantages of Oracle Database:

- Strong cross-platform and cross-app compatibility.
- Support from all major software and hardware vendors.
- Used extensively in the enterprise IT sector.
- Most popular relational database management system.
- Large developer community and excellent Oracle support.

- Robust security and privacy features such as encryption of data and networks, strong authentication and authorization of access

Disadvantages of Oracle Database:

- The local on-premises version of Oracle requires extensive SQL knowledge and administrative experience in database management that both PostgreSQL and MySQL does not require.
- Licenses for Oracle are pricey (Standard Edition is approximately 17,000 USD, Enterprise Edition is approximately 40,000 USD).
- High hardware requirements for local on-premises version.

#### **2.5.4 Conclusion**

After conducting a meticulous analysis of the three prominent database management systems, namely MySQL, PostgreSQL, and Oracle, we decided to choose PostgreSQL as the database management system used for this project. The reason for this decision is that PostgreSQL provides a wide range of data types that properly match the demands of our issue. For the needs of our project, PostgreSQL's adaptability and flexibility in managing a variety of data types have proven to be quite useful. In addition, we also found a DBMS PostgreSQL server that is free but still meets the requirements. This intriguing feature was crucial in helping us make up our minds. We may administer the database for our project without any cost burdens by utilizing this free PostgreSQL server. This enables us to manage our resources wisely and maintain our attention on the project's primary goals.

## 2.6 Related works

### 2.6.1 IELTS Online Tests

IELTS Online Tests<sup>1</sup>(IOT) belongs to InterGreat Education Group, founded in 2008. The website was created to help the community get ready for the IELTS exam by practicing IELTS mock tests. Until now, the website contains over 7 million completed tests with over 23 million users, which is considered as the best website for IELTS preparation.

IELTS Online Tests provides users with a huge collection of IELTS mock tests. These tests are divided into separate months for each year, the users can choose a month to start. For each month, there are two practice tests with all four modules (Listening, Reading, Writing, Speaking). After clicking on a test, the website will lead the users to a page for practice, the page is divided into two parts with questions on the left and an answering area on the right.

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<sup>1</sup>The official website of IELTS Online Tests: <https://ieltsonlinetests.com/>

Home / IELTS Exam Library

All Tests

Academic

General Training

Newest

## IELTS Mock Test 2022

• January	(3,252 votes)	3.7 ★	• July	(590 votes)	3.6 ★
• February	(1,630 votes)	3.8 ★	• August	(649 votes)	3.8 ★
• March	(1,275 votes)	3.9 ★	• September	(350 votes)	3.6 ★
• April	(960 votes)	3.6 ★	• October	(279 votes)	3.5 ★
• May	(894 votes)	3.7 ★	• November	(125 votes)	3.7 ★
• June	(728 votes)	4.0 ★			

**Figure 2.20:** A collection of practice tests in IELTS Online Tests

PRACTICE MODULES	LISTENING	READING	WRITING	SPEAKING
Practice Test 1	 6.5	 0 %	 0 %	 0 %
	<a href="#">Restart</a> ...	<a href="#">Take Test</a> ...	<a href="#">Take Test</a> ...	<a href="#">Take Test</a> ...
Practice Test 2	 0 %	 0 %	 0 %	 0 %
	<a href="#">Take Test</a> ...			

**Figure 2.21:** Modules of a practice test in IELTS Online Tests

**READING PASSAGE 1**

You should spend about 20 minutes on Questions 1-13 which are based on Reading Passage 1.

**Reading Passage 1**

## AUSTRALIA'S PLATYPUS

**AUSTRALIA'S PLATYPUS**

All of the creatures on the earth, the Australian platypus, *Otithorhynchus paradoxus*, is perhaps one of the most mysterious and reclusive. Derived from the Latin *platys* meaning 'flat and broad' and *pous* meaning 'foot', the platypus has long been an iconic symbol of Australia. Upon being discovered in Australia in the 1700s, sketches of this unusual creature were made and sent back to England whereupon they were considered by experts to be a hoax. Indeed, the incredible collection of its body parts – broad, flat tail, rubbery snout, webbed feet and short dense fur – make it one of the world's most unusual animals.

**SECTION 1: QUESTIONS 1-13**

**Questions 1-5**

Show Notepad

Do the following statements reflect the claims of the writer?

In boxes 1-5 on your answer sheet, write

YES	if the statement agrees with the views of the writer
NO	if the statement contradicts the views of the writer
NOT GIVEN	if it is impossible to say what the writer thinks about this

1. The appearance of the platypus caused experts to doubt it was real.  
 2. The amount of venom in a male platypus changes during the year.  
 3. Most platypus live in Eastern Australia.  
 4. Snake venom and platypus venom are very similar.

SECTION 1

59:41

Submit Review Solution

**Figure 2.22:** Test layout of IELTS Online Tests

### Advantages

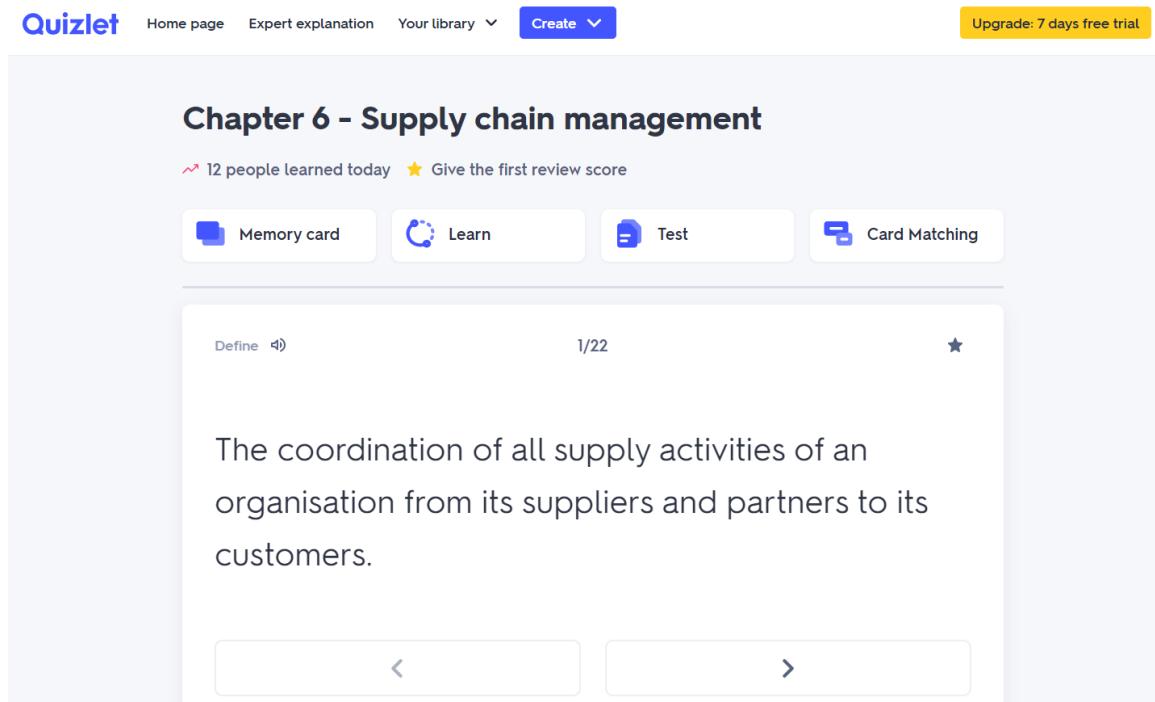
- Have a huge number of test resource
- Allow highlighting keywords while doing the test
- Have good layout and arrangement
- Easy to switch between questions
- Include timer to count down at the center

### Disadvantages

- Just limit to IELTS tests
- Cannot take note on keywords
- Do not have the feature of creating tests

## 2.6.2 Quizlet

Although Quizlet<sup>2</sup> is an application used mainly for creating flashcards to learn things easier and practice test is not its main function, it is still a great example for us to learn from. First of all, it allows people to freely create questions and answers which is a desired feature in our web application. Secondly, users can practice in test mode with questions and answers retrieved from the flashcards.



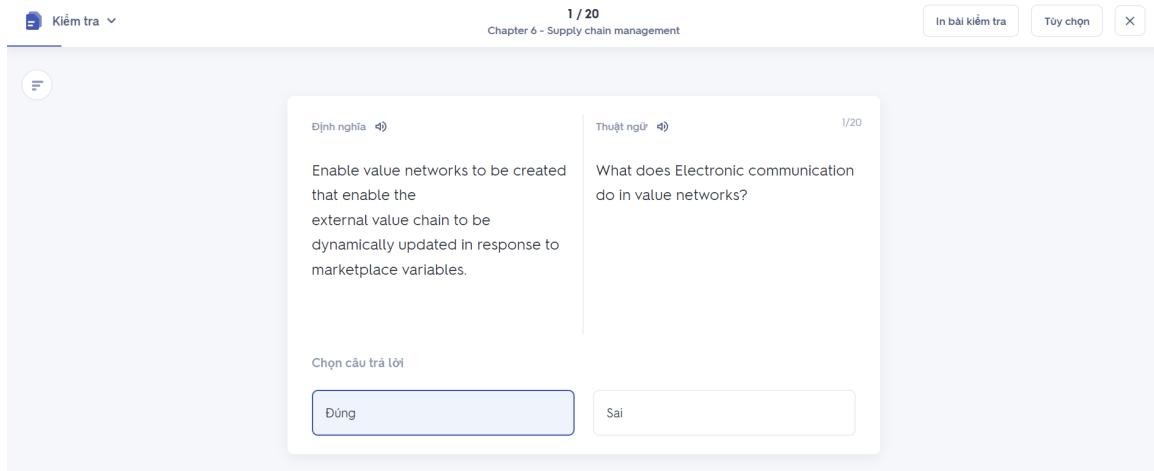
**Figure 2.23:** Quizlet flashcard layout

### Advantages

- Have the feature of creating tests
- Have a unique and interactive user interface
- Have the feature of printing the test

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<sup>2</sup>The official website of Quizlet: <https://quizlet.com/>



**Figure 2.24:** Test mode in Quizlet

### Disadvantages

- Only have multiple-choice questions which is quite limited
- Cannot take notes while doing tests
- Cannot highlight keywords

### 2.6.3 Bach Khoa E-learning (BKeL)

While Bach Khoa E-learning<sup>3</sup> is a multifunctional website that is mainly used to support the students to study courses at Ho Chi Minh City University of Technology more effectively as well as being a place for students and lecturers to interact with each other, it also has the feature of taking tests and quizzes, which makes it become a good example to gain more ideas and experience for our Capstone Project.

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<sup>3</sup>The official website of BKeL: <https://e-learning.hcmut.edu.vn/>

BÀI KIỂM TRA  
BÀI TẬP KẾT THÚC CHƯƠNG 3

HO CHI MINH IDEOLOGY (SP1037)\_VIDEO / BÀI TẬP KẾT THÚC CHƯƠNG 3

Quay lại

**Câu hỏi 1**  
Chưa được trả lời  
Chấm điểm của 2,00  
Có câu hỏi

Theo Hồ Chí Minh, con đường quá độ lén CNXH ở Việt Nam là:

A. Quá độ lén chủ nghĩa xã hội không qua giai đoạn phát triển tư bản chủ nghĩa  
 B. Quá độ lén chủ nghĩa xã hội không qua giai đoạn phát triển xã hội dân chủ  
 C. Quá độ lén chủ nghĩa xã hội không qua giai đoạn phát triển xã hội phong kiến  
 D. Quá độ lén chủ nghĩa xã hội không qua giai đoạn phát triển cộng sản chủ nghĩa

[Clear my choice](#)

[Trang kế tiếp](#)

Figure 2.25: Multiple-choice test layout in BKeL

BÀI KIỂM TRA  
BÀI TẬP KẾT THÚC CHƯƠNG 3

HO CHI MINH IDEOLOGY (SP1037)\_VIDEO / BÀI TẬP KẾT THÚC CHƯƠNG 3

Làm lại bài kiểm tra

Phương thức chấm điểm: Điểm cao nhất

Tóm tắt của bài làm trước của bạn		Điểm / 10,00	Xem lại
1	Đã hoàn thành Đã gửi Thứ tư, 16 Tháng mười một 2022, 5:24 PM	10,00	<a href="#">Xem lại</a>
2	Đã hoàn thành Đã gửi Chủ nhật, 11 Tháng mười hai 2022, 9:43 PM	10,00	<a href="#">Xem lại</a>

**Điểm cao nhất: 10,00 / 10,00.**

Figure 2.26: Display results after submitting in BKeL

## Advantages

- Have clear user interface
- Have timer to count down
- Can navigate between multiple questions

- Can choose various methods for marking

### **Disadvantages**

- Cost too much time to switch between questions
- Cannot take notes while doing tests
- Cannot highlight keywords
- Do not support well for constructed-response tests

# Chapter 3

## System analysis and design

*Chapter 3 presents a detailed analysis and design of the web application under consideration. This chapter first describes the system analysis, which includes establishing the web application's requirements and specifications, including its features, functionality, and user interface. Then, the chapter examines system design, which entails developing a detailed strategy for the web application's development, including its architecture, components, and interfaces.*

### 3.1 System analysis

#### 3.1.1 Functional requirements

##### Guest

- Login.
- Register (Not have an account yet).

##### User

- Have 2 modes for choosing (Create and Practice).
- Logout the account.
- Keep track of the achieved results.

- Tracking results of other users taking his/her created tests.
- Manage own account (Personal information).

- **In creating exams mode**

- Create three types of examination: Multiple choice, constructed-response, and fill-in-blank.
- Delete created tests.
- View the list of created tests.
- Print created tests.
- Set public or private status for created tests: Share or hide from people.
- Set time limit for the tests.
- Insert new questions.
- Remove questions.
- Set answers for the questions.
- Save/Update the tests.

- **In practicing mode**

- View the list of tests.
- Filter tests based on the subject of the tests: Math, English, Geography, IELTS, Calculus, and Physics.
- Filter tests based on the name of test.
- Choose a test to practice.
- View general information about the tests.
- Set time limit for the test before practicing.
- Have a timer for count-down.
- Answer questions in the test.
- Take note while doing the test.

- Highlight keywords on the questions.
- Create a to-do list.
- Mark the answers based on provided keys.
- View the solutions of the questions.

### **3.1.2 Non-functional requirements**

#### **Usability requirements**

- Have a user-friendly interface and easy to use for customers. In detail, users just need 4-5 minutes to get used to the application.
- Practice pages do not contain disturbing content including colorful figures, ads, and irrelevant text so that the users can focus when doing the tests.
- Minimize the number of interactions needed to reach the desired tests. In detail, users just need within 5 clicks to reach what they want.
- Display every necessary information to do a test in only one page including the name of the test, published time, time limit, number of questions, and illustrative image of the test.
- Notify an error instantly when users have bad interaction (e.g. fill in incorrect data type).

#### **Performance requirements**

- The system must be scalable enough to support 1,000 visits at the same time while maintaining optimal performance.
- Switch between questions within 1 second.
- Be able to load one page in just 5 seconds.

#### **Availability requirements**

- The system downtime is less than 1 minute a day.

- Not be affected by a third-party system.

### **Portability and compatibility**

- All the website features are accessible on popular browsers including Chrome, Firefox, Safari, and Microsoft Edge.
- Be usable from a mobile device, a tablet device or a normal computer/laptop.

### **Audit requirements**

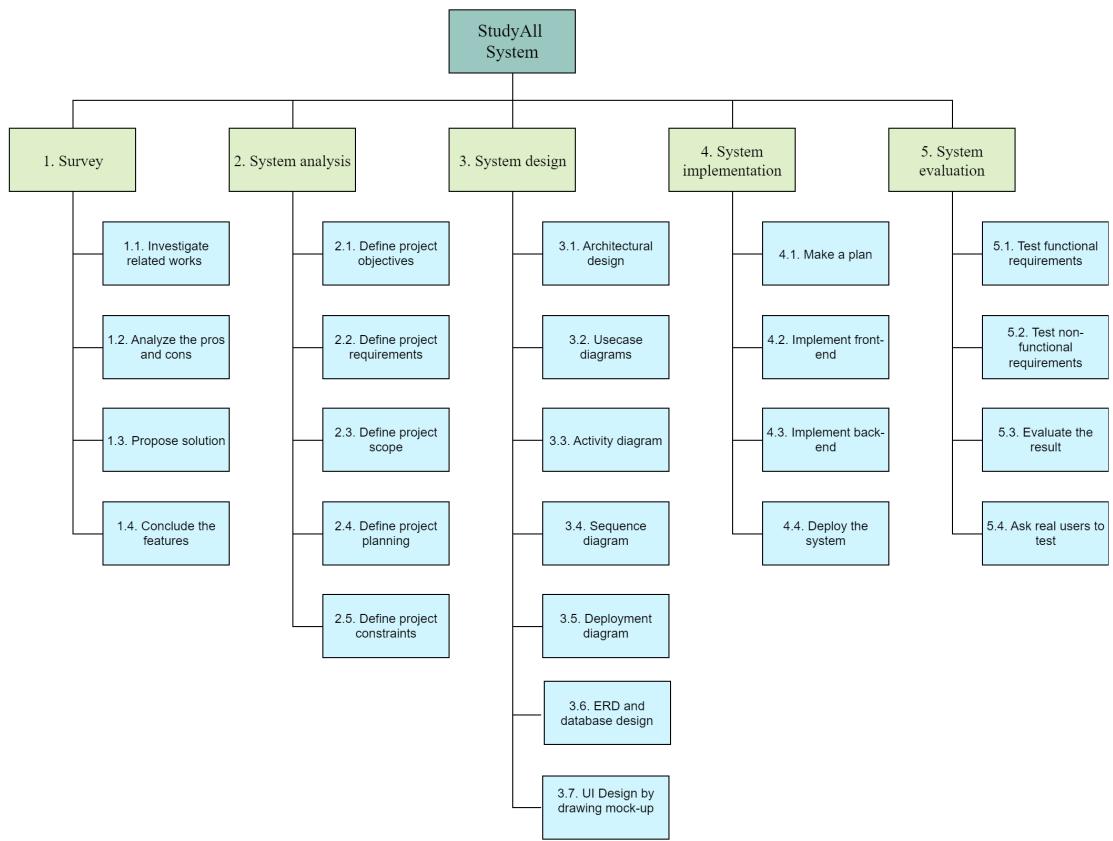
- There is a separate storage for storing audit data which is used for backup and admin checking.
- Audit data is inaccessible by users.

### **Maintainability requirements**

- Review code for every week of development.
- Follow carefully programming languages' conventions.
- Document the development process in detail.

### **3.1.3 Work breakdown structure (WBS)**

A work breakdown structure (WBS) is a project management tool that takes a step-by-step approach to complete large projects with several moving pieces. The detail WBS of our project is shown in Figure 3.1.



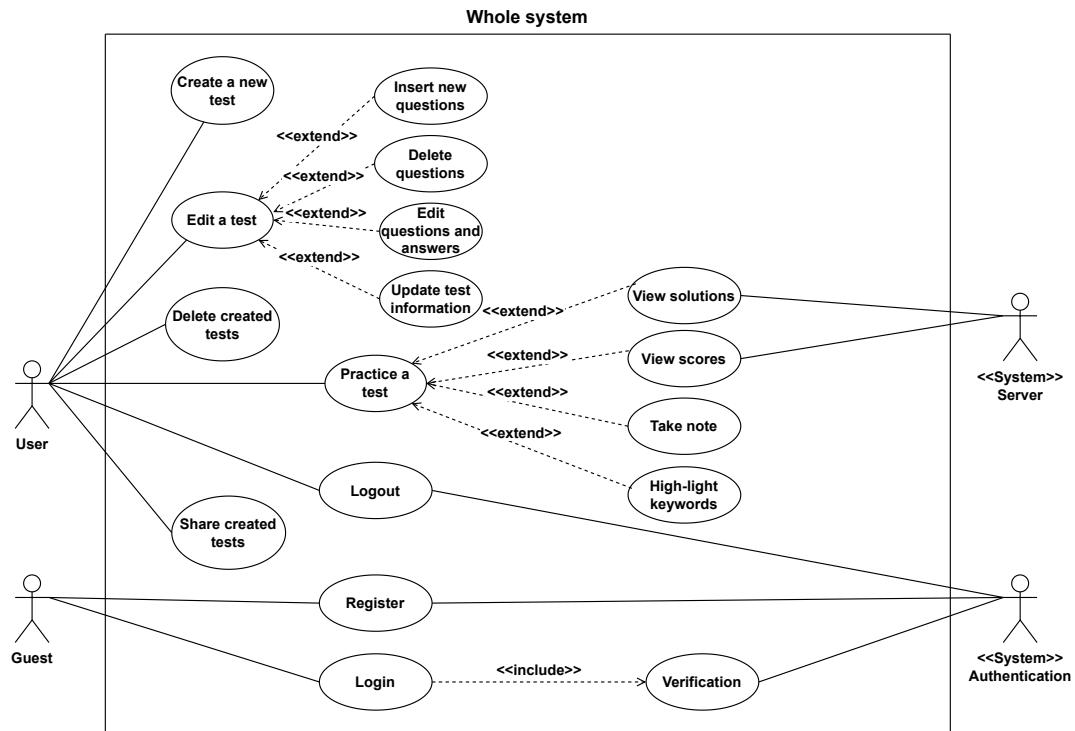
**Figure 3.1:** Work Breakdown Structure Diagram

## 3.2 System design

### 3.2.1 Use-case

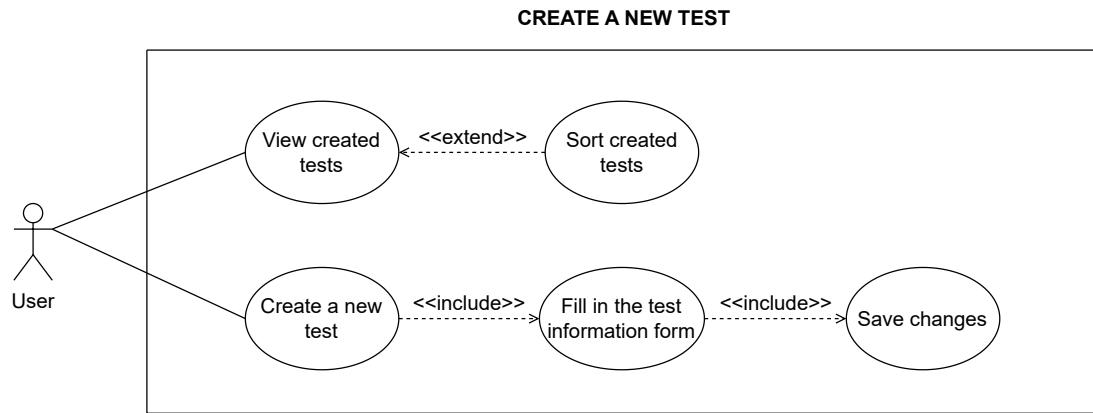
#### 3.2.1.1 Use-case diagram

Within our system, there are a variety of ways in which users interact, and Figure 3.2 provides a high-level illustration of these interactions. This includes a comprehensive view of the different actors involved in the system, as well as the various use cases and scenarios that are supported. To further explore and visualize these interactions, we will be using a series of detailed use-case diagrams. These diagrams will allow us to break down the interactions into smaller, more specific use cases, and provide a more granular understanding of the ways in which users engage with the system. By analyzing these use-case diagrams, we can gain valuable insights into how users are interacting with our system and identify areas for improvement.



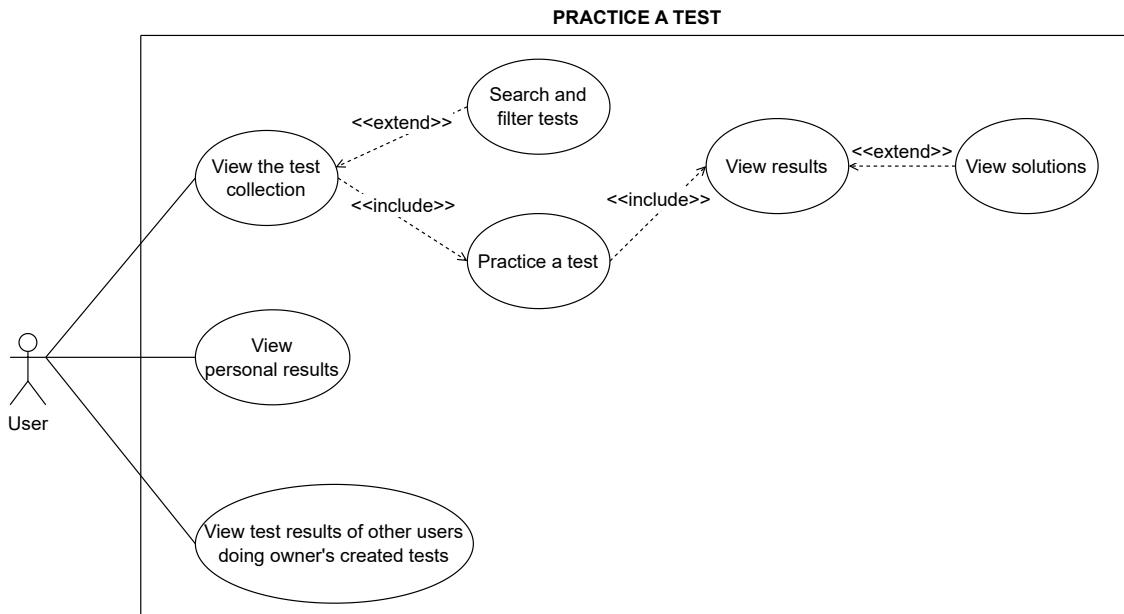
**Figure 3.2:** Overall use-case diagram

Figure 3.3 provides a visualization of how the user will create a new test and share the test with other users.



