An-Najah National University

Faculty of Engineering information technology

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NajahCodeX

Done by

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Disclaimer

Omar Shkokani and Shadi Basha have written this report as requirements for Bachelor's degree in Computer Engineering Department. No one modifies or corrects it because it will be evaluated by professors at An-Najah National University. It is worth mentioning that An-Najah National University does not have any responsibility for any word in this report.

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Abstract

The project presented an innovative platform aimed at empowering university students by providing them with essential problem-solving skills, a critical demand in today's market. Moreover, it offered students the opportunity to engage in local tournaments alongside their peers. The project encompassed various aspects of our learning journey, with a primary focus on enabling seamless submission of work to the server by all users simultaneously.

Additionally, we were committed to establishing an efficient point system and leaderboard, as well as implementing a mechanism for running test cases on submitted code. Furthermore, we prioritized security and user experience, incorporating authentication and authorization mechanisms to safeguard user data. Administrators and instructors benefited from a monitoring system that provided real-time insights into platform activities.

Practically, our project materialized as a versatile web application, providing students with a user-friendly interface for learning, enrolling in courses, and participating in tournaments, accessible from any location. Instructors and coordinators had the ability to enhance the learning experience by adding course materials, tasks, and tournament opportunities, while efficiently monitoring user progress. Although this project was new to our department, similar implementations, such as LeetCode and Codeforces, had demonstrated success in enhancing coding skills and fostering a sense of achievement among users. Our project aimed to build upon these successes and tailor them to the unique needs of our university community.

In summary, our platform aimed to revolutionize education at our university by equipping students with the problem-solving skills necessary for success in today's job market. We were committed to making learning enjoyable and accessible, bridging classroom knowledge with real-life challenges, and promoting teamwork. We were excited to bring this project to fruition, benefiting both our students and our university.

Chapter 1

Introduction

The project aims to consolidate efforts and centralize resources, as various university associations in the field of computer science, along with several computer instructors, currently utilize external platforms such as HackerRank or LeetCode. The goal of this project is to aggregate all these resources into a single platform, providing a centralized repository for problem-solving activities, particularly tailored for An-Najah University.

1.1 Problem Statement

Regardless of the use of external platforms like HackerRank and LeetCode by university associations and computer instructors for problem-solving activities, there remains a lack of centralized resources specifically tailored for the needs and curriculum of An-Najah University. Additionally, many existing platforms come with additional costs, which may not be feasible for university budgets. Therefore, a centralized platform that aggregates problem-solving resources, customizes content to align with the university's curriculum, and provides tools for instructors to monitor student progress effectively is necessary. Scalability without additional cost is essential, ensuring that the server infrastructure can expand seamlessly to accommodate growing user needs.

1.2 Objectives

Developing and implementing a specialized software platform suited to meet the unique needs of An-Najah National University, aimed at centralizing software content for enhanced accessibility and usability. The platform will be designed to be customizable and scalable, allowing for easy adaptation to evolving requirements and accommodating future growth and expansion.

1.3 Scope of the work

1. **Development of an Innovative Platform:** The project involves the development of an innovative platform aimed at empowering university students by providing essential problem-solving skills.

2. **Integration of Learning and Tournaments:** The platform offer to students the opportunity to engage in local tournaments alongside their peers.
3. **Integration of Test Case Mechanism:** Implementing a mechanism for running test cases on submitted code suggests the integration of automated testing functionalities to assess the correctness and efficiency of submitted solutions.
4. **Implementation of Point System and Leaderboard:** The project includes establishing an efficient point system and leaderboard to track user progress and foster competition among students.
5. **Monitoring System for Administrators and Instructors:** The project includes developing a monitoring system that provides real-time insights into platform activities for administrators and instructors.

Chapter 2

Constraints and Earlier Coursework

2.1 Constraint and Limitations

Some features, such as compilation and running codes, relied on a paid API for all programming languages. To eliminate costs and ensure scalability without additional expenses, we opted to develop these functions in-house by interfacing directly with the compiler. While this approach required significant time and effort to ensure accuracy, it allowed us to achieve our goal of providing cost-free and scalable functionality. However, due to resource constraints and the extensive effort required, we were only able to implement support for a subset of programming languages. As a result, we chose to focus on seven programming languages as a representative sample, acknowledging that adding support for all programming languages would have required a considerable amount of time and effort.