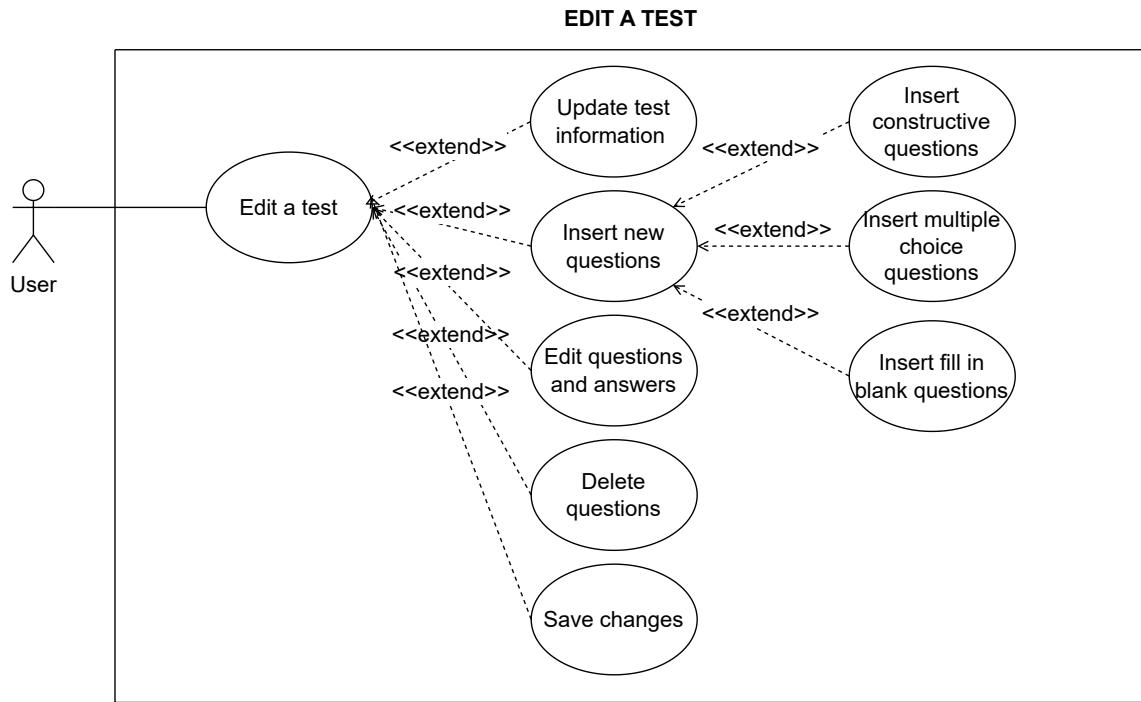
**Figure 3.3:** Use-case diagram for create a new test use-case

Figure 3.4 provides a visualization of how the user will use a created/shared test to practice and get the results as well as the solutions.



**Figure 3.4:** Use-case diagram for practice a test use-case

Figure 3.5 provides a visualization of how the user will edit their created tests by inserting new questions, deleting old questions, updating the test information, editing questions and answers.



**Figure 3.5:** Use-case diagram for edit a test use-case

### 3.2.1.2 Use-case scenario

#### Create a new test

**Table 3.1:** Use case scenario - Create a new test

Use Case ID	1
Use Case Name	Create a new test
Primary Actor	User
Secondary Actor	None
Description	Create a new test and add the created test to the test collection
Preconditions	Have logged into our application and move to “CREATE TEST” page
Successful End Condition	A new test is added into the test collection
Trigger	The user clicks on “CREATE” button
Normal Flow	<ol style="list-style-type: none"><li>1. User fills in the test information form</li><li>2. The user clicks on “Save” button</li></ol>
Exceptions	None
Alternative Flows	None

## Edit a test

**Table 3.2:** Use case scenario - Edit a test

Use Case ID	2
Use Case Name	Edit a test
Primary Actor	User
Secondary Actor	None
Description	A created test is modified
Preconditions	Have logged into our application and moved to “CREATE TEST” page
Successful End Condition	The test is modified and saved successfully
Trigger	The user clicks on “EDIT” button
Normal Flow	<ol style="list-style-type: none"><li>1. The user edits the test</li><li>2. The user clicks on “Save” button to save changes</li><li>3. System displays “Save successfully!”</li></ol>
Exceptions	None
Alternative Flows	None

## Delete created tests

**Table 3.3:** Use case scenario - Delete created tests

Use Case ID	3
Use Case Name	Delete created tests
Primary Actor	User
Secondary Actor	None
Description	Delete tests that were created by the user
Preconditions	Have logged into our application and moved to “CREATE TEST” page
Successful End Condition	The tests are removed from the collection of created tests
Trigger	The user clicks on the Square buttons to select the tests that need to be deleted
Normal Flow	<ol style="list-style-type: none"><li>1. Click on the “DELETE” button</li><li>2. System display: “Element Deleted”</li></ol>
Exceptions	In step 2: 2.a. User clicks on “Undo” button, tests will not be deleted and use case ends
Alternative Flows	None

## Share created tests

**Table 3.4:** Use case scenario - Share created tests

Use Case ID	4
Use Case Name	Share created tests
Primary Actor	User
Secondary Actor	None
Description	Share created tests with other users
Preconditions	Have logged into our application and moved to “CREATE TEST” page
Successful End Condition	The tests are shared with other users for practicing
Trigger	The user clicks on the “SHARE” button
Normal Flow	<ol style="list-style-type: none"><li>1. Add or remove emails in the share form</li><li>2. Click on the “SAVE” button</li><li>3. System display “Save successfully!”</li></ol>
Exceptions	In step 3: 3.a. User clicks on “CANCEL” button: old emails in the form will be kept and use-case ends
Alternative Flows	None

## Practice a test

**Table 3.5:** Use case scenario - Practice a test

Use Case ID	5
Use Case Name	Practice a test
Primary Actor	User
Secondary Actor	None
Description	Take a test to practice
Preconditions	Have logged into an account and moved to “PRACTICE TEST” page
Successful End Condition	Take a test and successfully submit the answers to get result
Trigger	The user clicks on “PRACTICE” button
Normal Flow	<ol style="list-style-type: none"> <li>1. User does the test</li> <li>2. User clicks on “SUBMIT” button to submit the answers</li> <li>3. System display rating box</li> <li>4. User rates the test and submits</li> <li>5. System receives answers and saves them to the database then marks answers based on provided keys</li> <li>6. System displays “Save successfully!”</li> <li>7. System displays the result to user</li> </ol>
Exceptions	None

Alternative Flows	<ul style="list-style-type: none"><li>A. Continue on step 7</li><li>8. User clicks on “VIEW ANSWER” button</li><li>9. User views the solutions</li></ul> <ul style="list-style-type: none"><li>B. Continue on step 7</li><li>8. User clicks on “Back to exam page”</li><li>9. User is redirected back to the page of test collection</li></ul>
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## Register

**Table 3.6:** Use case scenario - Register an account

Use Case ID	6
Use Case Name	Register
Primary Actor	Guest
Secondary Actor	Authentication
Description	Register an account
Preconditions	Guest gets access to our website then clicks on “SIGN IN” button in homepage
Successful End Condition	Register an account successfully
Trigger	Guest clicks on “SIGN UP” button
Normal Flow	<ol style="list-style-type: none"><li>1. Guest views the sign up form</li><li>2. Guest fills in the form</li><li>3. Click on the “SIGN UP” button</li><li>4. System checks valid information and saves to database</li><li>5. System display “Sign up successfully!”</li></ol>
Exceptions	3.a. Guest aborts the use case: No new account is created. The use case ends
Alternative Flows	4.a. Information is not valid and system display errors on the sign up form: Go back to step 2

## Login

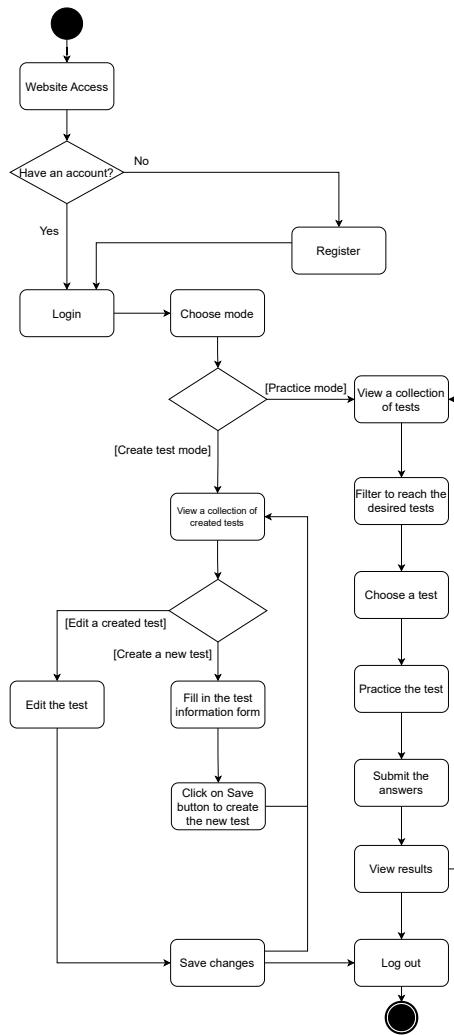
**Table 3.7:** Use case scenario - Login

Use Case ID	7
Use Case Name	Login
Primary Actor	Guest
Secondary Actor	Authentication
Description	Login to the application
Preconditions	Guest gets access to our website
Successful End Condition	Log into the website successfully
Trigger	Guest clicks on “SIGN IN” button in the homepage
Normal Flow	<ol style="list-style-type: none"><li>1. Guest views the sign in form</li><li>2. Guest fills in the form</li><li>3. Click on the “SIGN IN” button</li><li>4. System checks information’s validation</li><li>5. System displays “Sign in successfully!”</li><li>6. System displays the dashboard page</li></ol>
Exceptions	3.a. Guest aborts the use case: No new account is created. The use case ends

Alternative Flows	<p>2.a. Guest click on “Login with Google” button</p> <p>2.a.1. A Google’s login form pop up</p> <p>2.a.2. Fill in their email and password then submit</p> <p>2.a.3. Move to step 6</p> <p>2.b. Guest clicks on “Login with Facebook” button</p> <p>2.b.1. A Facebook’s login form pop up</p> <p>2.b.2. Fill in their facebook account then submit</p> <p>2.b.3. Move to step 6</p> <p>4.a. System displays “Invalid email or password”: Go back to step 2</p>
-------------------	---

### 3.2.2 Activity diagram

Figure 3.6 presents a comprehensive workflow of our system, offering a holistic view of how users will interact with and utilize the system's functionalities. This diagram serves as an informative tool to provide you with an overview of the user journey within our system, highlighting the key steps and interactions involved. By examining this activity diagram, you can gain a clear understanding of the overall flow and functionality of the system.



**Figure 3.6:** Overall activity diagram

### 3.2.2.1 Login and Register

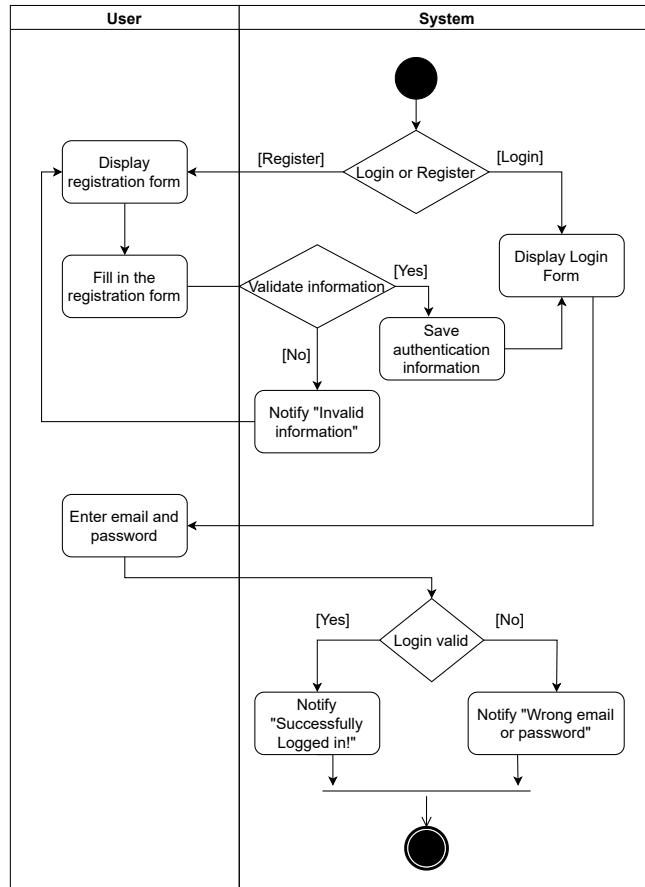
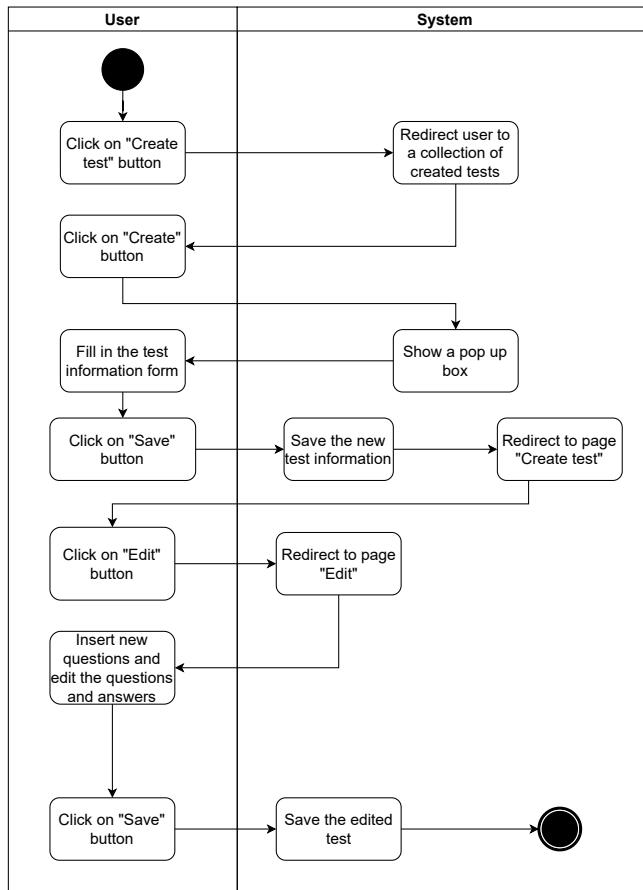


Figure 3.7: Activity diagram - Login/Register

#### Workflow explanation:

Users can register an account by clicking on “Sign up” button if they do not have an account or login by clicking on “Login” button. If users want to register, the website will redirect the users to Sign up page, where they can fill their information in the form. After clicking on “Sign up” button, system will save their username, email, profile picture, and password, then redirect them to the Login page. If they enter the right email and password, the system will inform them that they have successfully logged in. Otherwise, the system will inform them with an “Invalid email or password” notification.

### 3.2.2.2 Create a new test

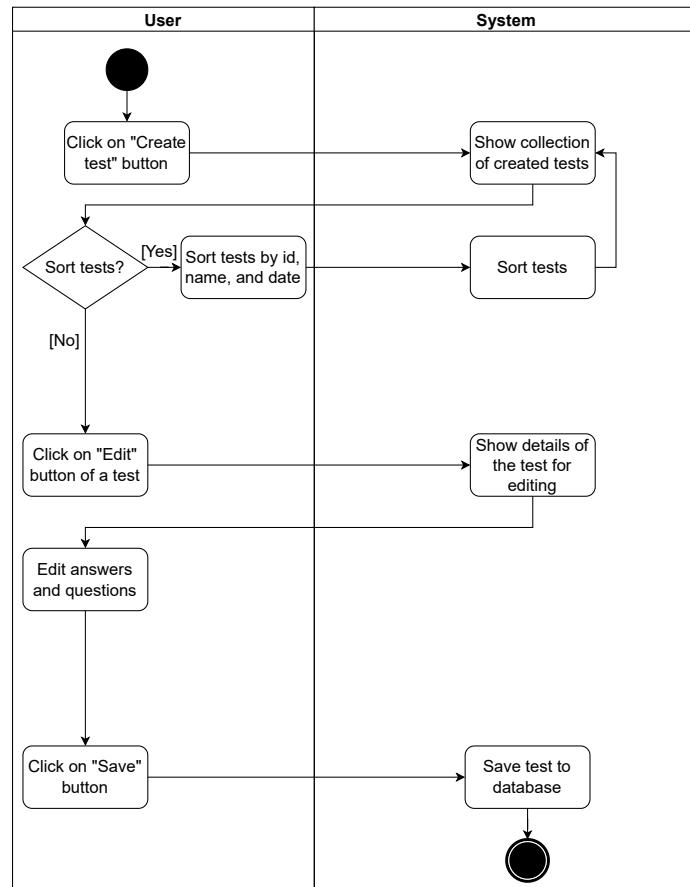


**Figure 3.8:** Activity diagram - Create new test

#### Workflow explanation:

Only users that have logged in can create a test. They can do it by clicking on “Create test” button. The system will redirect them to the Create test page, which has a button “Create”. The system will pop up a box so that users can fill in the information about the test. After saving the information, the system will redirect users to Create test page again. They can insert new questions and their answers as well as edit them. After clicking on the “Save” button, the system will save the whole test.

### 3.2.2.3 Edit a test

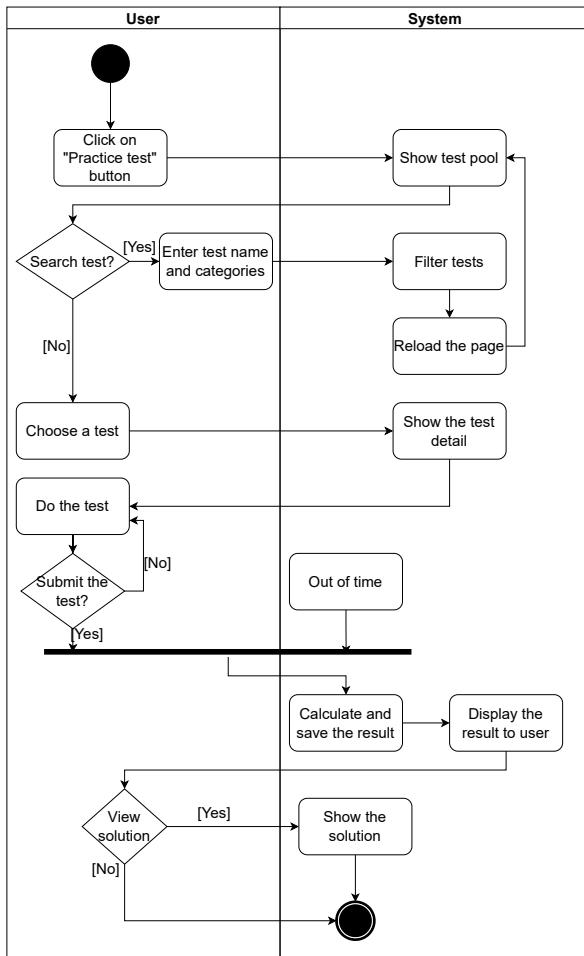


**Figure 3.9:** Activity diagram - Edit a test

#### Workflow explanation:

Only users that have logged in can create a test. They can do it by clicking on “Create test” button. The system will redirect them to a collection of created tests. Users can sort for reaching the test they want to edit faster. After choosing the test they want to edit by clicking on the “Edit” button, they can insert new questions and their answers as well as edit them. After clicking on “Save” button, the system will save the whole test.

### 3.2.2.4 Practice a test



**Figure 3.10:** Activity diagram - Practice a test

#### Workflow explanation:

After login successfully, users can practice their created tests or shared tests by clicking on the “Practice test” button. The system will show the pool of tests. Users can search for the test they want to take on the search bar or filter by their tags. They can choose a test to do by clicking on “Practice” button, then the system will show the test detail and the timer starts to count. If they want to end the test, just click on the “Submit” button. Besides, if time is up, the system will also end the test.

After that, the system redirects users to the “Result of test” page, where users can view their score and details of each answer. Users can choose to view the solution by clicking on “View answer” button and the system will show the test’s solution.

### 3.2.3 Deployment diagram

A UML deployment diagram is a visual representation of how run-time processing nodes are configured and the components that reside on them. Nodes are physical hardware used to deploy the application. An object-oriented system's physical components are modeled using deployment diagrams, a type of structure diagram.

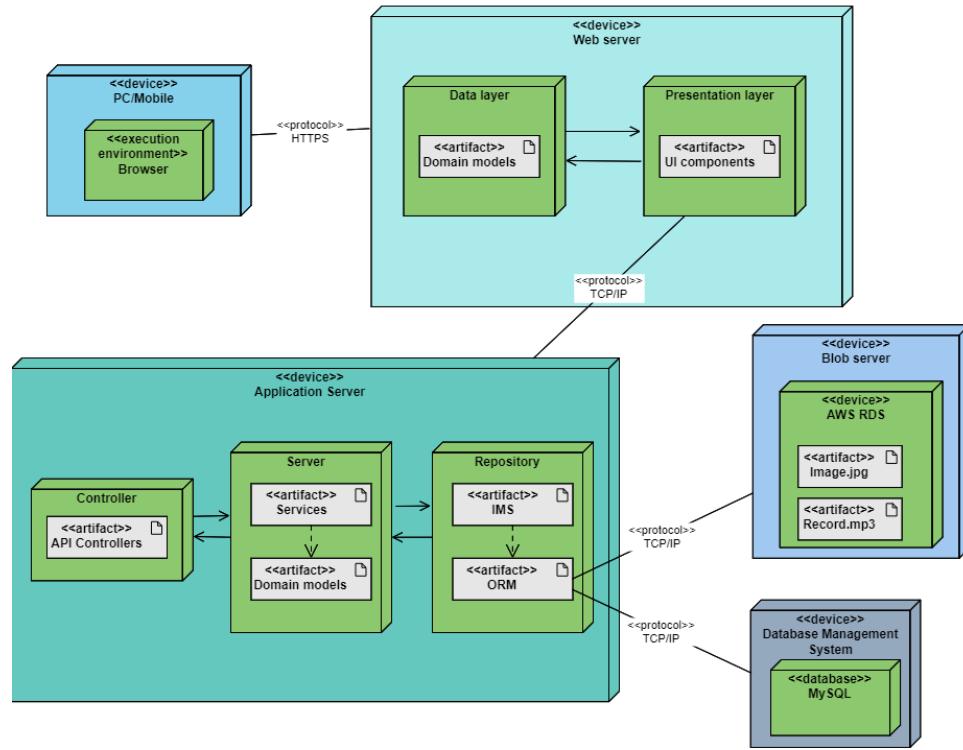


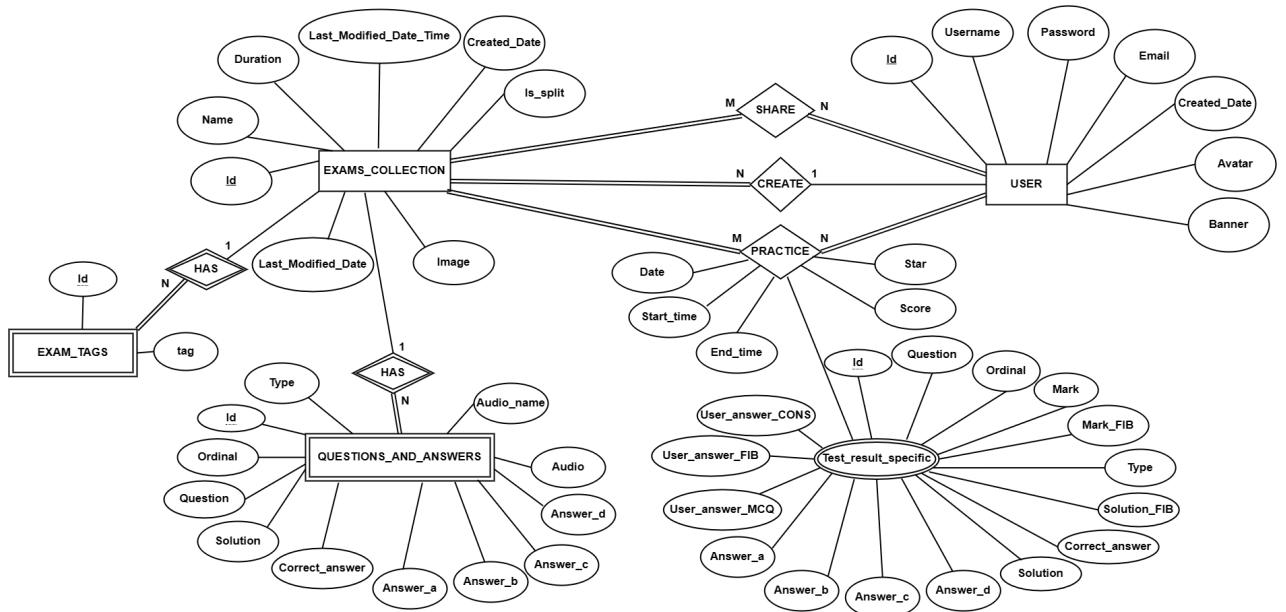
Figure 3.11: Deployment Diagram

In this diagram, it includes 5 main blocks: PC/Mobile, Web server, Application server, Blob server and Database Management System.