2.2 Earlier Coursework

- Web Development course:
  the courses focused on the programming languages required to accomplish the project, such as **HTML5, CSS3, JavaScript, React Js, Flutter, bootstrap, and Node Js**.
- Database Design & Management course:
  This platform's database is entirely made on MySQL. Database design principles and crucial concepts like dependencies, keys, and indexes were also covered in this course.
- Advanced Database course.
- Critical Thinking & Scientific Research course:
  In order to finish this course, students were taught how to read scientific publications and how to produce research papers using current technologies such as latex.
- Software Engineering course:
  All of the principles and approaches covered in this course, such as software requirements, architecture, and user acceptability, have been shown to be effective and helpful, and they were implemented in this project.

- Advanced Software Engineering course.

Chapter 3

Literature Review

3.1 Introduction

In this literature review, we'll explore two prominent online coding platforms, Codeforces and HackerRank, followed by an analysis of the enhancements brought by NajahCodeX to An-Najah National University.

3.2 Codeforces

Codeforces, founded by Mike Mirzayanov in 2010, is a competitive programming platform renowned for its algorithmic challenges, contests, and educational rounds. It offers a dynamic interface, fast-paced contests, and a strong emphasis on algorithmic and data structure-based challenges. With support for multiple programming languages and an integrated rating system, Codeforces provides a competitive environment for programmers to test their skills and improve problem-solving abilities.

3.3 HackerRank

HackerRank, established by Vivek Ravisankar and Hari Karunanidhi in 2012, is an online platform offering a diverse range of coding challenges, skill-based assessments, and interview preparation tools. Known for its extensive library of challenges across various domains, including algorithms, data structures, artificial intelligence, and machine learning, HackerRank provides a user-friendly interface and detailed problem statements. It supports multiple programming languages and offers interview preparation kits, coding tutorials, and company-specific challenges to help users prepare for technical interviews.

3.4 What enhancements did NajahCodeX bring?

NajahCodeX,specifically for An-Najah National University, brings significant enhancements to the field of coding education. By offering a centralized learning platform tailored to the university's academic context, NajahCodeX provides students, instructors, and administrators with a comprehensive resource for learning, practicing, and mastering coding

skills. With features such as curriculum integration, customizable learning paths, real-time progress tracking, and community collaboration, NajahCodeX enhances the learning experience and prepares students for success in coding competitions, technical interviews, and future career opportunities. Through its innovative approach to coding education, NajahCodeX reinforces the university's commitment to excellence and innovation in education.

Chapter 4

Methodology

4.1 Used Technologies

4.1.1 ReactJS

ReactJS is a free and open-source front-end JavaScript framework for creating UI components-based user interfaces.[**react**] Meta (previously Facebook) and a community of individual developers and corporations manage it. React may be used as a foundation for single-page, mobile, or server-rendered apps.

Why ReactJS?

1. React provides a clean and simple syntax called JSX syntax, which is comparable to HTML but allows the developer to insert JavaScript code into the front-end design, giving them more control over the component.
2. Reusability, one of React's most powerful features is reusable components. In another meaning, reusing an existing component rather than creating it again from scratch.
3. It supports a huge number of free libraries that give ready components that may make the development process easier for the developer.
4. Fast rendering.

4.1.2 .NET Framework

The .NET Framework is a versatile platform for developing applications, leveraging the power of C and other .NET languages. It was initially developed by Microsoft Corporation and released in 2002. Unlike traditional frameworks, .NET enables developers to build a wide range of applications, including web applications, desktop applications, and cloud services, using a unified development environment.

Why .NET Framework?

1. Asynchronous and Event-Driven: The .NET Framework provides asynchronous programming features, allowing developers to create responsive and scalable applica-

tions. Asynchronous methods enable non-blocking execution, ensuring that applications can continue performing tasks while waiting for I/O operations to complete.