- Block PC/Mobile: This is a device for users to access the information system through web browsers such as Coccoc, Chrome, Microsoft Edge, ... Block connects to web server via HTTPS protocol to download website's content and data for users.
- Web server: Block with the primary purpose of gathering and displaying data for user interaction. There are two layers inside the block: a presentation layer and a data layer.
- Application layer: The Application Layer interface directly interacts with application and provides common web application services. This layer has three 3 layers of controller layer, service layer and repository layer corresponding to pattern controller - service - repository.
- Blob server: This block contains the database only for storing media files such as images, recording files, or even video.
- Database management system: This block contains a database to store data of the system.

### 3.2.4 Entity Relationship Diagram (ERD)

Entity Relationship Diagram, also known as ERD, ER Diagram or ER model, is a type of structural diagram for use in database design. An ERD contains different symbols and connectors that visualize two important information: The major entities within the system scope, and the inter-relationships among these entities.



**Figure 3.12:** Entity Relationship Diagram

Since the Entity Relationship Diagram diagram was built base on the requirement description discussed above, you can still refer to Section 3.1 when reading the diagram for more clarity.

The Figure 3.13 shows our database schema, which is a logical structure that defines the tables, columns, constraints, and relationships of data in a database. It provides a blueprint for organizing and accessing data in a consistent and efficient way.

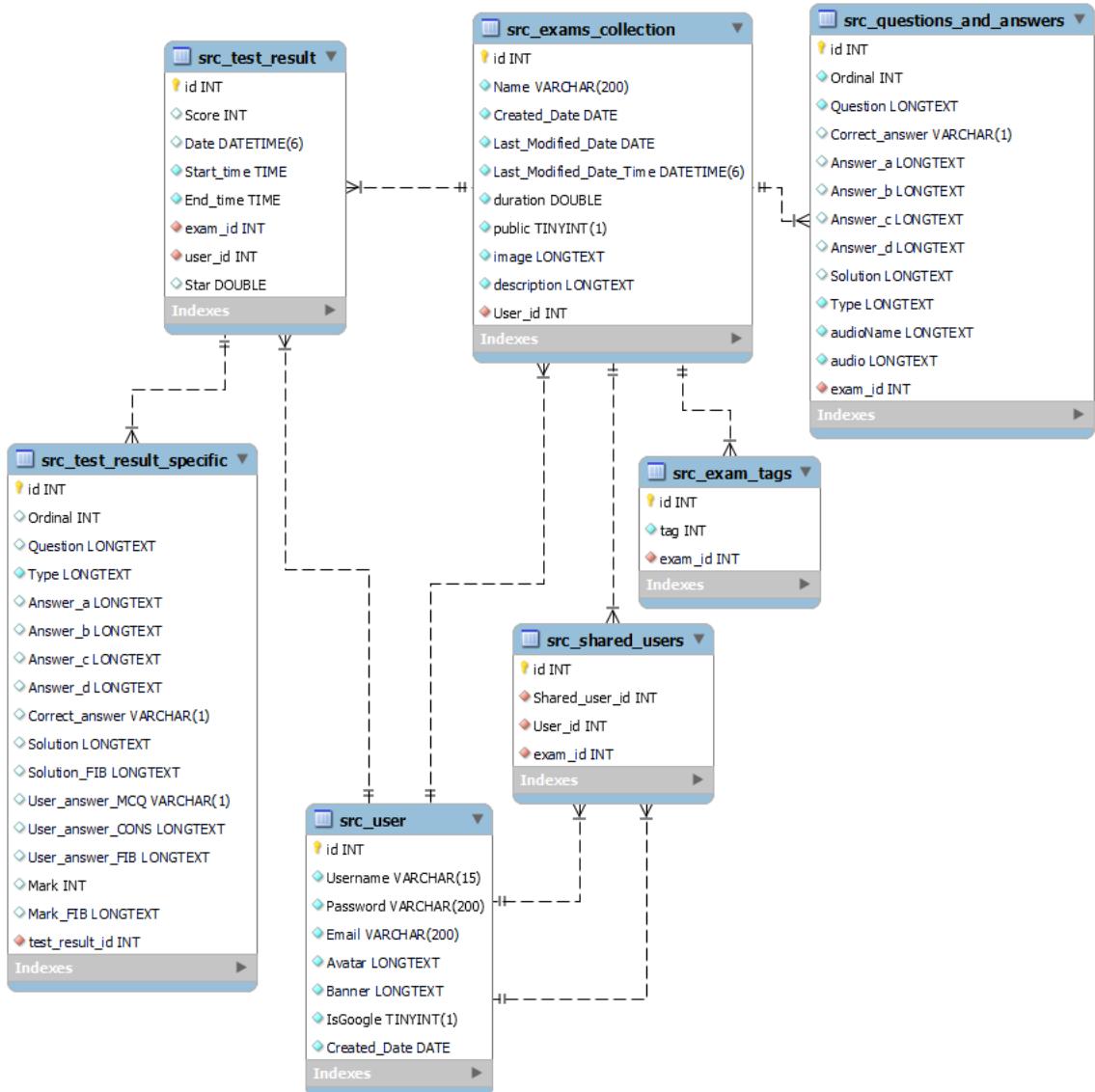
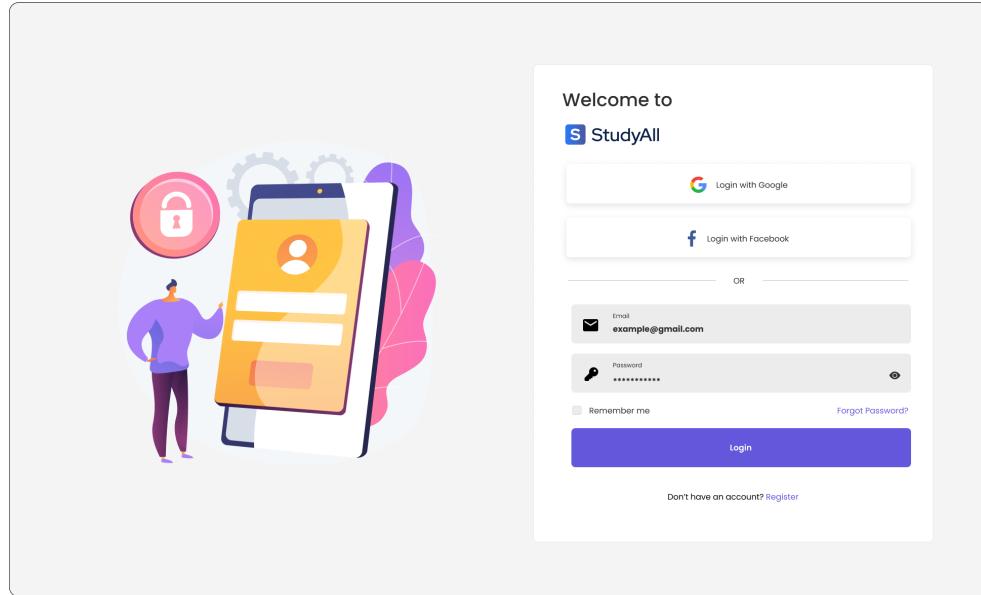


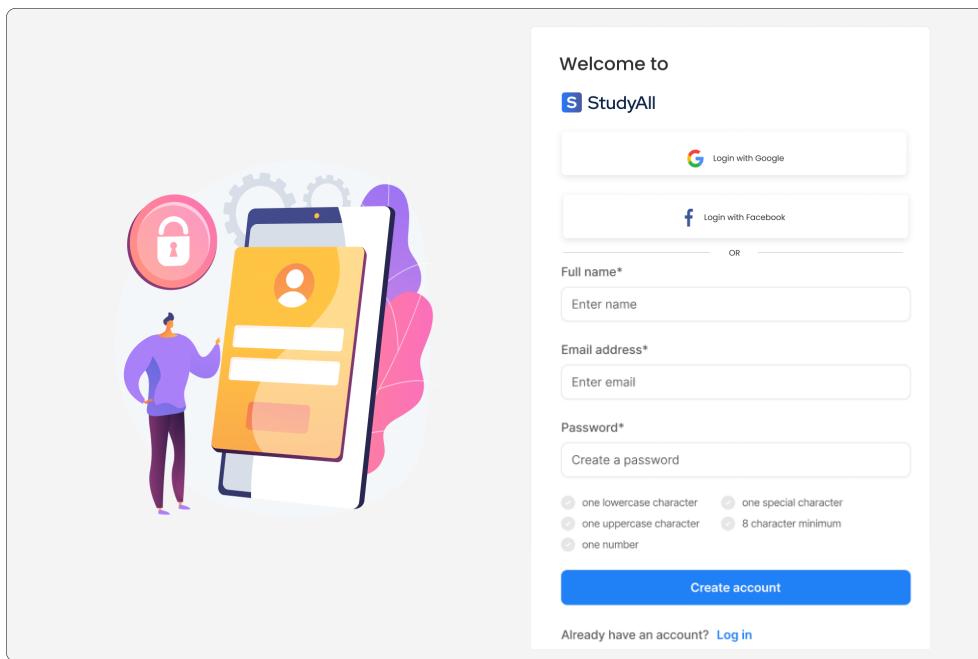
Figure 3.13: Our database schema

### 3.2.5 UI design

We have designed main screens of our system, including: “Login page” as shown in Figure 3.14, “Register page” as shown in Figure 3.15, “Create Test page” as shown in Figure 3.16 and 3.17, “Test collection page” as shown in Figure 3.18, “Practice Test page” as shown in Figure 3.20, “Edit Test page” as shown in Figure 3.19, “Result test page” as shown in Figure 3.21.



**Figure 3.14:** Mockup of Login page



**Figure 3.15:** Mockup of Register page

The mockup shows a web-based application interface for creating tests. At the top, there is a header with the 'StudyAll' logo, a search bar containing the placeholder 'useless items on white background', and several buttons: 'Create test', 'Online test', and 'Sign in'. Below the header, the main area is divided into two sections. On the left, a sidebar titled 'Tools' contains three expandable categories: 'Constructive exam' (with options 'Insert exam topic', 'Insert question', and 'Insert answering blank'), 'Multiple choice exam' (with 'Insert question and answer'), and 'Audio' (with 'Add audio file'). A 'Show More' button is at the bottom of this sidebar. On the right, the main workspace displays three questions. Each question has a toolbar above it with buttons for 'Split half page', 'Delete', 'Show all', 'Action', 'Save', and a grid icon. 'Question 1' is a constructive exam with three text input fields. 'Question 2' is a multiple choice exam with four radio buttons labeled A, B, C, and D, each next to a text input field. 'Question 3' is another constructive exam with three text input fields. Below the third question is a large empty text input field labeled 'Answer'.

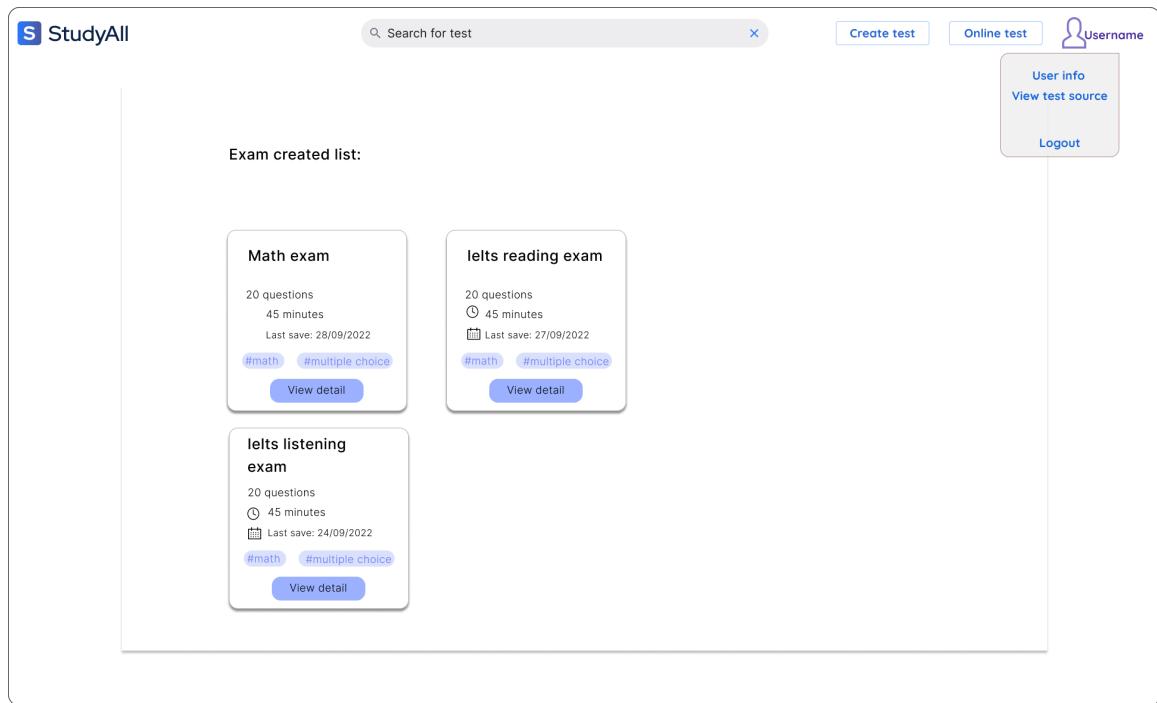
**Figure 3.16:** Mockup of Create test page 1

The mockup shows a web-based application for creating tests. At the top, there's a header with the 'StudyAll' logo, a search bar containing 'useless items on white background', and buttons for 'Create test', 'Online test', and 'Sign in'. Below the header is a toolbar with buttons for 'Split half page', 'Delete', 'Show all', 'Action', 'Save', and two grid icons.

The main area is divided into sections:

- Tools**: A sidebar with dropdown menus for 'Constructive exam', 'Multiple choice exam', and 'Audio', each with sub-options like 'Insert exam topic', 'Insert question', 'Insert answering blank', etc.
- Exam content**: A large empty box where content can be inserted.
- Question 1**: A section for a multiple-choice question with four options (A, B, C, D) each followed by an empty rectangular input field.
- Question 2**: Another section for a multiple-choice question with four options (A, B, C, D) each followed by an empty rectangular input field.
- Question 3**: A third section for a multiple-choice question with four options (A, B, C, D) each followed by an empty rectangular input field.
- Answer**: A section labeled 'Answer' with an empty rectangular input field.

**Figure 3.17:** Mockup of Create test page 2



**Figure 3.18:** Mockup of View source of created test page

The mockup shows the StudyAll platform's edit test feature. At the top, there is a search bar with the placeholder "useless items on white background", a "Create test" button, an "Online test" button, and a user profile icon labeled "Username".

The main area is divided into two sections: "Tools" on the left and "Exam content" on the right.

**Tools Section:**

- Constructive exam:**
  - Insert exam topic
  - Insert question
  - Insert answering blank
- Multiple choice exam:**
  - Insert question and the answer
- Audio:**
  - Add audio file

**Show More ▾**

**Exam content Section:**

**Question 1:** When travelling on an Indian train.  
 Passage: Indian rail travel is unavoidably dirty, and a balance must be struck between having the window shutters open to see the countryside and closing them against the heat and dust.  
 The air-conditioned carriages are generally comfortable, and the train catering manager takes orders, which he passes by phone to the next stop but two, where the food comes aboard in metal dishes. An excellent vegetarian meal of two curries, rice, pickle, naan bread, parathas and dal was no more than enough for my wife and me to have breakfast at 16 rupees (35p), although it was a fingers-in-the-dish exercise if you didn't have your own knife and fork. Rice plantations in the heat of the day gave way to cotton and maize fields in the evening, where farm workers stood on high stools cleaning the rice.  
 Our shower, breakfast and bed in the West End Hotel is £100, but a t-shirt and a pair of shorts, silk shirts and ties in Mahatma Gandhi Road are irresistible when offered at half, or sometimes even a third of European prices, and comfortable, well-made leather sandals are of an equally good value.  
 Options:  
 A  It is hard to keep the windows open because they are not balanced.  
 B  It is hot and dusty if the windows are closed.  
 C  You can get not very dirty if you want to see the views.  
 D  The windows are very hot and dirty.

**Question 2:** According to the passage, what is true about the food on the Indian train?  
 Options:  
 A  It could be ordered and cooked on the train.  
 B  It was cooked before it was put onto the train.  
 C  It was cooked at the start of the journey.  
 D  It was ordered before the journey.

**Question 3:** The writer  
 Options:  
 A  paid a lot of money for the food.  
 B  was satisfied with the amount of food he was given.  
 C  needed to go to the bank to pay for the food.  
 D  took his own knife and fork.

Figure 3.19: Mockup of Edit test page

**StudyAll**

useless items on white background

Create test

Online test

Username

**Exam content**

Indian rail travel is unavoidably dirty, and a balance must be struck between having the window shutters open to see the countryside and closing them against the heat and dust. The air-conditioned carriages are generally comfortable, and the train catering manager takes orders, which he passes by phone to the next stop but two, where the food comes aboard in metal dishes. An excellent vegetarian meal of two curries, rice, pickle, nan bread, poppadoms and lassi was more than enough for two people, and cost a rupee and a half at 16 rupees (35s), although it was a finger-in-the-dish exercise if you didn't have your own knife and fork. Rice plantations in the heat of the day gave way to cotton and maize fields in the evening, where farm workers stood on high stools cleaning the rice. Our shower, breakfast and bed were at the West End Hotel at Bangalore, which was welcome. The socks, silk shirts and ties in Mahatma Gandhi Road are irresistible when offered at half, or sometimes even a third of European prices, and comfortable, well-made leather sandals are of an equally good value.

**Question 1**

When travelling on an Indian train,

A  It is hard to keep cool because they are not balanced.  
 B  It is hot and dusty if the windows are closed.  
 C  You will get hot and dusty if you want to see the views.  
 D  the windows are very hot and dirty.

**Question 2**

According to the passage, what is true about the food on the Indian train?

A  It could be eaten and cooked on the train.  
 B  It was cooked before it was put onto the train.  
 C  It was cooked at the start of the journey.  
 D  It was ordered before the journey.

**Question 3**

The writer

A  paid a lot of money for the food.  
 B  was satisfied with the amount of food he was given.  
 C  needed to go back to pay for the food.  
 D  took his own knife and fork.

Timer: 15:00

SUBMIT

Question list: 1 2 3

**Figure 3.20:** Mockup of Practice test page

S StudyAll

useless items on white background

Create test

Online test

Username

**View answer**

**Do again**

**Result:** 3/3

**Accuracy:** 100%

(#right/#total)

**Time completion:** 14:38

**Right answer:** 3

**Wrong answer:** 0

**Skip answer:** 0

**Detail:**

1	✓
2	✓
3	✓

Congratulations

You did a great job in the test!

Figure 3.21: Mockup of Result of test page

# Chapter 4

## Implementation, deployment and system testing

*In this chapter, we will present the outcomes of our group's project and discuss our implementation process. We will demonstrate how we have developed our system and performed comprehensive system testing to ensure that it meets our project requirements. Additionally, we have successfully deployed our website on a server, providing convenient browser access for our users. Finally, the link of our website is <https://www.studyall.link>*

### 4.1 Implementation

#### 4.1.1 Techniques Applied - Concurrent update

In this section, there are techniques that we should take into account. But for our project, the most important one is concurrent update.

The concurrent update problem [33] can arise when many database sessions are allowed to update the same data simultaneously.

Optimistic concurrency control and pessimistic concurrency control are two concepts in the database that refer to how to handle read/write data with multi-session/multi-transaction.

- **Pessimistic lock**

Pessimistic concurrency control or pessimistic lock both describe the conflict resolution mechanism when many transactions change data on one or a set of records.

This mechanism works by locking a row before one of its attributes is changed through a call to the `setAttribute()` method. If any other transaction tries to access that locked row, they will be forced to wait until the first transaction completes. This mechanism uses the `SELECT...FOR UPDATE` syntax. Pessimistic locking is the safest locking mechanism because two transactions can never change the same row.

- **Optimistic lock**

Optimistic Locking allows multiple transactions to be completed without affecting each other. Instead of locking a row as soon as it is changed, with Optimistic Locking, it will wait until the changed row is posted before trying to get a lock. An exception will not be thrown until the conflicting transactions attempt to post their changes to the database.

Concurrent updates can occur in our program when many users with the same account attempt to edit the same test at the same time. This might result in data conflicts and inconsistencies, potentially resulting in errors or data loss. To overcome this problem, we have implemented an optimistic locking mechanism.

This method involves appending a version number to the test record in the database. When a user retrieves the test for editing, the version number is also retrieved. When the user saves the modifications, the version number is verified to confirm that it has not been altered by another user in the meantime. If the version number hasn't changed, the user's modifications are stored to the database. If the version number changes, it signifies that another user has already made modifications, and the user is warned of the conflict and requested to resolve it before storing the changes. This method allows numerous users to change the same test at the same time while reducing disputes and guaranteeing data consistency.

## 4.1.2 Project management

To manage the project, we have used Trello - a web-based project management and collaboration tool that allows individuals and teams to organize tasks, projects, and workflows in a visually intuitive way. Trello uses a system of boards, lists, and cards to help users get a clear view of who's doing what and what needs to get done.

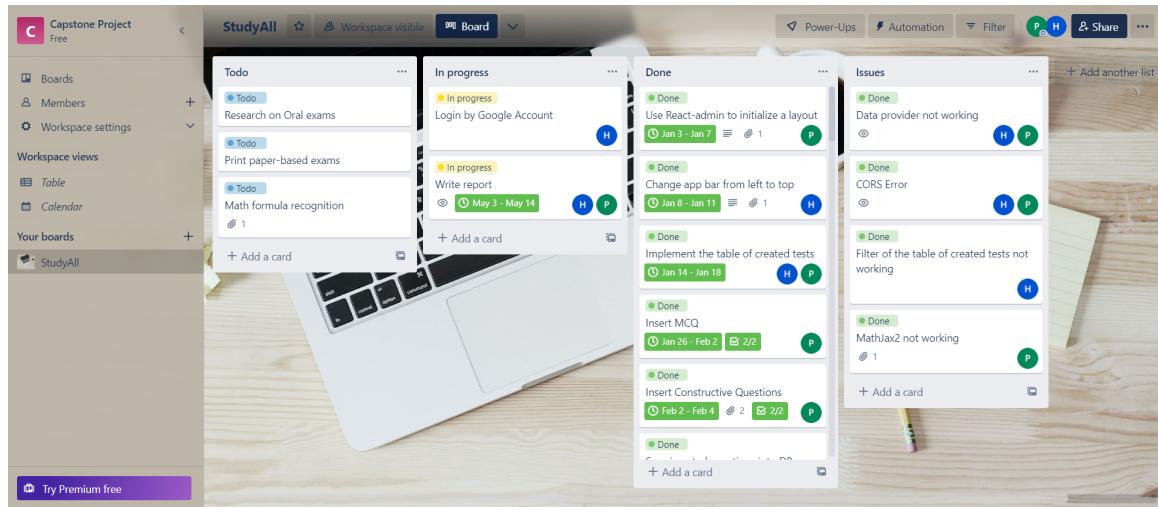


Figure 4.1: A board in Trello

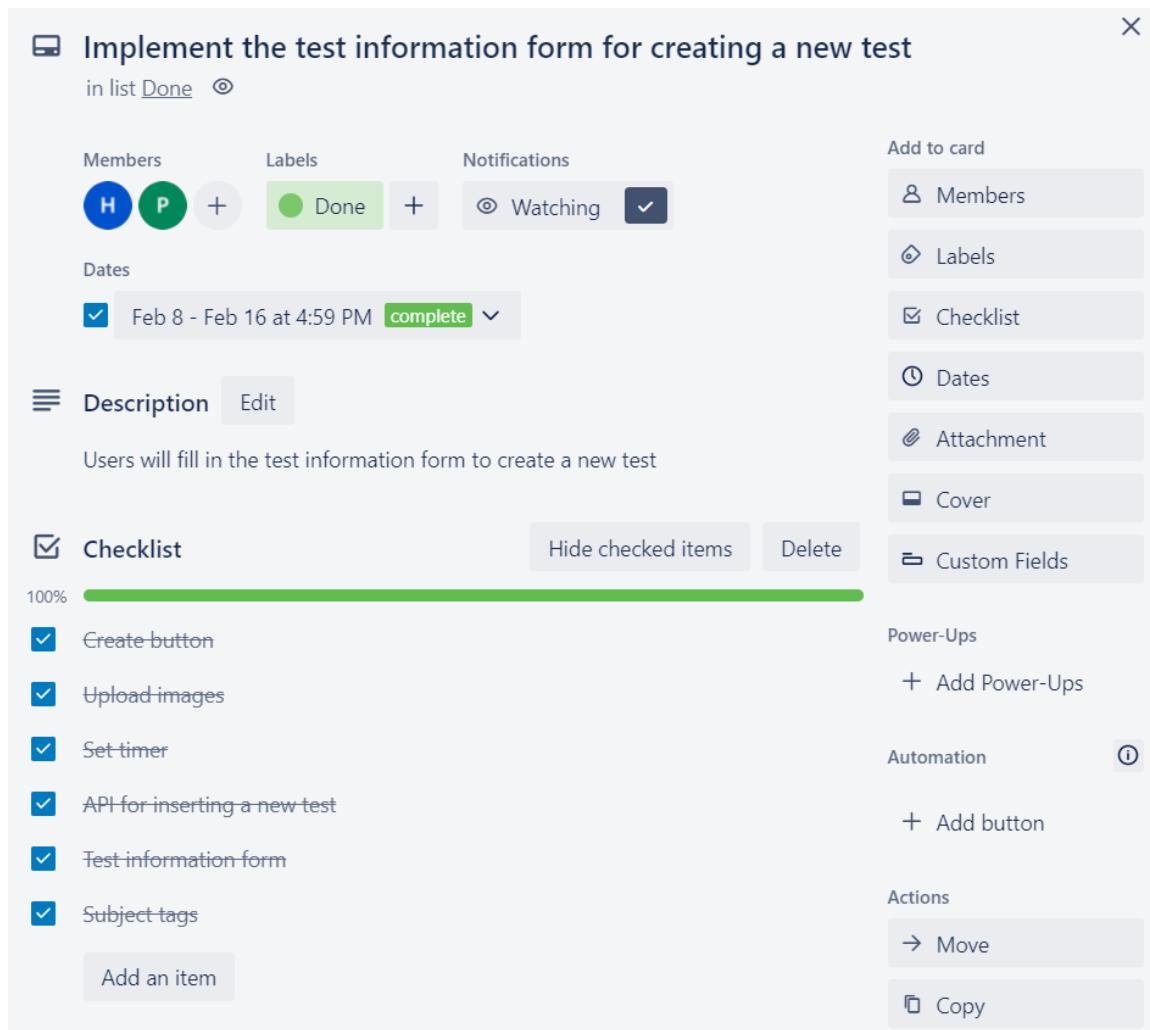
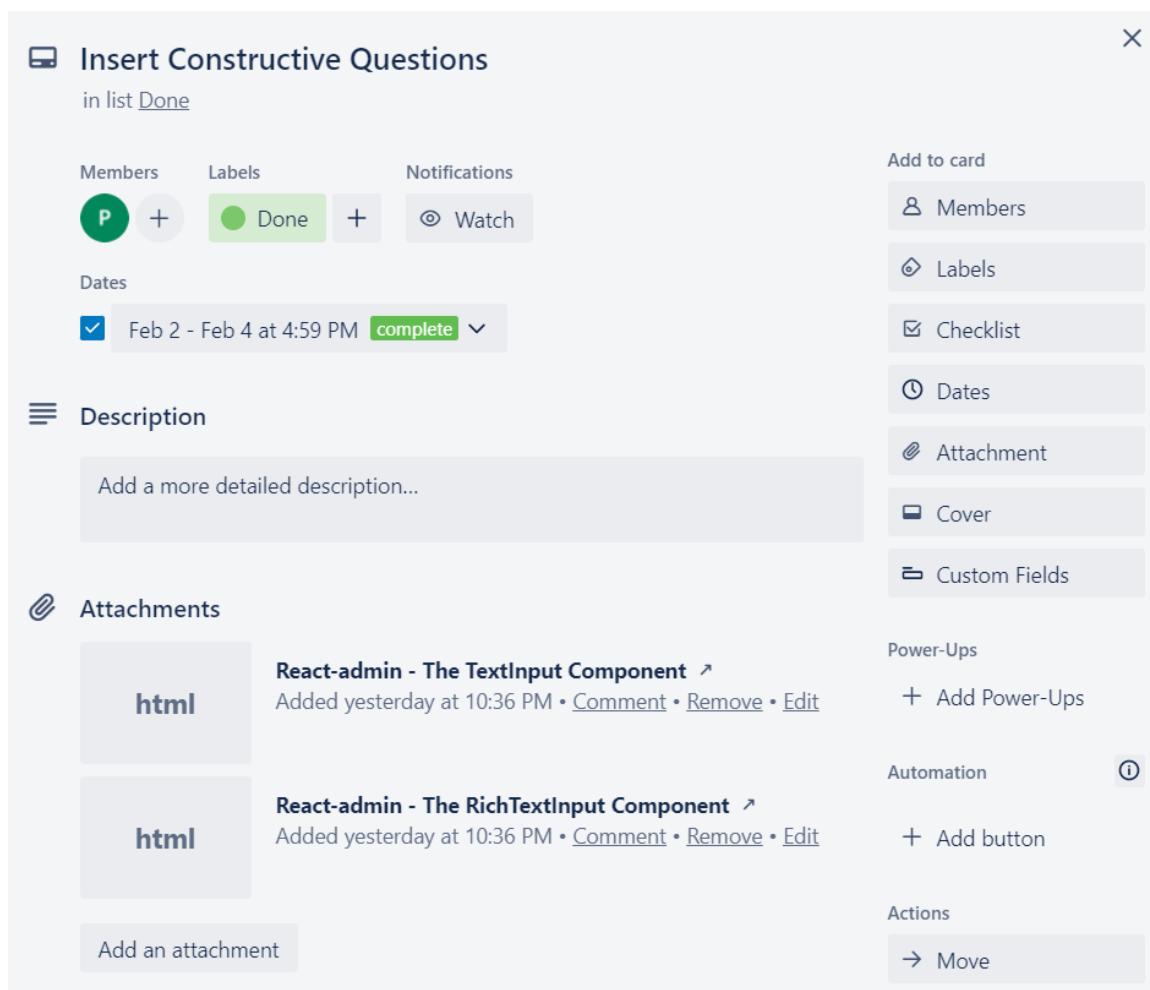


Figure 4.2: A card in Trello



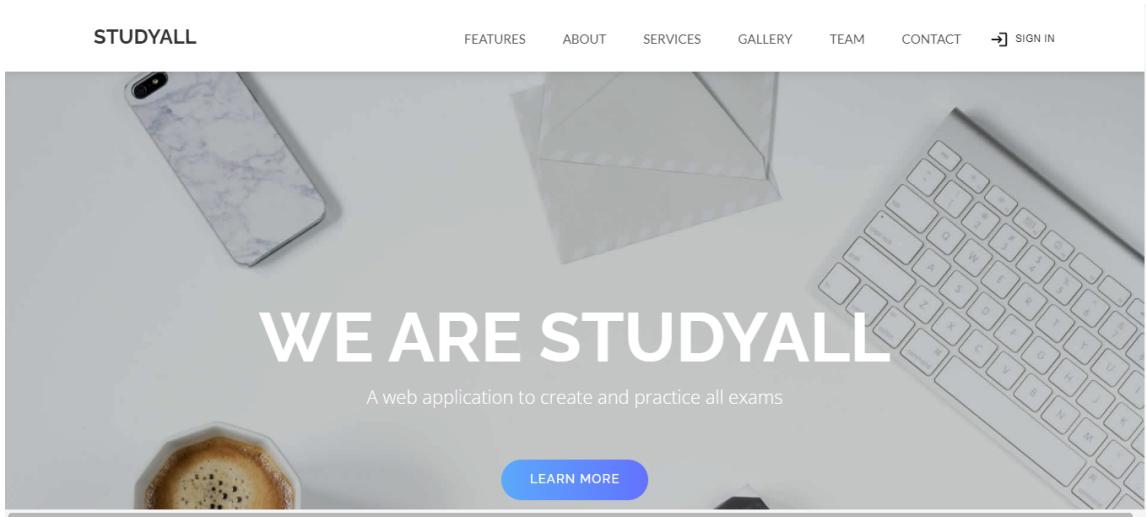
**Figure 4.3:** A card with attachments in Trello

### 4.1.3 System interface

Building upon the system designs outlined before, we have successfully developed and implemented a suite of web pages that fully satisfy our system requirements. These pages have been designed with the end user in mind, and feature an intuitive, user-friendly interface that allows users to easily navigate and interact with the system. By closely adhering to the system designs and requirements, we have been able to create a robust and reliable system that meets the needs of our users.

#### Homepage

The homepage provides users with an initial overview and introduction to our website. It includes a summary of the website's main features and links to the login/signup page which will drive users to other pages.

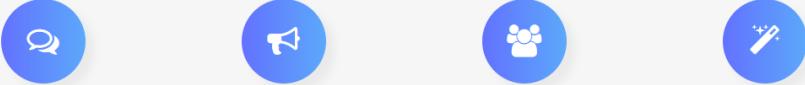


**Figure 4.4:** Home Page 1

**STUDYALL**

FEATURES    ABOUT    SERVICES    GALLERY    TEAM    CONTACT    SIGN IN

## FEATURES



<b>Create</b> Create several types of exams including multiple choice, constructed-response, audio, and fill in blank.	<b>Practice</b> Use created materials to practice before attending real exams to have the best performance.	<b>Share</b> Share your exam samples with your students, friends, etc.	<b>Keep track</b> Keep track of your practice results to plan and improve your performance day by day.
---	--	---	---

**Figure 4.5:** Home Page 2

**STUDYALL**

FEATURES    ABOUT    SERVICES    GALLERY    TEAM    CONTACT    SIGN IN



## ABOUT US

We are a team of two members coming from Ho Chi Minh City University of Technology. This web application is a part of our Capstone Project, we hope to give the community a free tool/software to use and solve their problems, especially in revising lessons and preparing for their important examinations.

### Why Choose Us?

✓ Reliable	✓ Diverse
✓ Convenient	✓ User-friendly
✓ Fast	✓ Versatile

**Figure 4.6:** Home Page 3

## GALLERY

One product, unlimited solutions.

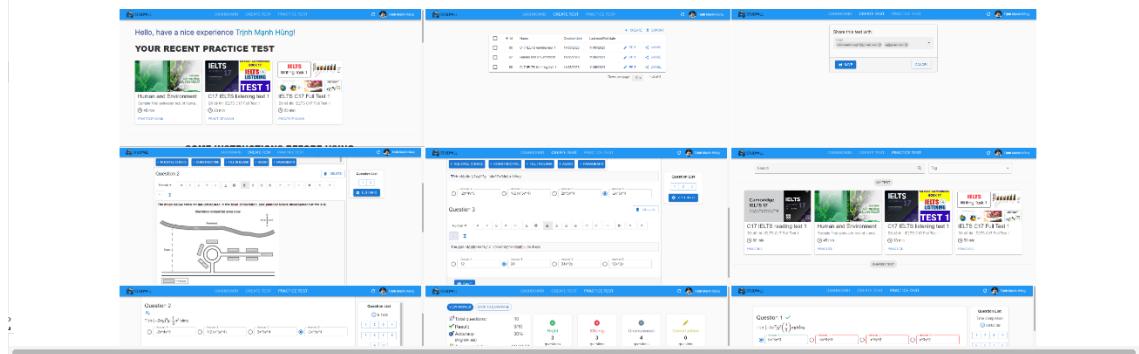


Figure 4.7: Home Page 4

## MEET THE TEAM

We are a team of 2 students from Ho Chi Minh City University of Technology.

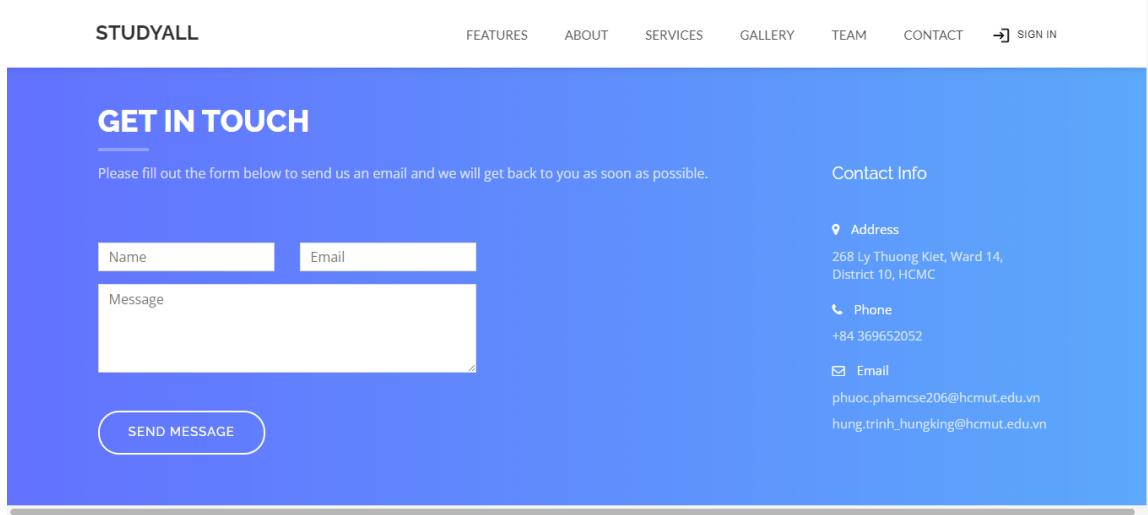


Pham Tan Phuoc  
Project Owner



Trinh Manh Hung  
Director

Figure 4.8: Home Page 5



**Figure 4.9:** Home Page 6

### Login and Signup page

Users can click on the “SIGN IN” button on the header to access login and register page.

The login page as in Figure 4.10 allows users who have already registered an account with the site to log in, access their account information, and reach our website’s features by using their email and password.

The signup page as in Figure 4.11, on the other hand, allows new users to create an account and gain access to personalized features and content. On this page, we require users to fill in their account information including their names, emails, passwords, and their profile pictures which will then be used for identity authentication on the login page.

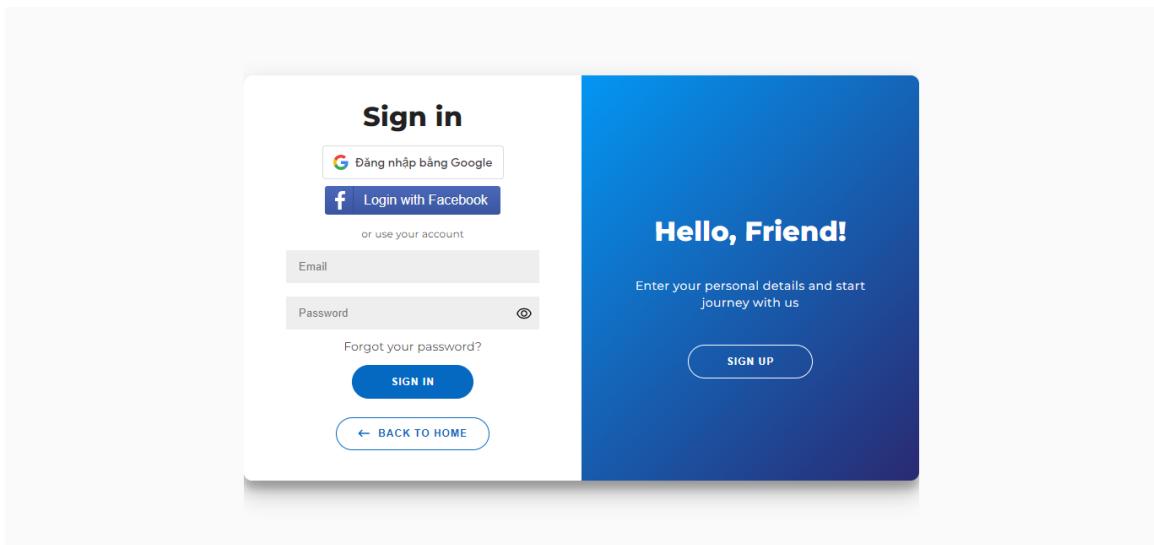


Figure 4.10: Login Page

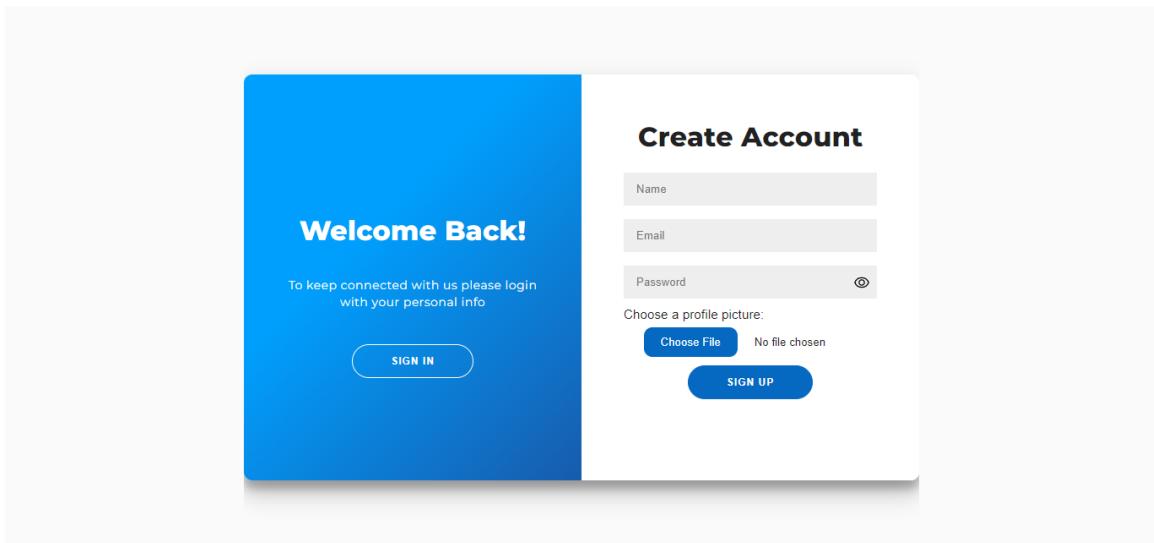


Figure 4.11: Sign Up Page

## Dashboard

In our dashboard page, users will view a list of their recent practice tests which allows users to redo these tests with just one click.

The screenshot shows the StudyAll dashboard with a blue header bar. On the left is the logo 'STUDYALL'. In the center are three navigation links: 'DASHBOARD', 'CREATE TEST', and 'PRACTICE TEST'. On the right is a user profile icon with the name 'Trịnh Mạnh Hùng'.

The main content area has a white background. At the top, it says 'Hello, have a nice experience Trịnh Mạnh Hùng!'. Below that is a section titled 'YOUR RECENT PRACTICE TEST' in bold black capital letters.

There are three cards displayed:

- Human and Environment**: Shows a thumbnail of a green leafy plant. Below it: 'Sample final semester test of huma...', '⌚ 45 min', and a 'PRACTICE AGAIN' button.
- IELTS Academic 17**: Shows a thumbnail of an IELTS book cover. Below it: 'C17 IELTS listening test 1', 'Bộ đề thi: IELTS C17 Full Test 1', '⌚ 20 min', and a 'PRACTICE AGAIN' button.
- IELTS Writing Task 1**: Shows a thumbnail of an IELTS book cover. Below it: 'IELTS C17 Full Test 1', 'Bộ đề thi: IELTS C17 Full Test 1', '⌚ 50 min', and a 'PRACTICE AGAIN' button.

---

**SOME INSTRUCTIONS BEFORE USING**

Figure 4.12: Dashboard Page 1

Besides, since some users may not be familiar with AsciiMath, we also introduce some instructions on this page to help them take some first steps before using our website.

The screenshot shows the Studyall dashboard with a blue header bar. In the top right corner, there is a user profile icon for 'Trịnh Mạnh Hùng'. Below the header, there are three buttons: 'DASHBOARD', 'CREATE TEST', and 'PRACTICE TEST'. Underneath these buttons, there are two grey rectangular buttons labeled 'PRACTICE AGAIN'.

In the center of the page, there is a section titled 'SOME INSTRUCTIONS BEFORE USING' in bold capital letters. Below this title, the text 'Math insertion feature' is written in blue. A sub-section titled 'AsciiMath' follows, with the text: 'For math insertion feature, we used AsciiMath which is an easy-to-write markup language for mathematics.' There are two bullet points below this:

- ✓ Check AsciiMath here: [AsciiMath](#)
- ✓ Take a look at Preview before inserting to have correct formulas!

To the right of this text, there is a modal window titled 'Formula' containing the mathematical expression  $\sum_{i=1}^n i^3 = \frac{n(n+1)}{2}$ . Below the formula, there is a 'Preview:' label and a rendered preview of the formula. At the bottom of the modal are 'CANCEL' and 'INSERT' buttons.

**Figure 4.13:** Dashboard Page 2

### Create test page

After clicking the “CREATE TEST” button, users can access a collection of tests they have created.

The screenshot shows the 'CREATE TEST' page of the Studyall application. The top navigation bar includes 'DASHBOARD', 'CREATE TEST' (which is the active tab), and 'PRACTICE TEST'. On the far right, there is a user profile icon for 'Trịnh Mạnh Hùng'.

The main content area features a table with a header row containing columns for 'Id', 'Name', 'Created date', and 'Last modified date'. Below the header, there are four data rows:

Id	Name	Created date	Last modified date	Actions
66	C17 IELTS reading test 1	11/05/2023	11/05/2023	<a href="#">EDIT</a> <a href="#">SHARE</a>
67	Human and Environment	11/05/2023	11/05/2023	<a href="#">EDIT</a> <a href="#">SHARE</a>
68	C17 IELTS listening test 1	11/05/2023	11/05/2023	<a href="#">EDIT</a> <a href="#">SHARE</a>

At the top right of the table, there are 'CREATE' and 'EXPORT' buttons. Below the table, there is a 'Rows per page:' dropdown set to '5' and a page number indicator '1-3 of 3'.

**Figure 4.14:** Test Created Management Page

Users can delete a created test as shown in the Figures 4.15 and 4.16.

The screenshot shows a table with the following data:

<input type="checkbox"/>	↑ Id	Name	Created date	Last modified date	<input type="button" value="EDIT"/>	<input type="button" value="SHARE"/>
<input type="checkbox"/>	66	C17 IELTS reading test 1	11/05/2023	11/05/2023	<input type="button" value="EDIT"/>	<input type="button" value="SHARE"/>
<input type="checkbox"/>	67	Human and Environment	11/05/2023	11/05/2023	<input type="button" value="EDIT"/>	<input type="button" value="SHARE"/>
<input type="checkbox"/>	68	C17 IELTS listening test 1	11/05/2023	11/05/2023	<input type="button" value="EDIT"/>	<input type="button" value="SHARE"/>
<input checked="" type="checkbox"/>	69	C17 IELTS writing test 1	11/05/2023	11/05/2023	<input type="button" value="EDIT"/>	<input type="button" value="SHARE"/>
<input type="checkbox"/>	70	IELTS C17 Full Test 1	11/05/2023	11/05/2023	<input type="button" value="EDIT"/>	<input type="button" value="SHARE"/>

Rows per page: 5 1-5 of 5

**Figure 4.15:** Delete A Created Test 1

The screenshot shows a table with the following data:

<input type="checkbox"/>	↑ Id	Name	Created date	Last modified date	<input type="button" value="EDIT"/>	<input type="button" value="SHARE"/>
<input type="checkbox"/>	66	C17 IELTS reading test 1	11/05/2023	11/05/2023	<input type="button" value="EDIT"/>	<input type="button" value="SHARE"/>
<input type="checkbox"/>	67	Human and Environment	11/05/2023	11/05/2023	<input type="button" value="EDIT"/>	<input type="button" value="SHARE"/>
<input type="checkbox"/>	68	C17 IELTS listening test 1	11/05/2023	11/05/2023	<input type="button" value="EDIT"/>	<input type="button" value="SHARE"/>
<input type="checkbox"/>	70	IELTS C17 Full Test 1	11/05/2023	11/05/2023	<input type="button" value="EDIT"/>	<input type="button" value="SHARE"/>

Rows per page: 5 1-4 of 4

Element deleted UNDO

**Figure 4.16:** Delete A Created Test 2

On create test page, users are allowed to create their own test by filling in a test information form. With the information provided in the form, a test will be initialized and users can take various actions with this new test.