2. Performance: Built on optimized runtime environments like the Common Language Runtime (CLR), the .NET Framework delivers high-performance execution of code. The Just-In-Time (JIT) compilation ensures that code is compiled into native machine code at runtime, resulting in efficient execution and reduced overhead.

3. Scalability: .NET applications are highly scalable, thanks to features like multithreading and asynchronous programming. The event-driven architecture of .NET allows applications to handle multiple requests concurrently, making them suitable for handling heavy workloads and serving a large number of users simultaneously.

4. Open-Source and Community Support: The .NET Framework has evolved into an open-source platform with extensive community support. Continuous improvements, bug fixes, and feature enhancements are released regularly, ensuring that developers have access to the latest advancements and best practices.

4.1.3 MySQL Database Management System

MySQL is a popular open-source relational database management system (RDBMS) that enables efficient storage, retrieval, and management of structured data. Developed by MySQL AB, which was later acquired by Oracle Corporation, MySQL has gained widespread adoption due to its reliability, scalability, and ease of use.

Why MySQL?

1. Open Source: MySQL is open-source, allowing free usage and customization.

2. Scalability: It scales well for large data volumes and high-traffic websites.

3. Performance: MySQL offers fast query execution and efficient data storage.

4. Reliability: Known for its stability and robust data integrity features.

5. Cross-Platform: Compatible with various operating systems, including Windows, Linux, and macOS.

4.1.4 Other technologies & tools

There are multiple other technologies used, including:

1. **Microsoft Visual Studio** is an integrated development environment (IDE) used for developing a variety of applications, including web, desktop, mobile, and cloud-based solutions. With features such as code editing, debugging, testing, and collaboration tools, Visual Studio provides a comprehensive development environment for building robust software products.

2. **Visual Studio Code** is a source-code editor made by Microsoft for Windows, Linux and macOS. Features include support for debugging, syntax highlighting, intelligent code completion, snippets, code refactoring, and embedded Git.

3. **Postman & Swagger** are API platforms designed for building and using APIs. They simplify each step of the API lifecycle and streamline collaboration, enabling

developers to create better APIs faster.

4. **GitHub** is an Internet hosting service for software development and version control using Git. It provides the distributed version control of Git plus access control, bug tracking, software feature requests, task management, continuous integration, and wikis for every project.

5. **Compilers** are essential tools used to translate source code into executable programs. In this project, we utilized compilers such as gcc, g++, and Java compiler (javac) to compile and execute submitted code.

4.2 NajahCodeX Web Application

4.2.1 Authentication and Validation

NajahCodeX is a platform that enables students to solve problems, participate in competitions, and allows group masters to add problems, create competitions, and establish plans. Both students and group masters can sign in to the platform and access all its features.

Sign Up

To register on the website, you must provide certain information such as username -nickname-, email address, student id and password see Figure 4.1

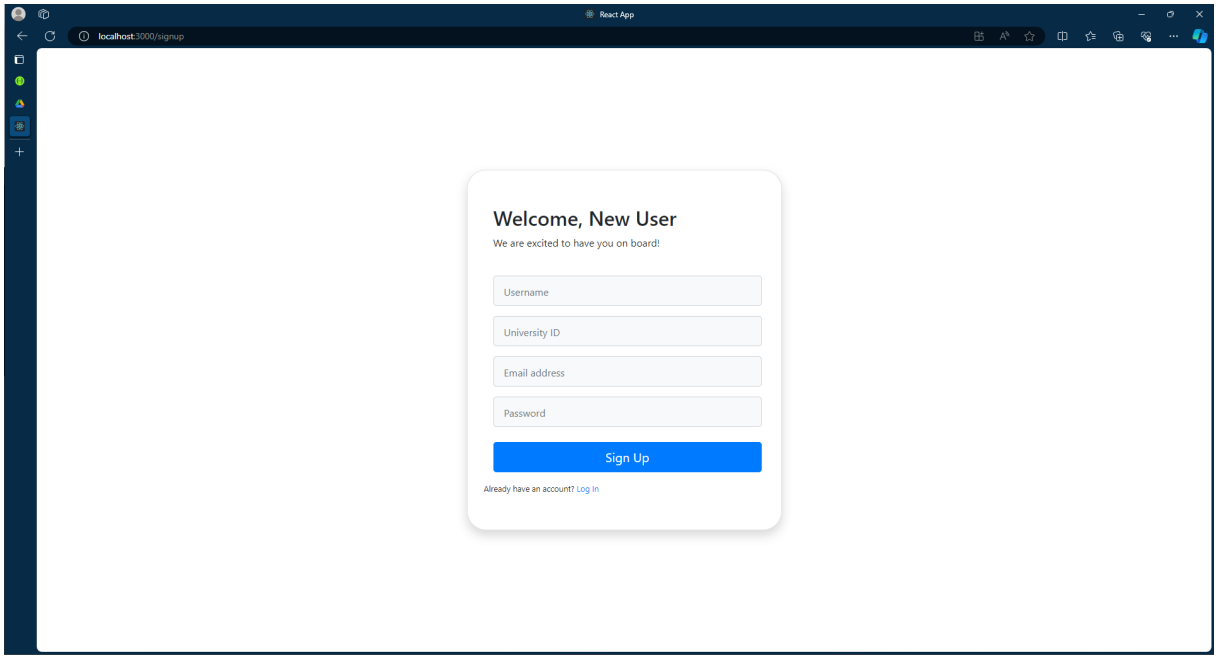


Figure 4.1: Sign up page

Validation

When a new user attempts to register, the backend validates the credentials. If the email is invalid or if the password does not meet the specified criteria, the backend returns an error message prompting the user to follow these properties:

- Must include at least one lowercase letter.
- Must include at least one uppercase letter.
- Must include at least one number.
- Must be at least 8 characters long.

See the example error message in Figure 4.2

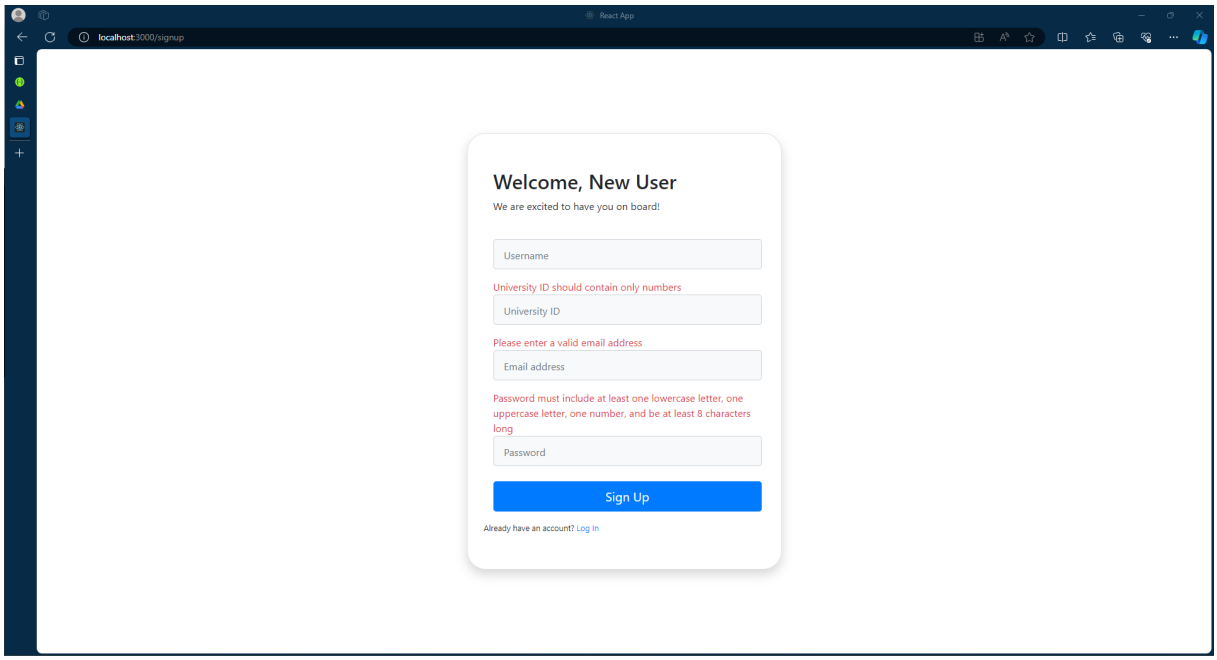


Figure 4.2: Password Validation Error

Login

To login to the website, enter your valid email address or username along with a valid password, as shown in Figure 4.3