The screenshot shows the 'CREATE TEST' section of the STUDYALL platform. At the top, there are navigation links: DASHBOARD, CREATE TEST (which is active), and PRACTICE TEST. On the right, there's a user profile icon and the name 'Trịnh Mạnh Hùng'. The main form fields include:

- Name \***: IELTS C17 Writing test 1
- Choose a profile picture:** A placeholder text 'Drop a picture to upload, or click to select one' with a file input field.
- Set duration?**: A toggle switch is turned on, and the input field shows '60 minutes'. A note below says 'Time is between 1 and 999'.
- Is public?**: A toggle switch is turned on.
- Tag \***: IELTS, English
- Description \***: Bố đề thi: IELTS C17 test 1

A blue 'SAVE' button is located at the bottom left of the form.

**Figure 4.17:** Create New Test Page

Users can insert different types of questions into the test including multiple-choice questions, constructive questions, and fill-in-blank questions. After editing the test, users can save those changes. The Figures 4.18 and 4.19 demonstrate creating sample IELTS writing test.

**Figure 4.18:** Create Sample IELTS Writing 1

**Figure 4.19:** Create Sample IELTS Writing 2

In addition, the Figures 4.20 and 4.21 illustrates creating sample math test.

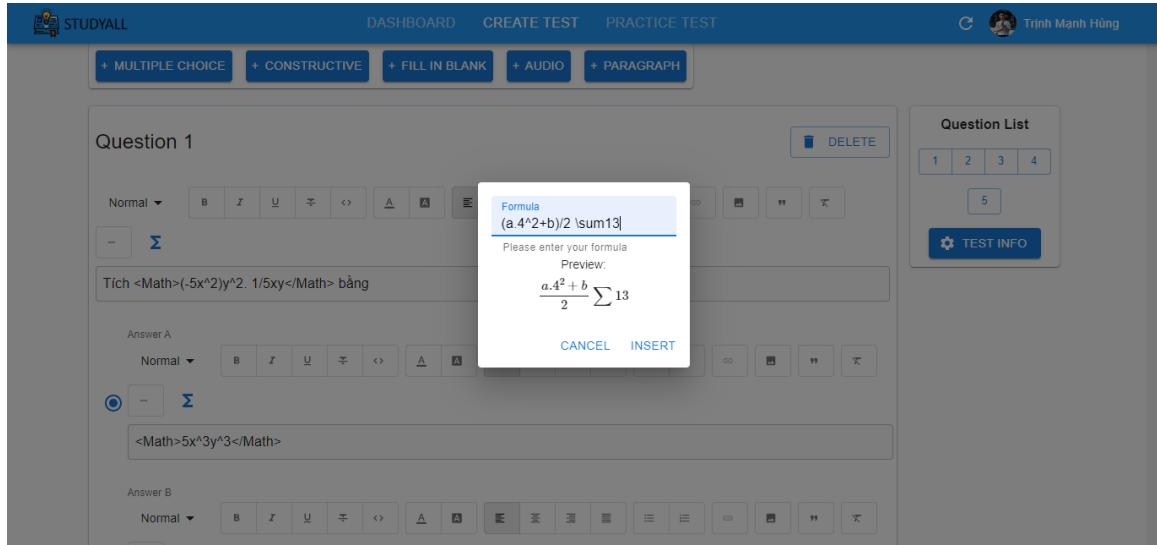


Figure 4.20: Create Sample Math Test 1

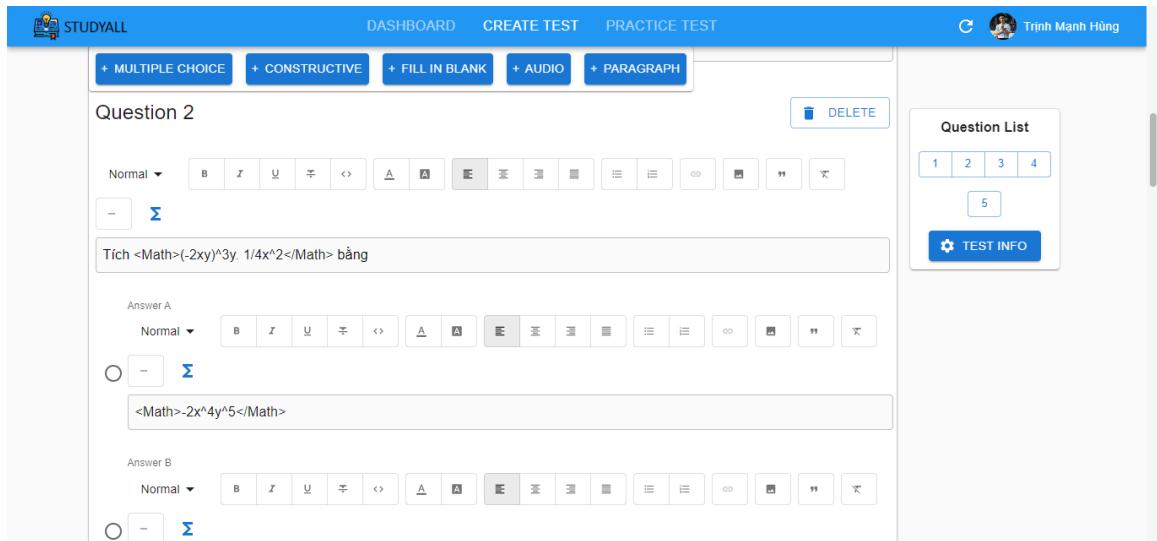


Figure 4.21: Create Sample Math Test 2

While editing a test, users can also edit its information including name, picture, duration, public status, and description as in Figure 4.22.

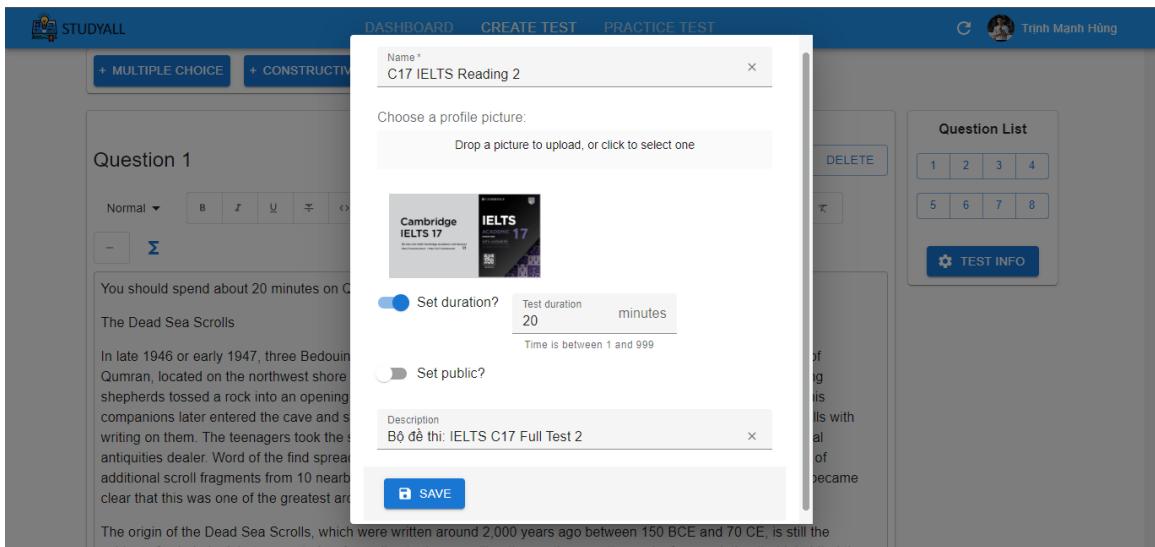
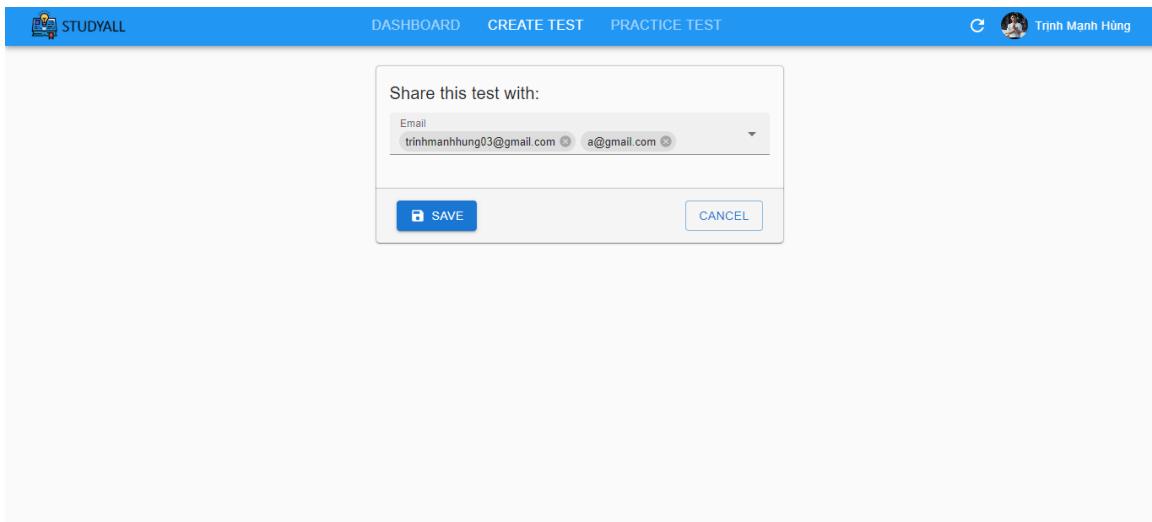


Figure 4.22: Edit Test Information

Also, a created test can be shared to other users in our application via email as in Figure 4.23.



**Figure 4.23:** Share Test Page

## Practice test page

On the practice test page, users will first see a collection of created and shared tests with which they are allowed to practice as in Figure 4.24.

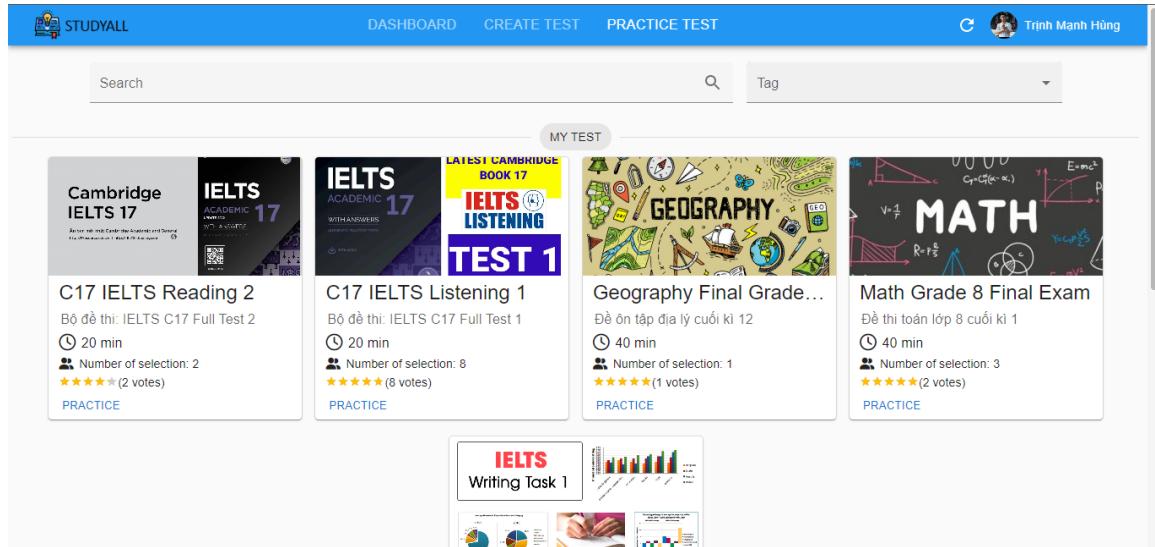


Figure 4.24: Test Pool Page

Users can use the search bar or the filter to reach their desired test by test categories or by test name like in Figures 4.25 and 4.26.

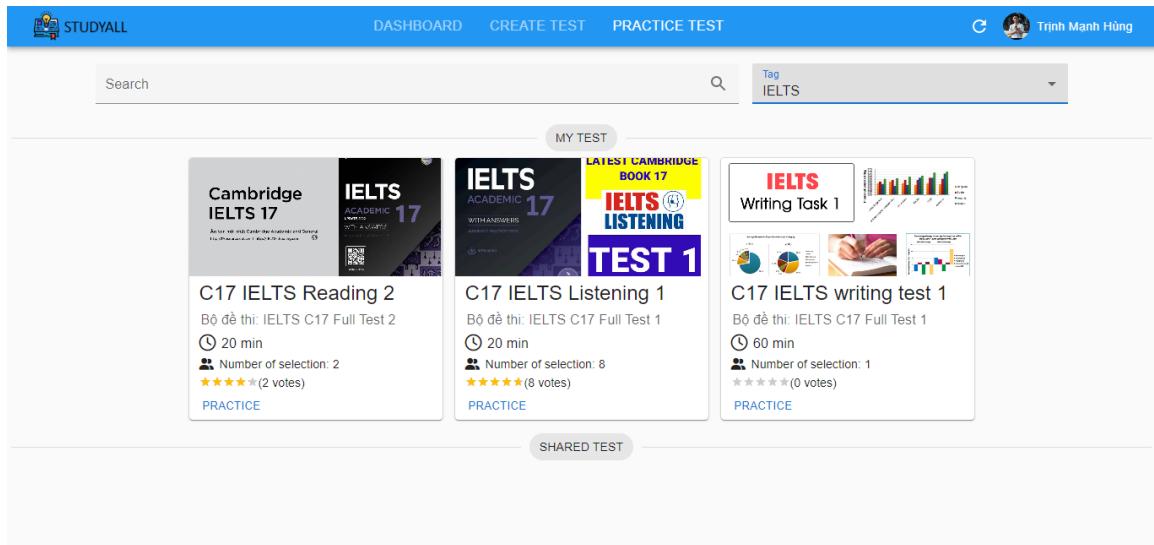


Figure 4.25: Filter Test By Tag

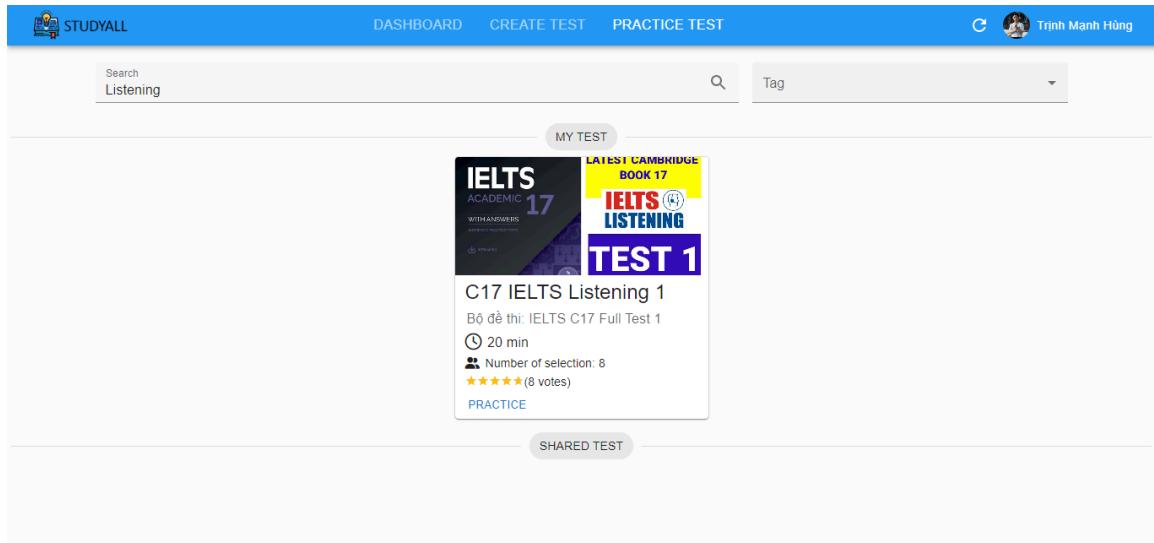


Figure 4.26: Filter Test By Name

After clicking on the Practice button, the users will start to do the test. While doing the test, the users can take notes and create a to-do list which are great features that we have added to our website for a better user experience. The Figures 4.27 and 4.28 shows practice test page of sample humans and environments exam. The Figures 4.29 and 4.30 is about mathematics test. The Figures 4.31 and 4.32 illustrates sample IELTS listening test. Lastly, the Figure 4.33 demonstrates IELTS writing test.

The screenshot shows the STUDYALL platform's practice test feature. At the top, there's a blue header with the logo, navigation links (Dashboard, Create Test, Practice Test), and a user profile for 'Trịnh Mạnh Hùng'. The main content area is divided into sections:

- Question 1:** A question about the economy structure of the human economy. It lists four options:
  - Answer A:** hunting->gathering-> agriculture-> grazing-> industry-> post-industry (selected)
  - Answer B:** gathering->hunting->grazing->agriculture->post-industry->post-industry
  - Answer C:** gathering-> hunting-> grazing-> agriculture-> industry-> post-industry
  - Answer D:** gathering-> hunting-> agriculture-> grazing-> industry-> post-industry
- Question 2:** A question about the theory of population. It lists two options:
  - Answer A:** Malthus's theory (selected)
  - Answer B:** Demographic transition theory

To the right, there's a sidebar with a 'Question List' showing a timer at 00:04:53 and numbered boxes for 1 through 10. Below that is a 'Todo List' section with a note input field and a plus sign icon.

**Figure 4.27:** Practice Test Humans And Environment 1

**STUDYALL**

DASHBOARD CREATE TEST PRACTICE TEST

Trịnh Mạnh Hùng

What's the role of Ozone layer on atmosphere?

Answer A: Atmosphere to a height of 50 km

Answer B: All atmosphere

Answer C: Only warm ocean

Answer D: Lithosphere thickness of 2-3 km from the ground

**Question 6**

The temperature of the troposphere 1 ..... with the increasing altitude. And the height of the troposphere at the equator is 2 ..... that at the poles.

1 Answer rises

2 Answer located

**Question List**  
 00:03:31

1	2	3	4
5	6	7	8
9	10		

**SUBMIT**

**Todo List**

Note

- câu 1
- câu 2 A

Figure 4.28: Practice Test Humans And Environment 2

**STUDYALL**

DASHBOARD CREATE TEST PRACTICE TEST

Trịnh Mạnh Hùng

**Question 1**

Tích  $(-5x^2)y^2 \cdot \frac{1}{5}xy$  bằng

Answer A:  $5x^3y^3$

Answer B:  $-5x^3y^3$

Answer C:  $-x^3y^3$

Answer D:  $x^3y^2$

**Question 2**

Tích  $(-2xy)^3 \cdot y \cdot \frac{1}{4}x^2$  bằng

Answer A:  $-2x^4y^5$

**Question List**  
 00:39:41

1	2	3	4
5			

**SUBMIT**

**Todo List**

Note

Figure 4.29: Practice Test Math 1

STUDYALL

DASHBOARD CREATE TEST PRACTICE TEST

Trịnh Mạnh Hùng

**Question 5**

Note here Note something

Kết quả của phép tính  $(ax^2 + bx - c) \cdot 2a^2x$  bằng

Answer A:  $2a^4x^3 + 2a^2bx^2 - 2a^2cx$

Answer B:  $2a^3x^3 + bx - c$

Answer C:  $2a^4x^2 + 2a^2bx^2 - a^2cx$

Answer D:  $2a^3x^9 + 2a^2bx^2 - 2a^2cx$

Question List  
00:38:31  
1 2 3 4 5  
SUBMIT

Todo List  
Note

Figure 4.30: Practice Test Math 2

STUDYALL

DASHBOARD CREATE TEST PRACTICE TEST

Trịnh Mạnh Hùng

II 2:44 / 6:46

**Question 1**

Complete the notes below.  
Write ONE WORD AND/OR A NUMBER for each answer.

**Buckworth Conservation Group**

**Regular activities**

Beach

- making sure the beach does not have 1 ..... on it
- no 2 .....

Nature reserve

- maintaining paths
- nesting boxes for birds installed
- next task is taking action to attract 3 ..... to the place
- identifying types of 4 .....

Question List  
0:16:58  
1 2 3 4  
5 6 7 8  
SUBMIT

Todo List  
Note

Figure 4.31: Practice Test IELTS Listening 1

**Question 6**

**Questions 15 and 16**

Choose **TWO** letters, **A-E**.

Which **TWO** features of the lighthouse does Lou mention?

A why it was built  
B who built it  
C how long it took to build  
D who staffed it  
E what it was built with

1 .....  
2 .....

1 Answer C  
2 Answer D

**Question List**  
0:16.23  
1 2 3 4  
5 6 7 8  
SUBMIT

**Todo List**  
Note +

Figure 4.32: Practice Test IELTS Listening 2

**Question 2**

It is important for people to take risks, in both their professional lives and personal lives.

Do the advantages of taking these risks outweigh the disadvantages?

Answer  
Normal ▾ B Z ፩ ቤ <> ስ ስ ስ ስ ስ ስ ስ ስ ስ ስ ስ

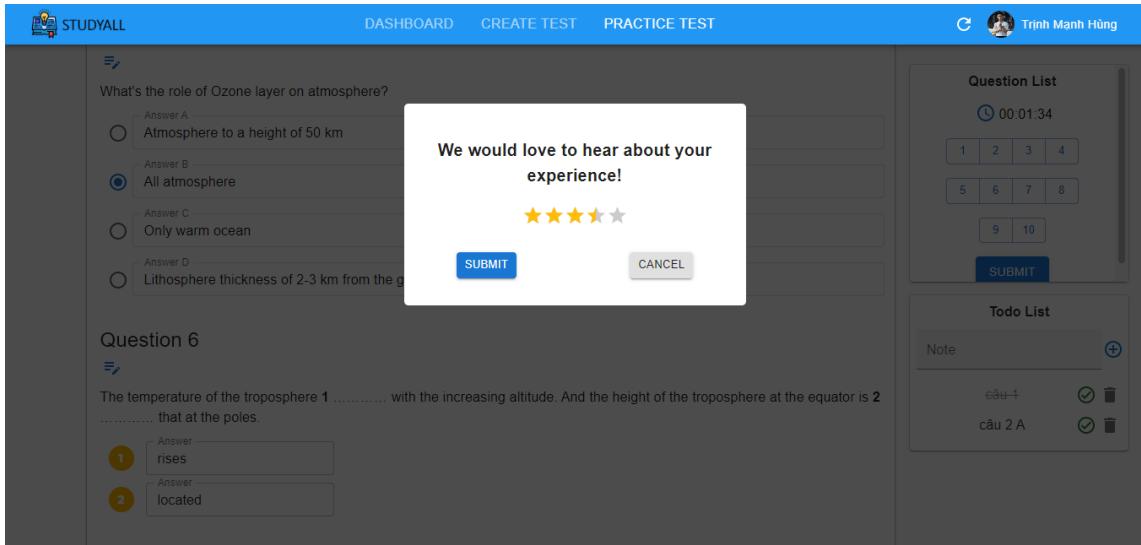
Some would argue that taking risks, both in terms of one's private life and one's working career, is advantageous overall. I am generally in agreement with this contention due to the potential for advancement and growth. Firstly, risk-taking can expedite one's career goals. Many workers decide early on that they are content with their position in society and therefore often fail to actualize their potential. Others, however, attempt various business enterprises and transition from field to field in order to find a good match. Although this may lead to short-term setbacks, in the long-term such ambitious individuals are far more likely to become very successful in life. Assuming that these risks are taken early in one's career, there is a strong likelihood that they will eventually profit the risk-taker in question. Moreover, an individual who takes risks will also develop more mature personal relationships. In more conservative countries, many young people do not begin to have serious romantic relationships until after university. The result of this is that they are often immature and it can lead to poor and naive choices in terms of marriage and parenting. In contrast, a person who takes risks in their personal life and enters into various relationships throughout high school and university will become a better judge of character. Their allegedly risky behavior can then serve as the foundation for personal growth and increased maturity. In conclusion, taking risks can be a catalyst for tremendous growth and is therefore advisable. The disadvantages of risk-taking can also be mitigated in most contexts by

**Question List**  
0:05:24  
1 2  
SUBMIT

**Todo List**  
Note +

Figure 4.33: Practice Test IELTS Writing

After completing the test or time-out, a pop up will display to ask user to rate the test as in Figure 4.34. The answers are submitted to the system and the result will be calculated automatically by the system. The users will then be redirected to the result page to view their results. The Figures 4.35, 4.36, 4.37, and 4.38 show overall results of different subjects.