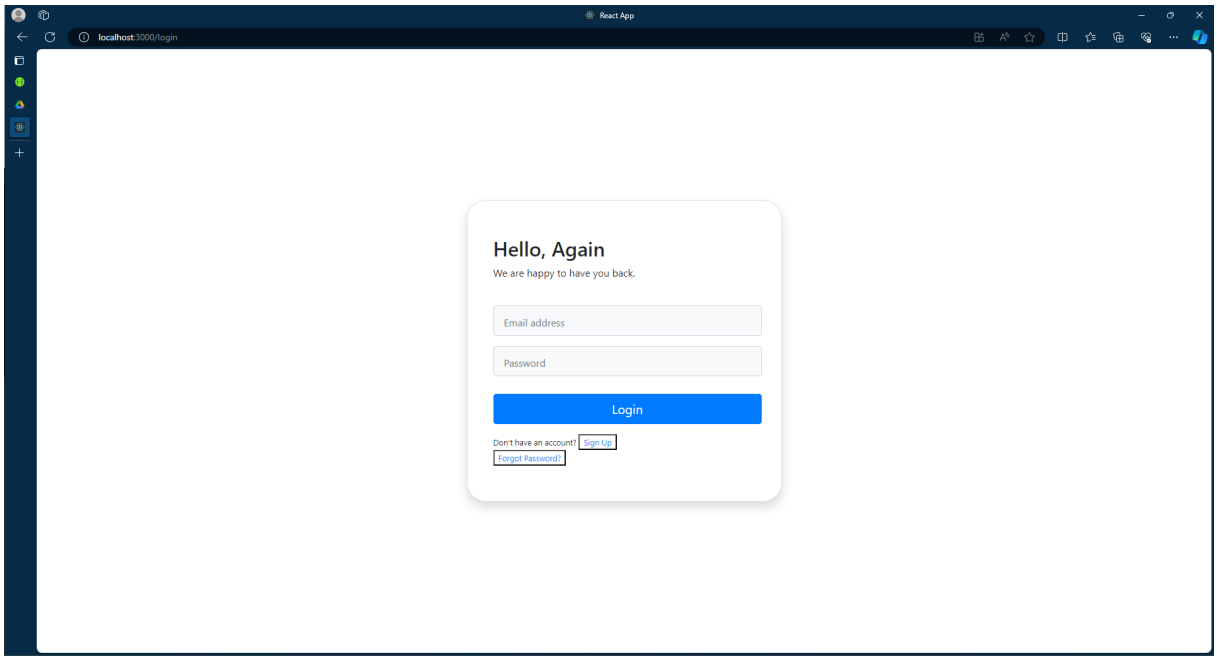


Figure 4.3: Login Form

Reset Password

Users can reset their password by clicking on 'Forget Password'. The page shown in Figure 4.4 will then appear, where users can enter their email address to receive a new

password. After receiving the new password via email, users can log in and change their password as needed.

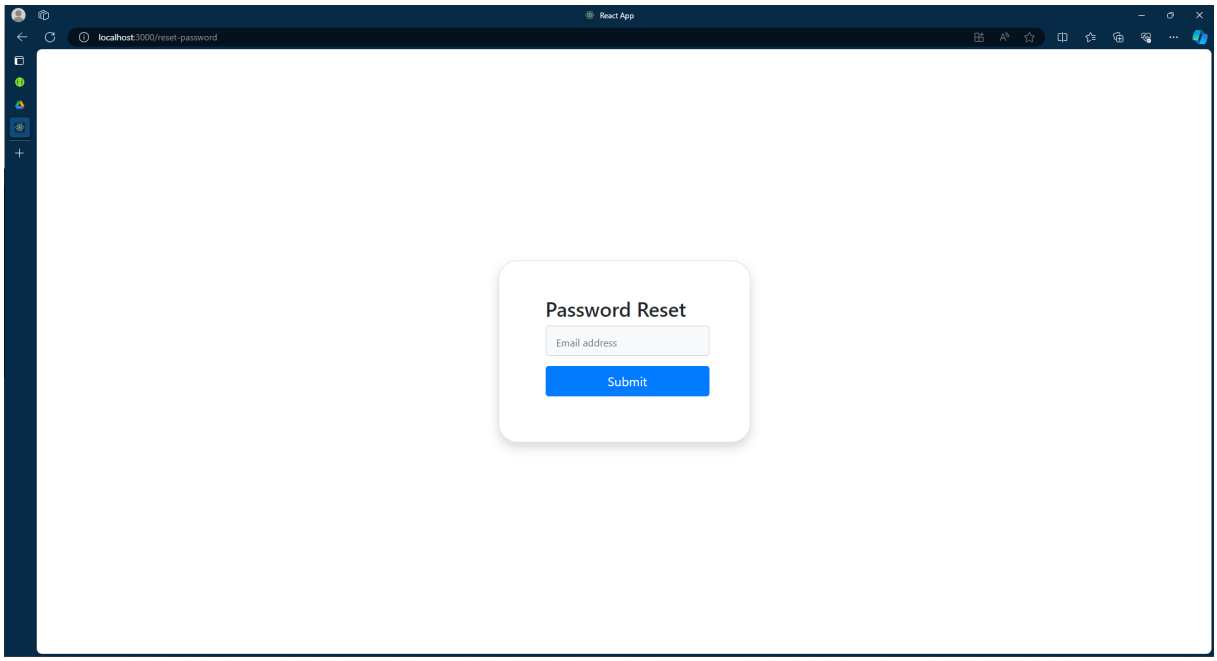


Figure 4.4: Reset Password Page

4.2.2 Home Page

On the home page, the navigation bar is visible, and we discuss the content in the next section.
The home page contains several components:

- Leaderboard: This displays the top five users with the highest points earned from competitions.
- Tip of the Day: This is a feature where only administrators and group masters can add text tips.
- Create New Post: This feature is available only to administrators and group masters, allowing them to publish announcements about competitions and share any necessary information. They can also make posts private to the group, as shown in Figure 4.5. The author of a post has the ability to delete it.