**Figure 4.34:** Rate The Test User Have Practiced

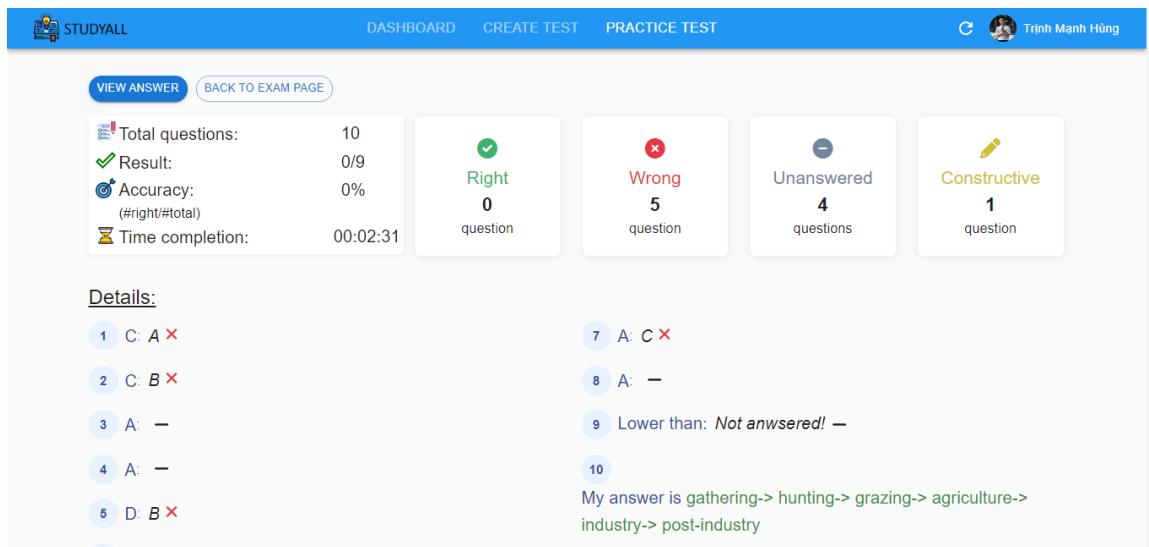


Figure 4.35: View Test Result Humans And Environment

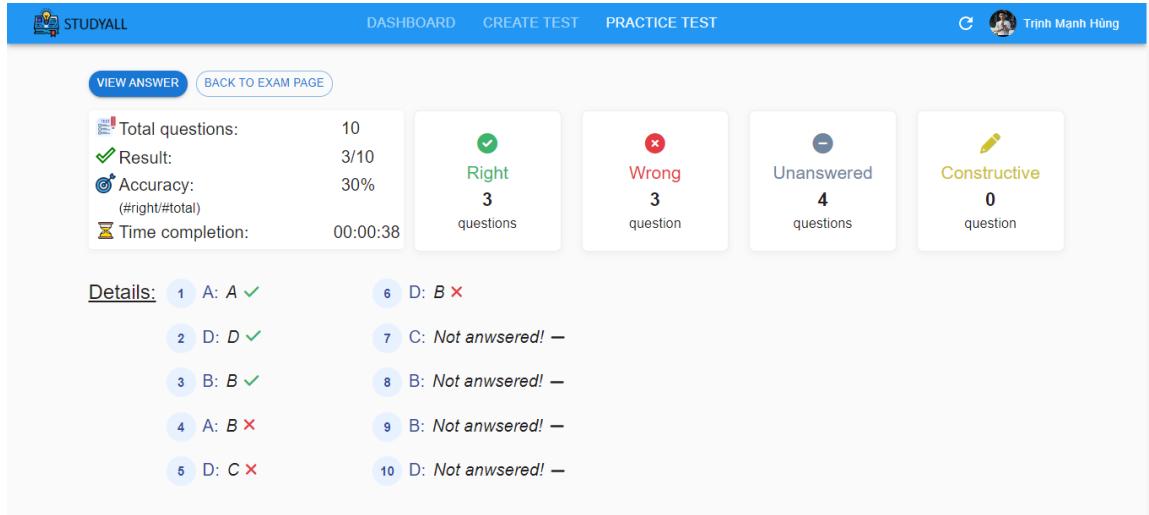


Figure 4.36: View Test Result Math

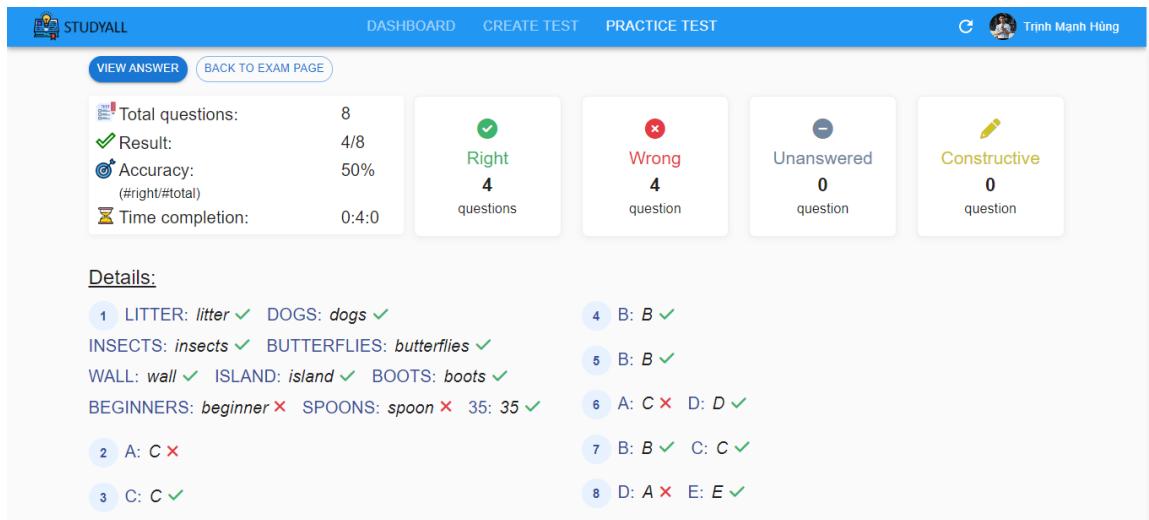


Figure 4.37: View Test Result IELTS Listening

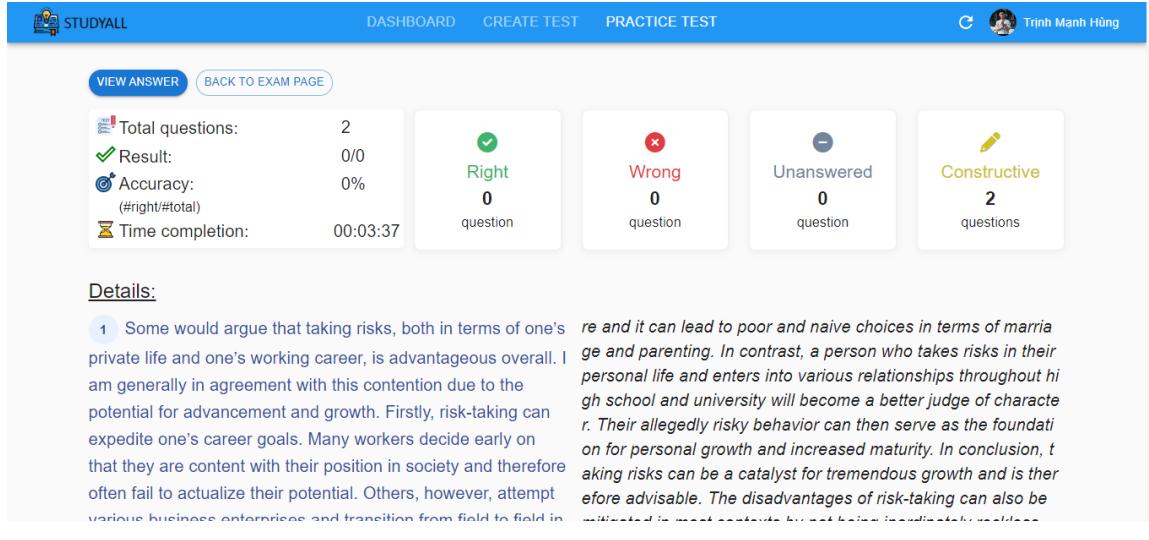


Figure 4.38: View Test Result IELTS Writing

It is also possible to view the solutions by clicking on “View answer” button. The Figures 4.39, 4.40, 4.41, 4.42, 4.43, 4.44, illustrate the test result specific of different subjects.

**Question 1 ✗**  
What is the economic structure of the human economy?  
 Answer A: hunting->gathering-> agriculture-> grazing-> industry-> post-industry  
 Answer B: gathering->hunting->grazing->agriculture->post-industry->post-industry  
 Answer C: gathering-> hunting-> grazing-> agriculture-> industry-> post-industry  
 Answer D: gathering-> hunting-> agriculture-> grazing-> industry-> post-industry

**Question 2 ✗**  
What is not theory of population?  
 Answer A: Malthus's theory  
 Answer B: Demographic transition theory  
 Answer C: Lenin's theory

**Figure 4.39:** View Test Result Specific Humans And Environment

**Question 2 —**  
Tích  $(-2xy)^3 \cdot y \cdot \frac{1}{4}x^2$  bằng  
 Answer A:  $-2x^4y^5$   
 Answer B:  $\frac{1}{2}(x^5y^4)$   
 Answer C:  $2x^5y^4$   
 Answer D:  $-2x^5y^4$

**Question 3 ✓**  
Thu gọn  $6x^4y^2 : \left(\frac{1}{2}x^2y\right)^2$ , ta được  $24x^2y$   
 Answer A: 12  
 Answer B: 24  
 Answer C:  $24x^2y$

**Figure 4.40:** View Test Result Specific Math 1

Question 5 ×

Kết quả của phép tính  $(ax^2 + bx - c) \cdot 2a^2x$  bằng

Answer A  $2a^4x^3 + 2a^2bx^2 - 2a^2cx$

Answer B  $2a^3x^3 + bx - c$

Answer C  $2a^4x^2 + 2a^2bx^2 - a^2cx$

Answer D  $2a^3x^2 + 2a^2bx^2 - 2a^2cx$

**Figure 4.41:** View Test Result Specific Math 2

Question	Answer	Status
5	Answer: BUTTERFLIES wall	✓
6	Answer: WALL island	✓
7	Answer: ISLAND boots	✓
8	Answer: BOOTS beginner	✗
9	Answer: BEGINNERS spoon	✗
10	Answer: SPOONS 35	✓
	Answer: 35	

**Figure 4.42:** View Test Result Specific IELTS Listening

**Question 1**

It is important for people to take risks, in both their professional lives and personal lives.

Do the advantages of taking these risks outweigh the disadvantages?

User Answer

Some would argue that taking risks, both in terms of one's private life and one's working career, is advantageous overall. I am generally in agreement with this contention due to the potential for advancement and growth.

Firstly, risk-taking can expedite one's career goals. Many workers decide early on that they are content with their position in society and therefore often fail to actualize their potential. Others, however, attempt various business enterprises and transition from field to field in order to find a good match. Although this may lead to short-term setbacks, in the long-term such ambitious individuals are far more likely to become very successful in life. Assuming that these risks are taken early in one's career, there is a strong likelihood that they will eventually profit the risk-taker in question.

Moreover, an individual who takes risks will also develop more mature personal relationships. In more conservative countries, many young people do not begin to have serious romantic relationships until after university. The result of this is that they are often immature and it can lead to poor and naive choices in terms of marriage and parenting. In contrast, a person who takes risks in their personal life and enters into various relationships throughout high school and university will become a better judge of character. Their allegedly risky behavior can then serve as the foundation for personal growth and increased maturity.

Question List  
Time completion  
🕒 00:03:37  
1 2

**Figure 4.43:** View Test Result Specific IELTS Writing 1

In the far north of the map, houses are planned to be built on farmland. A road in front of it leads to a bridge that crosses over a river. This bridge leads to a road, with housing to the west. The new road meets a ring road currently located in the centre of the zone. It is proposed to remove all the factories around the ring-road.

Turning to developments in the southern section of the map, branching off the ring-road westwards is a new road with housing constructed along it. Another road branches to the east of the ring road with new housing and a playground, and a school at the end of the road. All factories will be removed from this road. Finally, branching off the ring-road towards the south the current road will have shops on the west and a medical complex on the east, and the road will lead to a new roundabout that replaces the current T-intersection.

Answer: Two illustrations are provided showing the manufacturing quarter of a town called Norbiton at present and the future layout. Overall, this area will be completely transformed into a residential area. At present, the area is located east of the town with a river running from the west to the east in the north, north of which is farmland. In the middle, there is a roundabout with two exits, one of which links to a main road in the south and the other is oriented towards the east, and some factories are scattered on both sides of it as well as around the roundabout. In the future, two new exits will be added to the roundabout. One heading northwest and the other north, which will cross a newly added bridge allowing access to new housing, leaving only the countryside in the northeast. A small roundabout will be constructed on the main road, linking to the large roundabout. The factories will be replaced with housing and facilities such as shops and a medical centre. A school will be built in the east with a new park located nearby.

BACK

Question List  
Time completion  
🕒 00:03:37  
1 2

**Figure 4.44:** View Test Result Specific IELTS Writing 2

## Personal profile page

On the personal profile page, the personal exam results will be displayed to the users so they can easily keep track of their study performance.

The screenshot shows the user profile page for 'Trịnh Mạnh Hùng'. At the top, there is a navigation bar with 'STUDYALL' logo, 'DASHBOARD', 'CREATE TEST', 'PRACTICE TEST', and a user icon 'Trịnh Mạnh Hùng'. Below the navigation bar is a decorative banner featuring a person in a dynamic pose against a dark, fantastical background with mythical creatures like a dragon. The user's name 'Trịnh Mạnh Hùng' is displayed prominently below the banner. A table follows, showing two exam entries:

Name	Date	Score	Time taken	Action
IELTS C17 Full Test 1	05/11/2023 11:01:44	0	01:00:37	<a href="#">VIEW</a>
C17 IELTS listening test 1	05/11/2023 10:44:42	4	00:04:00	<a href="#">VIEW</a>

Figure 4.45: User Profile Page

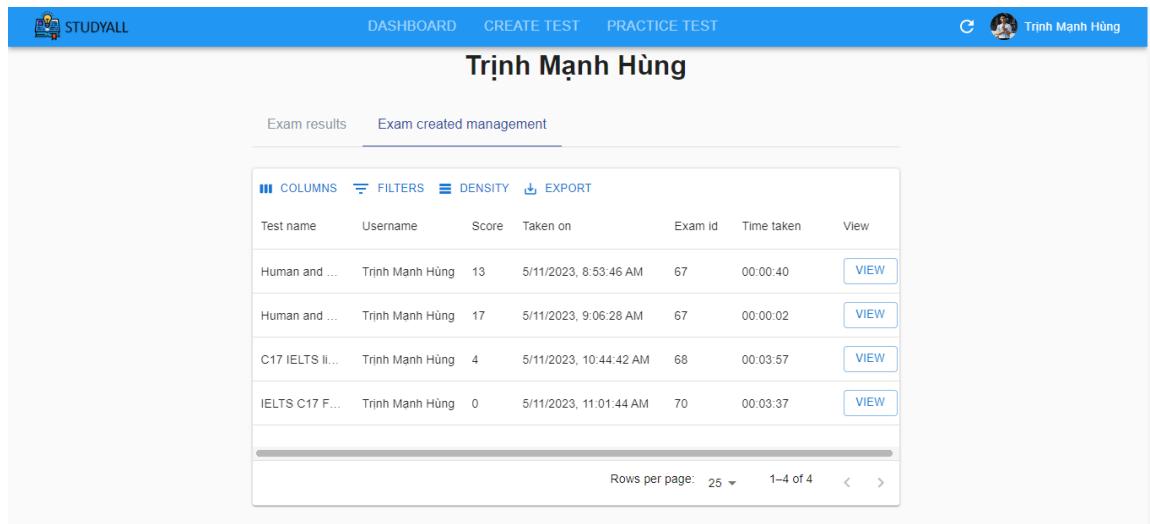
The screenshot shows the 'Test Results Management' page for the same user. The interface is similar to Figure 4.45, with the 'Exam results' tab selected. The table displays four distinct exam entries:

Name	Date	Score	Time taken	Action
IELTS C17 Full Test 1	05/11/2023 11:01:44	0	00:03:37	<a href="#">VIEW</a>
C17 IELTS listening test 1	05/11/2023 10:44:42	4	00:03:57	<a href="#">VIEW</a>
Human and Environment	05/11/2023 09:06:28	17	00:00:02	<a href="#">VIEW</a>
Human and Environment	05/11/2023 08:53:46	13	00:00:40	<a href="#">VIEW</a>

At the bottom of the table, there are pagination controls: 'Rows per page: 5', '1–4 of 4', and navigation arrows. A checkbox for 'Dense padding' is also visible.

Figure 4.46: User's Test Results Management Page

Besides, the users are allowed to manage the activities of other users who have done their created tests through the table of exam-created management.



The screenshot shows a user interface for managing created tests. At the top, there is a navigation bar with 'STUDYALL' logo, 'DASHBOARD', 'CREATE TEST', 'PRACTICE TEST', and a user profile 'Trịnh Mạnh Hùng'. Below the navigation bar, the title 'Trịnh Mạnh Hùng' is displayed. Underneath, there are two tabs: 'Exam results' and 'Exam created management', with 'Exam created management' being the active tab. A table follows, with columns: 'Test name', 'Username', 'Score', 'Taken on', 'Exam id', 'Time taken', and 'View'. The table contains four rows of data. At the bottom of the table, there are pagination controls: 'Rows per page: 25', '1–4 of 4', and navigation arrows.

Test name	Username	Score	Taken on	Exam id	Time taken	View
Human and ...	Trịnh Mạnh Hùng	13	5/11/2023, 8:53:46 AM	67	00:00:40	<button>VIEW</button>
Human and ...	Trịnh Mạnh Hùng	17	5/11/2023, 9:06:28 AM	67	00:00:02	<button>VIEW</button>
C17 IELTS li...	Trịnh Mạnh Hùng	4	5/11/2023, 10:44:42 AM	68	00:03:57	<button>VIEW</button>
IELTS C17 F...	Trịnh Mạnh Hùng	0	5/11/2023, 11:01:44 AM	70	00:03:37	<button>VIEW</button>

**Figure 4.47:** User's Created Test Management Page

The users are also able to update their personal information including their full name, avatar, banner image as in Figure 4.48 and 4.49. Or users can change their password as in Figure 4.50 in just a few minutes using this page.

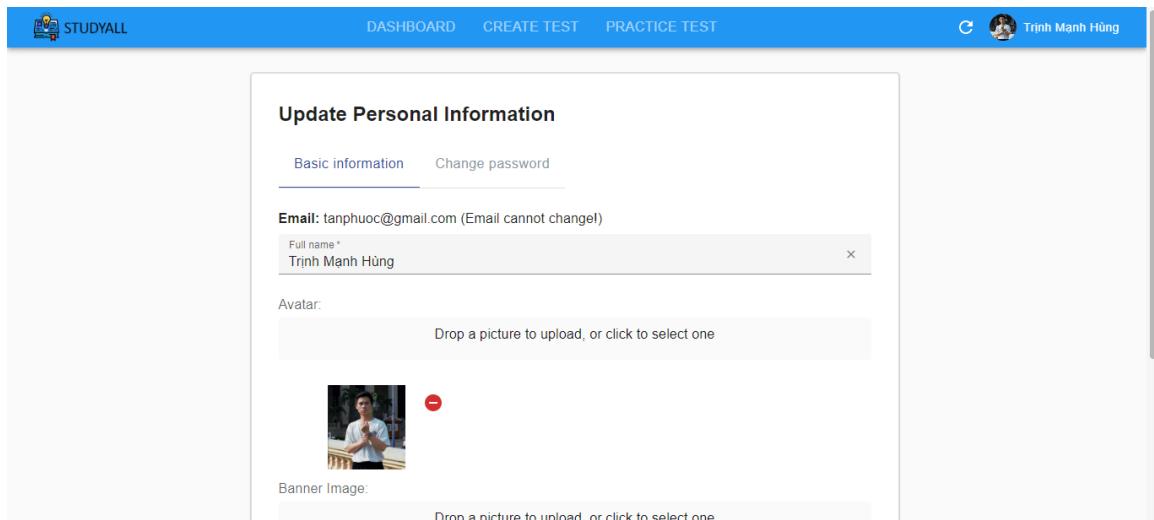


Figure 4.48: Update User Information Page 1

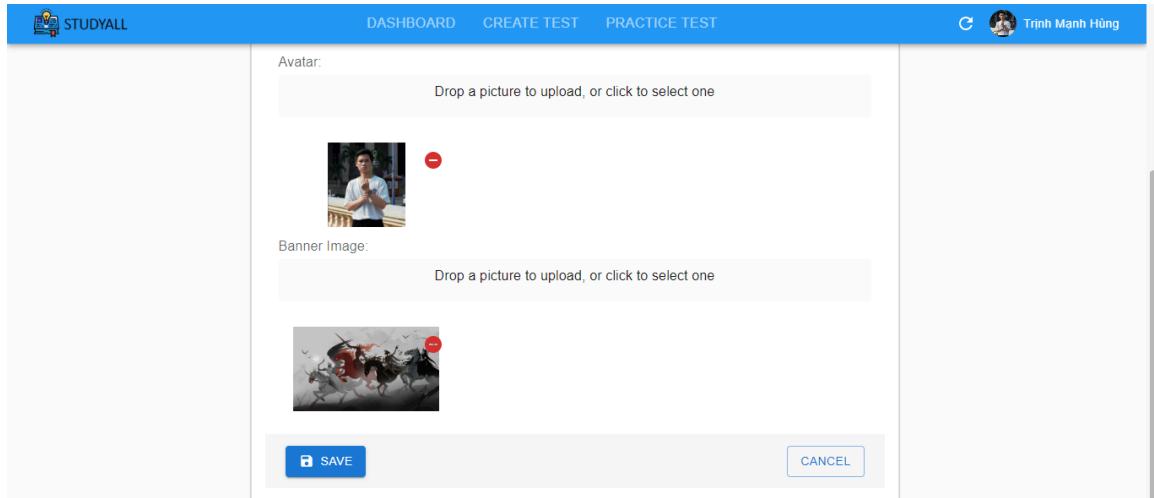
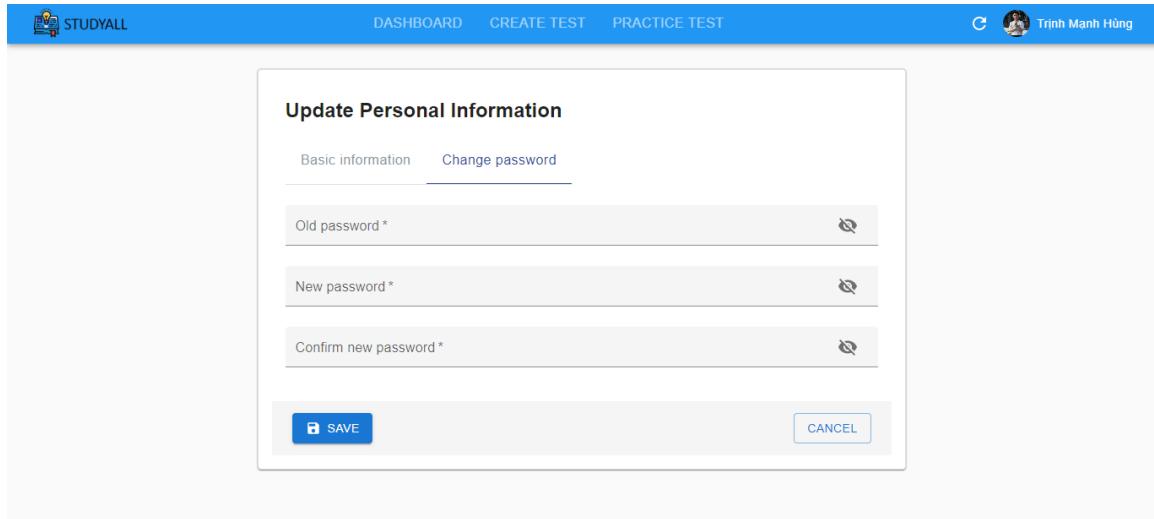


Figure 4.49: Update User Information Page 2



**Figure 4.50:** Change Password Page

## 4.2 Deployment

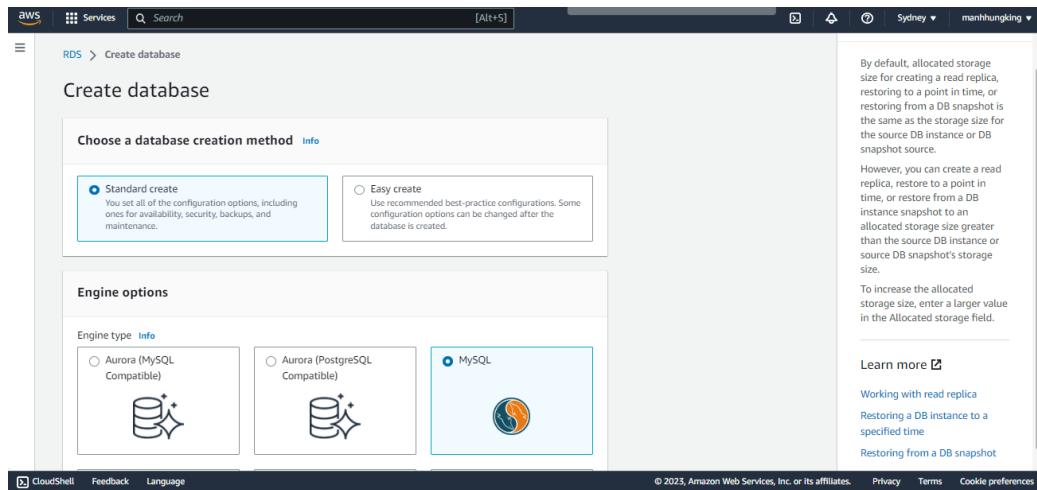
### 4.2.1 Setting environment for database

In order to set up the environment for database using Amazon Web Services RDS (Relational Database Service). Firstly, we need to create an RDS instance in the AWS Management Console. The RDS instance is a managed database service that allows us to create, operate, and scale a relational database in the cloud with ease.

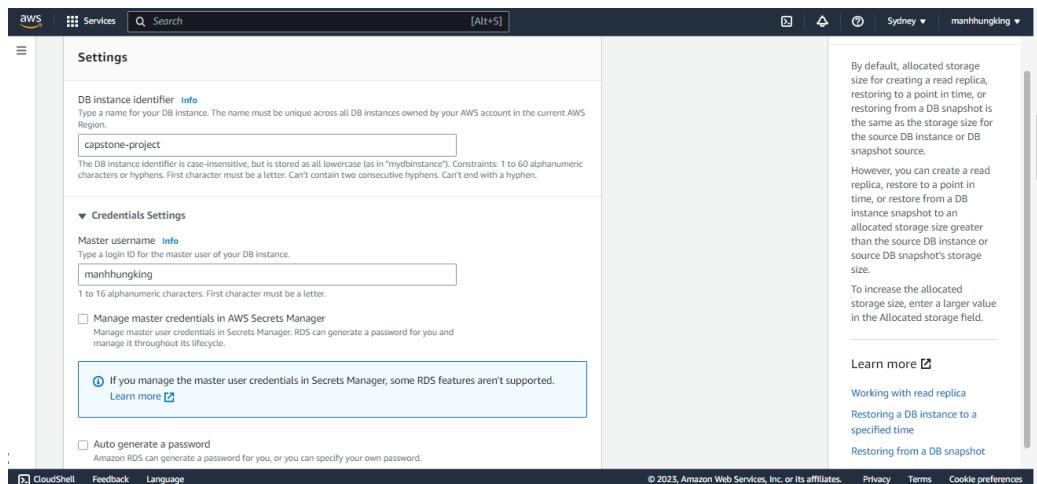
To create an RDS instance, we need to select the database engine and for our project is MySQL like in the Figure 4.58

Then we specify the instance type and storage, set up the database username and password, and configure the security group rules to control the incoming and outgoing traffic to the instance as in Figure 4.52, 4.53.

After all the steps above, the RDS instance connection is up and running as depicted in Figure 4.54, we can start integrating the database with the application.



**Figure 4.51:** Choosing deployment method



**Figure 4.52:** Launch an instance

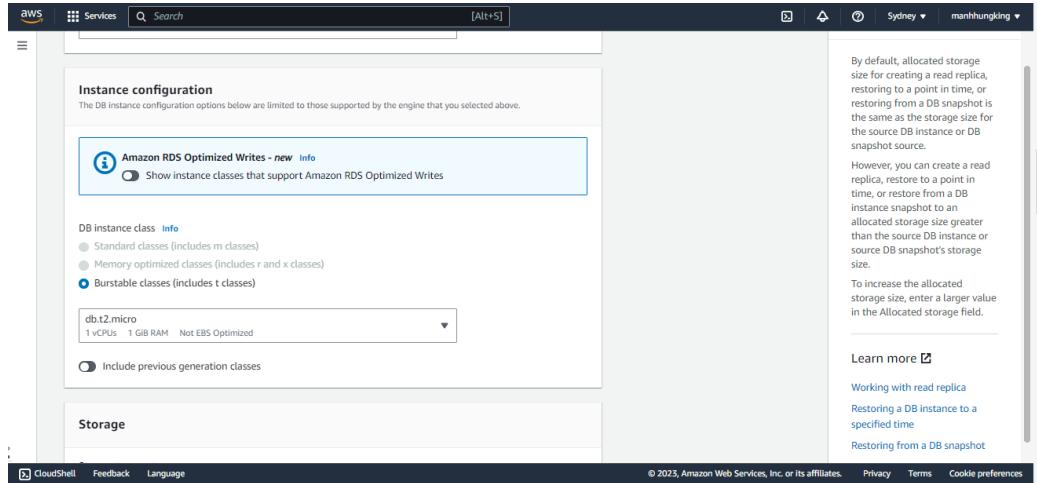


Figure 4.53: Configure the instance

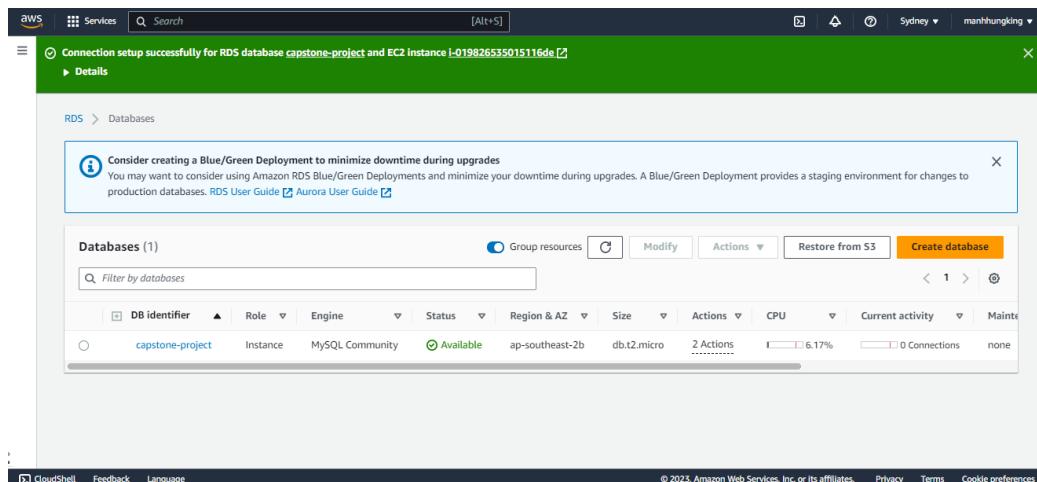


Figure 4.54: Setup the instance successfully

## 4.2.2 Buying domain name studyall.link

For our project, our team has opted to use the domain **.link**. Since **.link** is a generic top-level domain (TLD) managed by Verisign - a global provider of domain name registry services located in America, it is ideal for creating social media or professional networking websites or any other website that gathers people who share similar interests in one place.

Our group buy the domain named **studyall.link** via Amazon Route 53 - a highly scalable Domain Name System (DNS) web service. Firstly, we check if that domain is ready for buying and add it to cart like in Figure 4.55.

The screenshot shows the AWS Route 53 Domain Search interface. The search bar at the top contains 'studyall'. Below the search bar, there is a 'Check' button. To the right of the search bar, there is a dropdown menu showing 'link - \$5.00'. On the left, there are three steps: '1: Domain Search', '2: Contact Details', and '3: Verify & Purchase'. The main area displays the availability of 'studyall.link'. A table shows the following information:

Domain Name	Status	Price / 1 Year	Action
studyall.link	Available - In Cart	\$5.00	Add to cart

Below this, there is a section for 'Related domain suggestions' with another table:

Domain Name	Status	Price / 1 Year	Action
leitsall.com	Available	\$13.00	Add to cart
studentsall.net	Available	\$11.00	Add to cart
studiesall.link	Available	\$5.00	Add to cart
studiesall.net	Available	\$11.00	Add to cart
studyall.ninja	Available	\$18.00	Add to cart

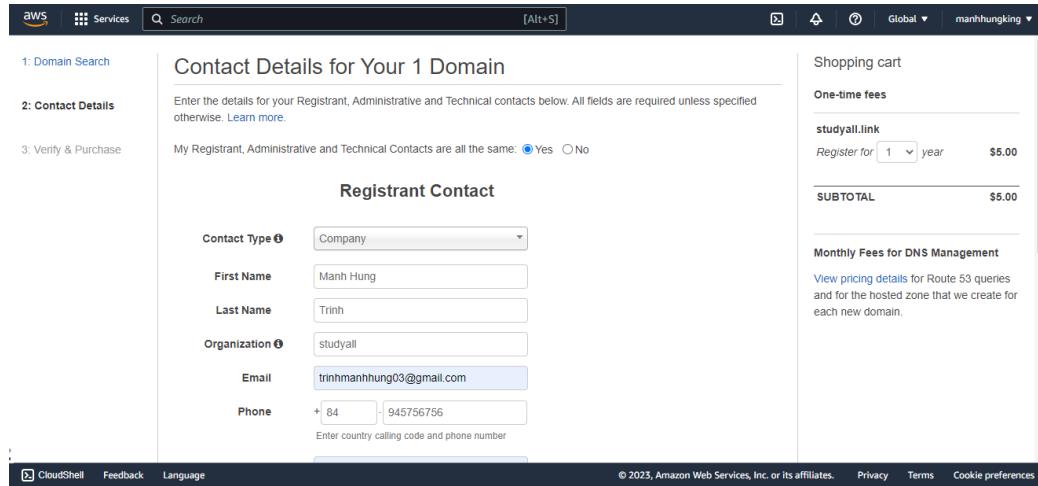
To the right, there is a 'Shopping cart' summary:

One-time fees
studyall.link Register for 1 year \$5.00
SUBTOTAL \$5.00

Below the shopping cart, there is a note about 'Monthly Fees for DNS Management' and a link to 'View pricing details for Route 53 queries and for the hosted zone that we create for each new domain.'

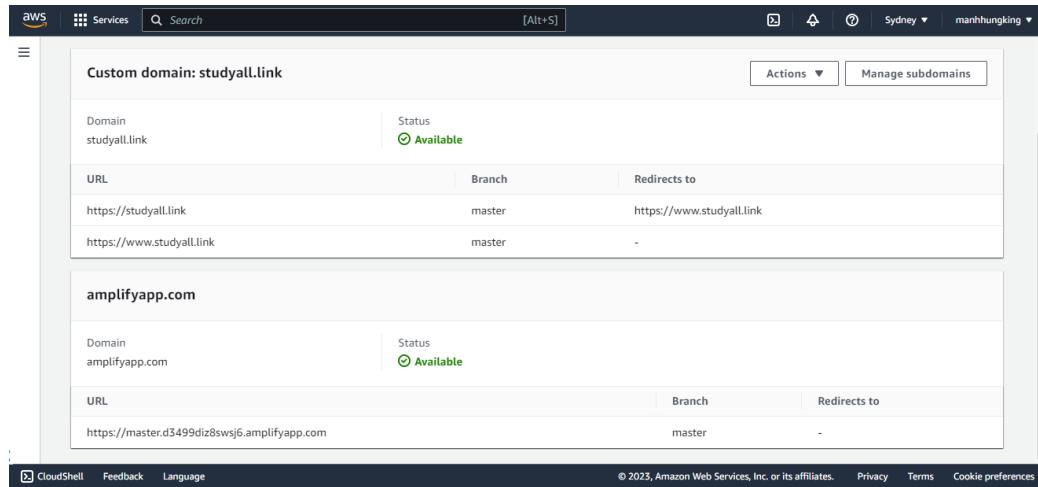
Figure 4.55: Search for domain name

Then we custom that domain name contact details to give our users a more tailored and professional experience while ensuring that everyone who requires our organization's information can simply access it, you can have a look at Figure 4.9.



**Figure 4.56:** Setting contact details for domain name

After waiting for verifying and purchasing as in Figure 4.57, we have already configed the domain name and it is ready to use in the latter step of deployment.



**Figure 4.57:** Config the domain name successfully

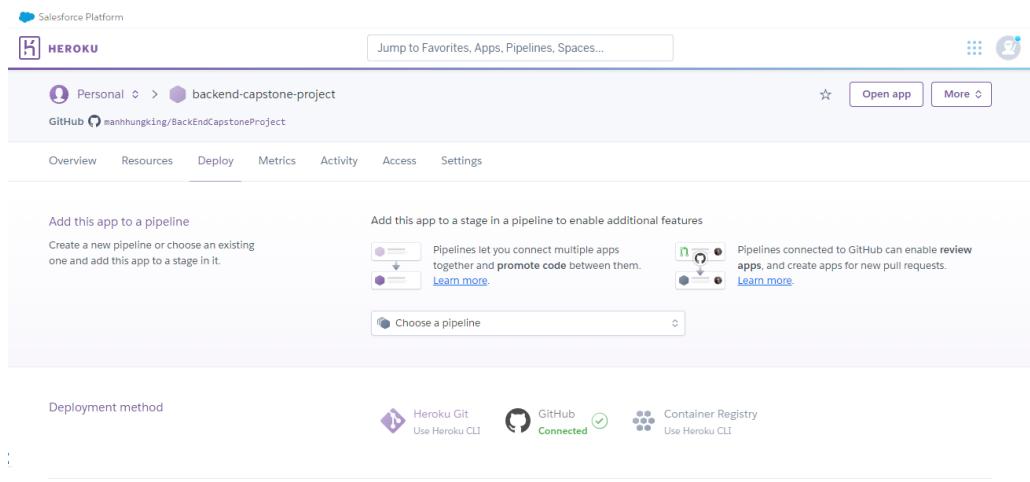
### 4.2.3 Deploying backend

For backend deployment, we have utilized Heroku because Heroku is a container-based cloud Platform as a Service (PaaS) – one of the most popular services that allow developers to deploy, manage and scale modern apps. Heroku supports all major programming languages. We can develop your apps in Java, Ruby, Scala, Node.js, Clojure, Python, PHP and Go and deploy them to Heroku.

And in the case of python programming language and framework Django, Heroku has some significant advantages such as:

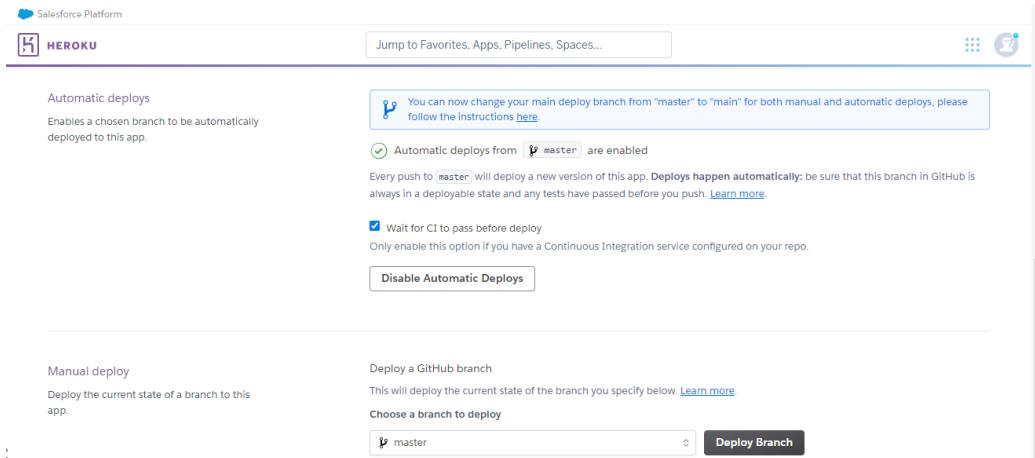
- Easy setup - as a PaaS, programmer don't need to know how to install and configure Apache, nginx, unicorn, passenger, MySQL, Postgres, etc.
- Easier to scale initially - spin up more dynos, size up DBs, etc.
- Great plugin support for third party apps

After creating new app in Heroku, we choose the deployment method for this app is GitHub as shown in the Figure 4.58.

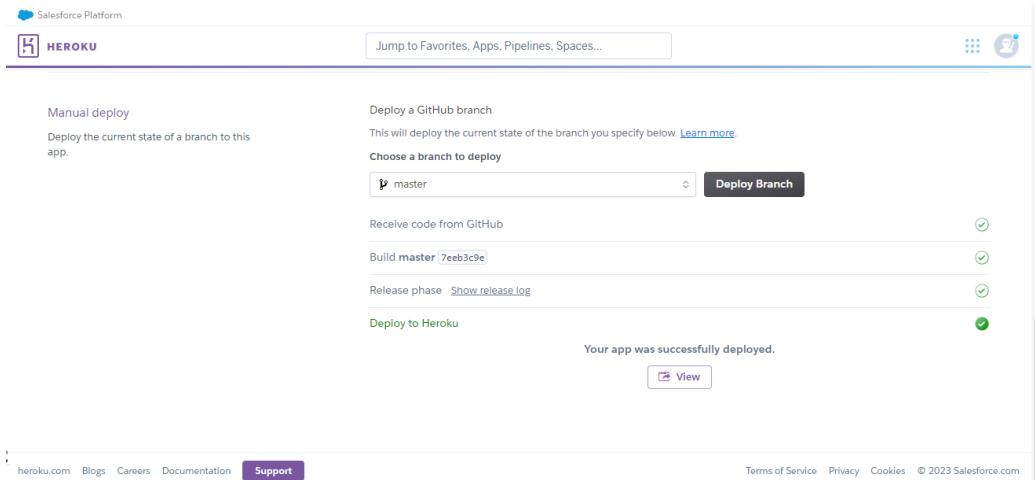


**Figure 4.58:** Choosing deployment method

Then we set automatically deploy whenever there are any new update in our git branch master demonstrated by Figure 4.59, then we have result as shown in Figure 4.60.



**Figure 4.59:** Setting our branch master to be automatically deployed to this app.



**Figure 4.60:** Deploy backend sucessfully

#### 4.2.4 Deploying frontend

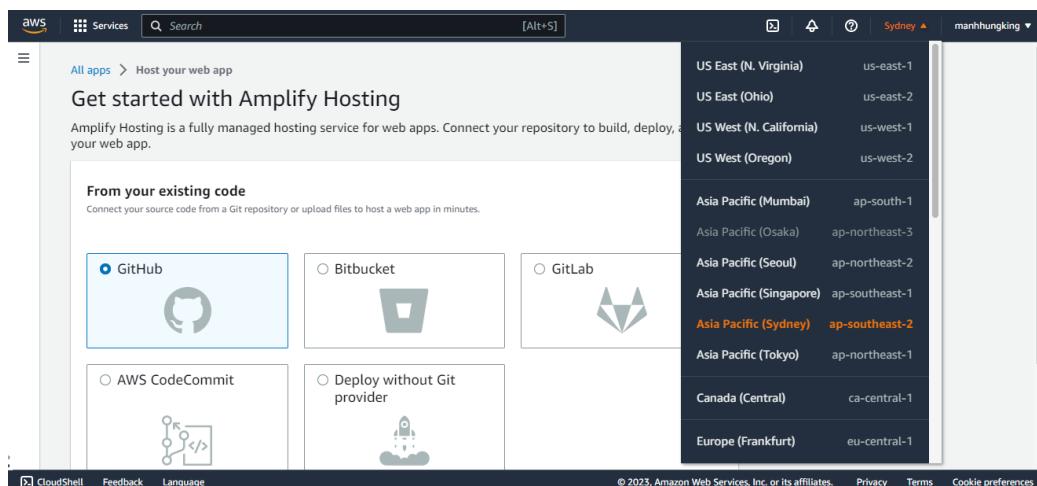
The final step in website deployment is deploying frontend. For our project, we choose Amazon Web Services (AWS) Amplify[34]. AWS is a full-stack platform made to let developers of websites and mobile apps create scalable, full-stack applications that are

hosted by AWS. The platform comes with a wide range of tools and services that let customers quickly create backends, connect apps, instantaneously deploy static web sites, and manage content outside of the AWS dashboard. AWS Amplify is one of the many excellent services offered by Amazon Web Services that is growing popularity and has significantly sped up and simplified developer tasks.

Some advantages of AWS Amplify are:

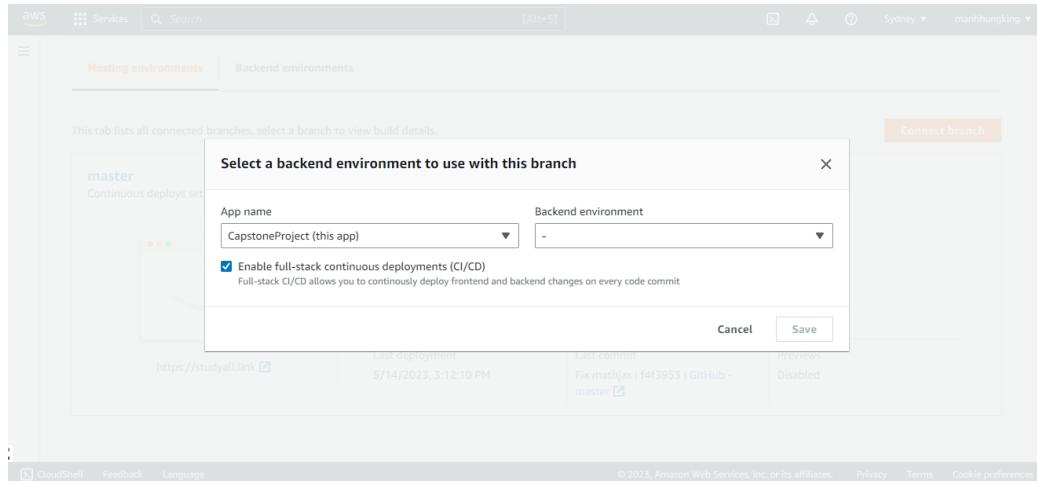
- Free to start
- Easy deployment and UI driven
- Backend support
- Web-Based analytics
- Usage-based payment

Now, we will start deploying our frontend by choosing the region of AWS Amplify and connect to our repository via GitHub.



**Figure 4.61:** Choosing region AWS Amplify and using GitHub

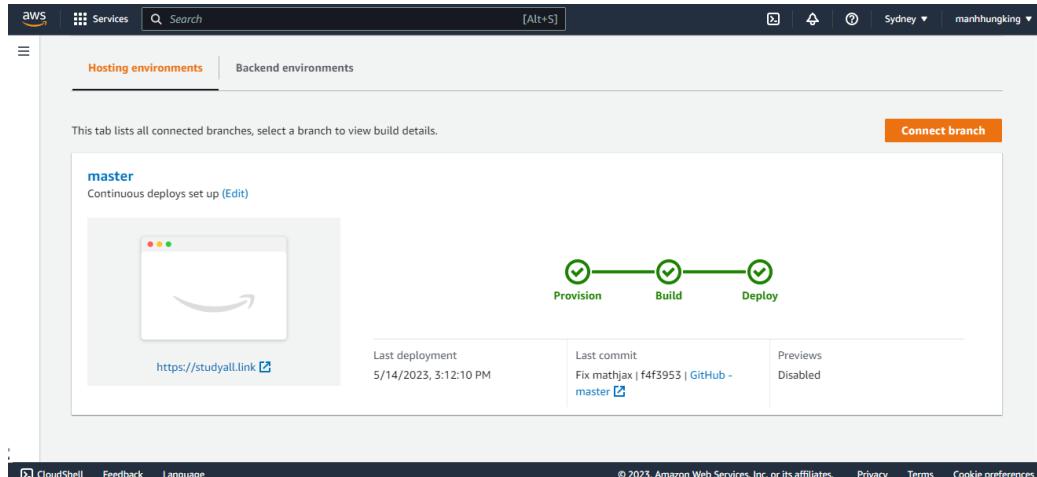
Then we enable auto deploy so that whenever new code is committed to the repository, it automatically and manually deploys to the production environment.



**Figure 4.62:** Enable using GitHub

This avoids wasting time and effort and guarantees that users may always access the most recent modifications immediately.

We have now completed the deployment of Frontend, and users may now access it by going to the proper URL as shown in Figure 4.63 that we have bought before. However, it's crucial to carry out some post-deployment procedures in the next section to make sure the application is operational and prepared for use in production before we can declare the deployment to be complete.



**Figure 4.63:** Finish deploying frontend

## 4.3 System testing

System testing is a critical part of the software development life cycle (SDLC), as it helps to identify defects or errors in the system that could impact its functionality, reliability, or security. Therefore, to ensure that our system is working correctly and meeting the specified requirements before it is released to users, we have built a table of test scenarios that contain different use-case scenarios for testing main workflows of our website.

Upon review of the below table, we have every reason to believe that our system has successfully fulfilled the majority of our proposed requirements and achieved the ultimate goal of our project. Nevertheless, given the limited time and resources available, we were unable to fully complete all functional and non-functional requirements during implementation. Having said that, we remain committed to fulfilling these necessary requirements in the near future in order to further enhance and refine our product.

ID	Name	Test case description	Precondition	Step name	Step description	Expected Result	Result
<b>[Homepage]</b>							
TC-001-001	Send a message	User fills all fields in the message form to send a message to StudyAll	None	Step 1	User rolls to the end of home page	An email with the message is sent to StudyAll and a notification of success is displayed to the user	Passed
				Step 2	User sees the message form where he/she can fill in to send message to StudyAll		
				Step 3	User fills all fields in the message form including name, email, and message		
				Step 4	User clicks on "Send message" button		
TC-001-002	Send a message	User fills all fields except email in the message form to send a message to StudyAll	None	Step 1	User rolls to the end of home page	A remind of "Please fill out this field" is displayed to the user	Passed
				Step 2	User sees the message form where he/she can fill in to send message to StudyAll		
				Step 3	User only fills in the information of name, message, and lets the email empty		
				Step 4	User clicks on "Send message" button		
TC-002-001	Redirect to signin/signup page	User clicks on "Sign in" button to reach signin/signup page	None	Step 1	User clicks on "Sign in" button	User is redirected to the signin/signup page	Passed
<b>[Sign in page]</b>							
TC-003-001	Sign in	User fills all fields in the sign in form	User has registered an account	Step 1	User fills in email field and password field in the form	User successfully logins to our service	Passed
				Step 2	User clicks on "Sign in" button		
TC-003-002	Sign in	User only fills email field in the sign in form	User has registered an account	Step 1	User only fills email field in the form	A notification of invalid email or password is displayed to the user	Passed
				Step 2	User clicks on "Sign in" button		
TC-003-003	Sign in	User only fills password field in the sign in form	User has registered an account	Step 1	User only fills password field in the form	A notification of invalid email or password is displayed to the user	Passed
				Step 2	User clicks on "Sign in" button		
TC-003-004	Sign in	User signs in by google account	User has registered a google account	Step 1	User clicks on "Google account" button	User successfully logins to our service	Passed
				Step 2	User selects a google account		
<b>[Sign up page]</b>							
TC-004-001	Sign up	User fills all fields in the sign up form correctly	None	Step 1	User fills all fields in the sign up form correctly	User successfully registers an account and a notification of success is displayed to user	Passed
				Step 2	User clicks on "Sign up" button		
TC-004-002	Sign up	User fills in the sign up form and leaves one field empty	None	Step 1	User fills in the sign up form and leaves email field empty	A notification of "This input is required!" is displayed to the user	Passed
				Step 2	User clicks on "Sign up" button		
TC-004-003	Sign up	User fills all fields in the sign up form but password is not long enough	None	Step 1	User fills in the sign up form with a 7-character password	A notification of "At least minimum 8 characters!" is displayed to the user	Passed
				Step 2	User clicks on "Sign up" button		
<b>[Dashboard]</b>							
TC-005-001	Recent practice tests	System displays recent practice tests to the user	User has practiced at least one test	Step 1	User is viewing dashboard page	Recent practice tests are displayed to the user successfully	Passed
TC-005-002	Recent practice tests	User clicks on "Practice again" button on a recent practice test to redo the test	Recent practice tests are displayed to user	Step 1	User is viewing dashboard page	The user is driven to Practice page to redo the test	
<b>[Create test page]</b>							
TC-006-001	Create a new test	User fills all fields in the test information form to create a new test	User clicks on "Create test" button	Step 1	User clicks on "Create" button	The user successfully creates a new test with the information provided in the form	Passed
				Step 2	User fills all fields in the test information form		
				Step 3	User clicks on "Save" button		
TC-006-002	Create a new test	User fills in the test information form and leaves one mandatory field empty	User clicks on "Create test" button	Step 1	User clicks on "Create" button	A remind of "Please fill out this field" is displayed to the user	Passed
				Step 2	User fills in the test information form and leaves tag field empty		
				Step 3	User clicks on "Save" button		
TC-007-001	Insert contents in a created test	User inserts multiple choice questions in the created test	A test was created	Step 1	User clicks on "Edit" button	Two multiple choice questions are inserted to the test	Passed
				Step 2	User clicks on "+ Multiple choice" button twice		
				Step 3	User clicks on "Save" button		
TC-007-002	Insert contents in a created test	User inserts constructive questions in the created test	A test was created	Step 1	User clicks on "Edit" button	Two constructive questions are inserted to the test	Passed
				Step 2	User clicks on "+ Constructive" button twice		

TC-007-003	Insert contents in a created test	User inserts audios in the created test	A test was created	Step 1 User clicks on "Edit" button Step 2 User clicks on "+ Audio" button twice Step 3 User uploads two audios Step 4 User clicks on "Save" button	Two audios are inserted to the test	Passed
TC-007-004	Insert contents in a created test	User inserts audios in the created test but uploads videos	A test was created	Step 1 User clicks on "Edit" button Step 2 User clicks on "+ Audio" button Step 3 User uploads a video	The video cannot be uploaded	Passed
TC-007-005	Insert contents in a created test	User inserts fill-in-blank questions in the created test	A test was created	Step 1 User clicks on "Edit" button Step 2 User clicks on "+ Fill in blank" button twice Step 3 User clicks on "Save" button	Two fill-in-blank questions are inserted to the test	Passed
TC-007-006	Insert contents in a created test	User inserts paragraphs in the created test	A test was created	Step 1 User clicks on "Edit" button Step 2 User clicks on "+ Paragraph" button twice Step 3 User fills in the new paragraph forms Step 4 User clicks on "Save" button	Two paragraphs are inserted to the test	Passed
TC-008-001	Remove contents from the test	User removes an inserted multiple choice question from the test	A multiple choice question was inserted into the test	Step 1 User clicks on "Edit" button Step 2 User clicks on "Delete" button at the inserted multiple choice question Step 3 User clicks on "Save" button	The multiple choice question is removed from the test	Passed
TC-008-002	Remove contents from the test	User removes an inserted constructive question from the test	A constructive question was inserted into the test	Step 1 User clicks on "Edit" button Step 2 User clicks on "Delete" button at the inserted constructive question Step 3 User clicks on "Save" button	The constructive question is removed from the test	Passed
TC-008-003	Remove contents from the test	User removes an inserted audio from the test	An audio was inserted into the test	Step 1 User clicks on "Edit" button Step 2 User clicks on "Delete" button at the inserted audio Step 3 User clicks on "Save" button	The audio is removed from the test	Passed
TC-008-004	Remove contents from the test	User removes an inserted fill-in-blank question from the test	A fill-in-blank question was inserted into the test	Step 1 User clicks on "Edit" button Step 2 User clicks on "Delete" button at the inserted fill-in-blank question Step 3 User clicks on "Save" button	The fill-in-blank question is removed from the test	Passed
TC-008-005	Remove contents from the test	User removes an inserted paragraph from the test	A paragraph was inserted into the test	Step 1 User clicks on "Edit" button Step 2 User clicks on "Delete" button at the inserted paragraph Step 3 User clicks on "Save" button	The paragraph is removed from the test	Passed
TC-009-001	Edit test information	User updates test information	A test was created	Step 1 User clicks on "Edit" button Step 2 User clicks on "Test info" button Step 3 User fills new information in the test information form Step 4 User clicks on "Save" button	Test information is updated	Passed
<b>[Practice test page]</b>						
TC-0010-001	Tests for practicing	User's created tests are displayed for practicing	The user has created some tests	Step 1 User is viewing practice test page	User's created tests are displayed to the user	Passed
TC-0010-002	Tests for practicing	Tests shared to the user by other users are displayed for practicing	Other users have shared tests with the user	Step 1 User is viewing practice test page	Tests shared to the user by other users are displayed to the user	Passed
TC-0011-001	Search bar	User uses the search bar to search for the desired tests	Some tests are displayed to the user	Step 1 User types a part or whole keyword on the search bar	Tests which have their names related to the keyword are displayed successfully to the user	Passed
TC-0012-001	Filter by tags	User uses the filter to get the desired tests	Some tests are displayed to the user	Step 1 User selects their desired tags on the filter	Tests which are tagged as the tags selected by the user are displayed successfully to the user	Passed
TC-0013-001	Redirect to practice page	User clicks on "Practice" button to get to practice page	Some tests are displayed to the user	Step 1 User clicks on "Practice" button	The user is driven to Practice page to do the test	Passed
TC-0014-001	Practice a test	User practices a created/shared test and submits the answers	There are tests for the user to practice	Step 1 User clicks on "Practice" button of a test Step 2 User answers the questions in the test Step 3 User submits the answers by clicking on "Submit" button	The answers are submitted, the score is calculated automatically by the system, and the user is redirected to the result page to view his/her score	Passed

TC-0014-002	Practice a test	User practices a created/shared test and waits for time-out	There are tests which have been set limited time for the user to practice	Step 1 User clicks on "Practice" button of a test Step 2 User answers the questions in the test Step 3 User waits for time-out	The answers are submitted automatically when time-out, the score is calculated automatically by the system, and the user is redirected to the result page to view his/her score	Passed
TC-0015-001	Take notes when practicing	User takes notes when practicing a test	There are tests for the user to practice	Step 1 User clicks on "Practice" button of a test Step 2 User clicks on "Take note" button Step 3 User fills in the note	The user can take note in the text field for noting	Passed
TC-0016-001	Create a to-do list	User creates a to-do list while doing a test	There are tests for the user to practice	Step 1 User clicks on "Practice" button of a test Step 2 User fills in the "Note" text field Step 3 User clicks on "+" button	The note when the user fills in the "Note" text field is added into the to-do list	Passed
TC-0017-001	View test result	User submitted the answers and view the test result	User submitted the answers	Step 1 User is viewing the test result page	The test result including the number of right, wrong answers and the score is displayed to the user	Passed
TC-0018-001	View solutions	User submitted the answers and view the solutions of the test	User submitted the answers	Step 1 User is viewing the test result page Step 2 User clicks on "View answer" button	The user is redirected to the view solutions page and the solutions are displayed to the user	Passed
<b>[Personal profile page]</b>						
TC-0019-001	View exam results	The user views the exam results of the exams that he/she has done	User has practiced at least one test	Step 1 User is viewing the personal profile page	A table of the exam results of the exams that the user has done is displayed	Passed
TC-0019-002	View exam results	The user views the details of the exam results of the exams that he/she has done	User has practiced at least one test	Step 1 User is viewing the personal profile page Step 2 User clicks on "View" button of an exam result row	The user is driven to the test result page of the test	Passed
TC-0020-001	Manage created exams	The user views the results of other users who have done his/her created exams	Other users have practiced the tests shared by the user	Step 1 User is viewing the exam created management page	A table of the exam results of other users is displayed	Passed
TC-0020-002	Manage created exams	The user views the detailed results of other users who have done his/her created exams	Other users have practiced the tests shared by the user	Step 1 User is viewing the exam created management page Step 2 User clicks on "View" button of a row	The user is driven to the test result page of other users	Passed
TC-0021-001	Update personal info	The user updates his/her basic personal information	The user has logged in successfully	Step 1 User is viewing the personal profile page Step 2 User clicks on "Pen" button on the avatar Step 3 User clicks on "Basic information" button Step 4 User fills in the personal information form Step 5 User clicks on "Save" button	The personal information is updated successfully	Passed
TC-0021-002	Update personal info	The user updates his/her basic personal information but not give his/her new full name	The user has logged in successfully	Step 1 User is viewing the personal profile page Step 2 User clicks on "Pen" button on the avatar Step 3 User clicks on "Basic information" button Step 4 User fills in the personal information form except his/her full name Step 5 User clicks on "Save" button	A notification of "Please fill out this field" is displayed to the user	Passed
TC-0022-001	Update password	The user updates his/her password	The user has logged in successfully	Step 1 User is viewing the personal profile page Step 2 User clicks on "Pen" button on the avatar Step 3 User clicks on "Change password" button Step 4 User fills in the password form correctly Step 5 User clicks on "Save" button	The password is updated successfully	Passed
TC-0022-002	Update password	The user updates his/her password but confirms new password incorrectly	The user has logged in successfully	Step 1 User is viewing the personal profile page Step 2 User clicks on "Pen" button on the avatar Step 3 User clicks on "Change password" button	A notification of "Password mismatched" is displayed to the user	Passed

				Step 4   User fills in the password form but confirms new password incorrectly		
				Step 5   User clicks on "Save" button		
TC-0022-003	Update password	The user updates his/her password but the new password is the same as the old password	The user has logged in successfully	Step 1   User is viewing the personal profile page	A notification of "New password is the same as old password" is displayed	
				Step 2   User clicks on "Pen" button on the avatar		
				Step 3   User clicks on "Change password" button		
				Step 4   User fills in the password form but the new password is the same as the old password		
				Step 5   User clicks on "Save" button		

**Table 4.1:** Test case scenarios

# Chapter 5

## Project Evaluation

### 5.1 Feasibility evaluation

#### 5.1.1 Technological feasibility

In this project, we have opted to utilize popular technologies such as ReactJS and Django, which have gained significant attention due to their vast communities and extensive investment. By choosing these technologies, we are confident that our system will be able to meet the proposed functional and non-functional requirements. This decision also presents the added benefit of having access to a wide range of resources and support from both the user community and the development community, which can be particularly helpful in ensuring the longevity and scalability of our project.

##### Front-end

- ReactJS
- Material UI
- React-admin
- MathJax
- Tiptap

##### Back-end

- Django
- MySQL

## Deployment

- Amazon Web Services
- Heroku

The chosen technologies for our system are entirely fitting based on the proposed requirements. Additionally, since we plan to have some updates in the long run, selecting technologies that are maintained by prominent companies and boast large communities may offer benefits in expanding features in the future. With a strong backing of resources and support, these technologies have the potential to facilitate the seamless growth and development of our system over time. Furthermore, due to the fact that a number of our proposed features were not supported by any existing platforms, we were required to build our system from scratch. Despite the additional time and workload that this direction entailed, it provides us with greater flexibility and control over our product. In the future, this will allow us to easily expand and maintain our product as our needs evolve.

### 5.1.2 Economic feasibility

In terms of economic feasibility, our utilization of open-source technologies has greatly reduced the costs associated with development and maintenance. With the ability to easily replace these technologies with similar options, our project benefits from a significantly lower financial burden.

For system deployment, since we decided to use AWS (Amazon Web Services), we do not need to invest in costly hardware, data centers, or other physical infrastructure to host our application, which will drastically lower the costs related to physical infrastructure. With AWS, we are able to utilize the cloud-based infrastructure provided by AWS, which offers a range of computing resources, including virtual servers, storage, and databases, among others.

Reducing the requirement for specialized IT personnel and support is another way that AWS can cut expenses. By utilizing AWS services, we can leverage the expertise

of AWS engineers and technical staff, who manage and maintain the cloud infrastructure and handle routine tasks such as security updates, backups, and monitoring. By doing so, it may lessen the workload for our IT personnel and free up resources to work on other aspects of our product.

Finally, AWS provides a variety of price options that can help people and businesses save money. For instance, we can decide not to pay for resources that never get used and just pay for the services we actually need. Particularly in cases where our project may encounter varying demand for its services, this can lead to considerable cost reductions. AWS also offers a number of tools and services for cost optimization that may be used to optimize spending and lower total expenses.

## 5.2 Result evaluation

Our initial goal is to create a dynamic and user-friendly web application that enables individuals to create, edit, and share their own exam samples, which allows them to utilize these materials to prepare for upcoming exams. Our application will offer a diverse range of question types, providing users with greater flexibility in designing their test forms based on their individual preferences and requirements. To further assist users in their exam preparation, the product incorporates various helpful tools, such as a note-taking facility and keyword highlighting.

We have conducted system testing in pursuit of our goal and are confident that our system can meet the goal and the proposed requirements. The limited budget and time we had to work with, however, prevented us from completing all of the functional and non-functional needs throughout implementation as well as developing a wider variety of exam genres. Having said that, we are still dedicated to completing these important standards as soon as possible in order to improve and hone our product even more.

# Chapter 6

## Summary and Future Plan

*This chapter serves as a summary of our project, highlighting the lessons we have learned, the challenges we have faced, and our plans for future project development.*

### 6.1 Summary

#### 6.1.1 Summary of Results

For the Research and Design phase, we were able to gain the necessary technological knowledge for the project, which is the first step before we can fully implement the system. Following that, we also defined every requirement needed for our system and designed the system with use-case diagrams, activity diagrams, deployment diagram, and ERD.

With a clear vision in mind, in this Capstone Project, we have accomplished the successful implementation of the majority of our proposed features. Comprehensive system testing has been conducted to ensure our system can satisfy the requirements and achieve our goal of providing a comprehensive exam preparation tool for the community.

### **6.1.2 Opportunities during the process**

First of all, thanks to the advice of our instructors, we were able to prepare every necessary components for the Capstone Project as well as overcome the challenges during our work. Not only that, through bi-weekly meetings with Dr. Quan Thanh Tho, we could learned a lot of things from other teams, which really helped us in fixing our problems on time and improving our solutions.

Secondly, since we both have special interest with our topic, we always actively researched on necessary knowledge and tried to fix our problems as soon as possible. Having meetings every week, we were able to cooperate smoothly and know each other better day by day. The workload was shared equally between us based on the strengths and weaknesses of each person so all tasks were completed as planned.

### **6.1.3 Challenges during the process**

In the beginning, since each of us had our own work and different schedules, we found it difficult to effectively communicate and work with each other. Not only that, in the early stage, the ideas about our Capstone Project were still ambiguous and unclear, we also had some arguments on deciding the right direction to go. However, by openly talking and sharing our ideas with each other, we were on the right track in no time.

Moreover, since the number of features for our web application was huge for a team of two people, the workload was quite heavy. Therefore, it required us to share this workload reasonably and scheduled our private work smartly, which undoubtedly helped us to progress as planned.

## **6.2 Future plan**

### **Improve the user interface design for better usability**

Due to limited time and resources, it is currently difficult for us to put together the optimal user interface. Nevertheless, we recognize the significance of a contemporary and user-friendly interface and intend to prioritize its enhancement in the future. Our objective is to improve the user experience by incorporating aesthetically appealing and functional design elements.

Here are a few strategies we are going to apply to design an aesthetically appealing and functional user interface:

1. User-Centered Design: Understand your intended audience's needs, preferences, and behaviors first. Utilize the results of user research to inform your design decisions.
2. Visual Hierarchy: Utilize visual hierarchy to prioritize the most essential elements and create a well-organized user interface. This will make it simpler for users to navigate and locate the information they seek.
3. Consistency: Maintain consistency in your design elements, including color, typography, and layout. This will help users comprehend how to interact with your interface and instill a sense of comfort.
4. Simplification: Simplify the interface by eliminating superfluous elements and information. This will reduce cognitive burden and make it simpler for users to concentrate on the most important elements.
5. Accessibility: Ensure that your interface is accessible to disabled users. This includes supplying alternative text for images, using appropriate color contrast, and providing keyboard accessibility.

### **Incorporate a wider variety of exam genres**

Currently, our website offers only a limited variety of exam formats, including multiple-choice, constructive, and fill-in-blank. However, we are committed to expanding our offerings in response to customer feedback in order to enhance our service. Our objective is to offer a wider variety of assessment options to meet the diverse requirements of our users.

We are actively investigating the inclusion of several new exam genres to our platform, including the following:

- Performance-based assessments: These tests evaluate the test-taker's ability to conduct a particular task or set of tasks. Simulations, case studies, and practical, hands-on examinations are examples of performance-based assessments.

- Oral exams: These exams require test takers to respond to questions verbally. Oral examinations can assess communication skills, subject knowledge, and the capacity for critical thought.
- Project-based assessments: Examinees are required to complete a project or assignment that demonstrates their mastery of a specific skill or area of knowledge.

### **Incorporate some AI features**

We intend to integrate AI features into our website to enhance the user experience by providing more convenient and individualized services. To remain ahead of the competition and meet the changing needs of our customers, we plan to implement cutting-edge AI capabilities such as image recognition and speech recognition. We have already researched some techniques such as Math formula recognition and Speech-to-Text which would be very helpful for our use cases. In addition, it is also worth considering utilizing an AI-powered algorithm that analyzes user behavior to provide personalized content recommendations and search results that are going to be extremely useful for enhancing the user experience.

### **Implement the feature of printing paper-based exams**

Since teachers and lecturers comprise a significant portion of our primary target audience, we can anticipate the need for printing online exams onto paper. Therefore, we desire to develop this feature in the near future so that teachers and lecturers can simply print their exams with a single click, which could make our product a valuable offline and online teaching and learning tool.

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# **Appendix A**

## **Workload**

### **A.1 Work Evaluation**

During this Capstone Project, together, we have been able to list down the necessary requirements, design an overall architecture for our application, and successfully implement a system that can meet our goal. Along with actively working on our own, when facing challenges, we also contact Dr. Quan Thanh Tho and Mr. Mai Duc Trung to get advice for solving our issues. Thanks to that effort, we have successfully had an effective work process and reached our goals.

About the task assignment, we equally joined every part of the project from designing to implementing. To make sure that both of us understand the ideas and technologies used in the project, during our work, we had private meetings every week to review and impart knowledge for each other. Thanks to that way, we were able to keep track of the progress and ensure that both of us can catch up with each other. Besides, by having discussions about the work assignment, we know each other better - strengths and weaknesses, therefore, we can assign work more effectively and appropriately to have the best progress.

## A.2 Task Assignment

The following figure shows how we assign tasks between us.

Member	Tasks	Percentage
Phạm Tân Phước	<ul style="list-style-type: none"><li>- Determine user story</li><li>- List down functional and nonfunctional requirements</li><li>- Determine project scope</li><li>- Research on suitable front-end frameworks</li><li>- Determine suitable system architecture</li><li>- Draw use case diagram and use case scenario</li><li>- Conceptual and logical database design</li><li>- Research on related works</li><li>- Manage project progress</li><li>- Build Homepage</li><li>- Implement messaging by email feature</li><li>- Build Signin/Signup page</li><li>- Build Dashboard page</li><li>- Build Create-test pages</li><li>- Implement create-test related features</li><li>- Implement share-test feature</li><li>- Implement search and filter by tags feature</li><li>- Improve user experience (UX)</li><li>- Perform system testing</li></ul>	50%
Trịnh Mạnh Hùng	<ul style="list-style-type: none"><li>- Determine user story</li><li>- List down functional and nonfunctional requirements</li><li>- Determine project scope</li><li>- Research on suitable back-end frameworks</li><li>- Research on suitable DBMS</li><li>- Draw mock-up by Figma</li><li>- Research on related works</li><li>- Build Practice-test pages</li><li>- Implement practice-test related features</li><li>- Build personal information &amp; result management pages</li><li>- Implement Signin by Google account feature</li><li>- Implement Signin by Facebook account feature</li><li>- Implement test rating feature</li></ul>	50%

	<ul style="list-style-type: none"><li>- Resolve Concurrent Update Conflicts</li><li>- Make the website responsive</li><li>- Improve search engine optimization (SEO)</li><li>- Deploy the system</li></ul>	
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