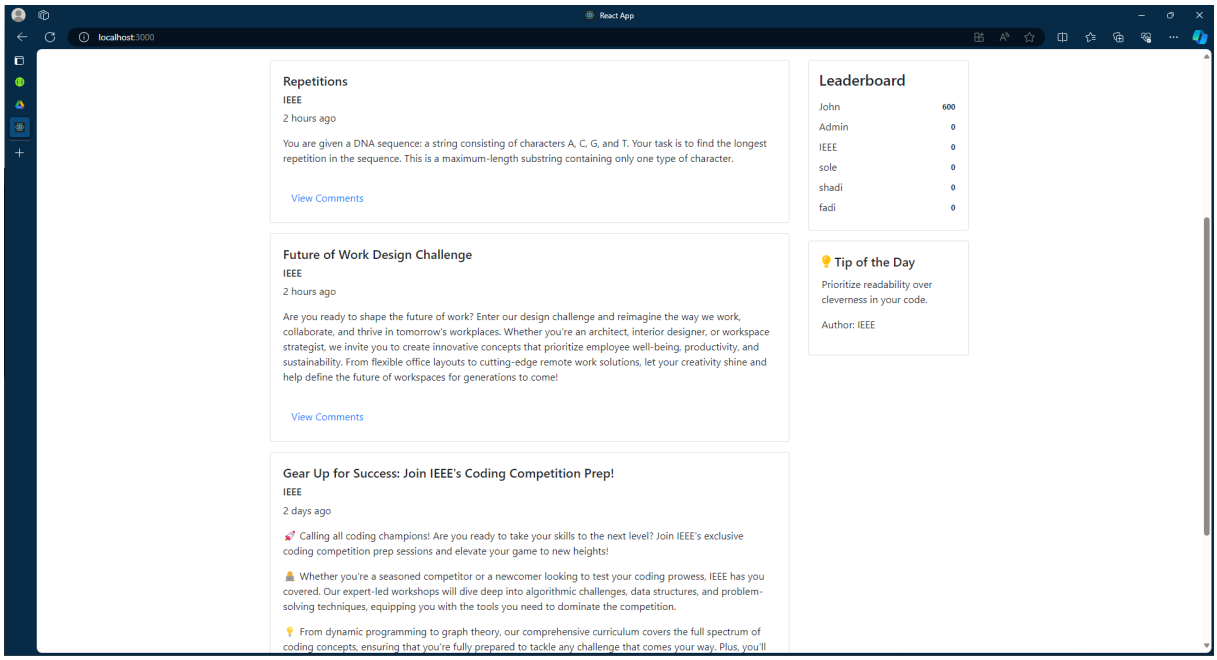


Figure 4.5: Home page

Users can add comments to posts to interact with administrators or group masters, and they can also delete their own comments as shown in Figure 4.6

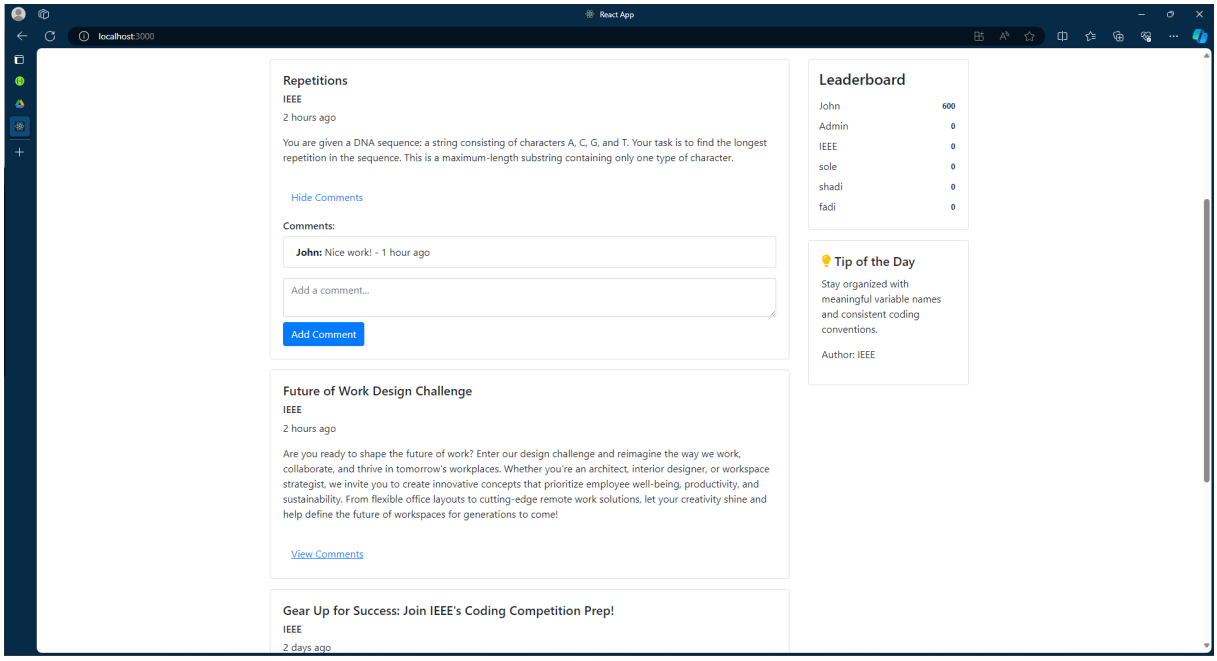


Figure 4.6: Post example

4.2.3 Navigation bar and sidebar

Navigation bar

Navigation bar has five links as shown in the Figure 4.7 and this is static whether to the user, group-master or admin.

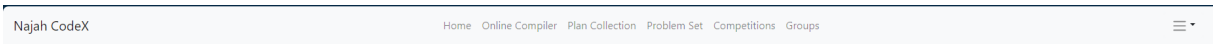


Figure 4.7: Navigation bar

Sidebar

The sidebar appears as a dropdown menu, and it varies depending on whether the user is logged in or not. We illustrate the differences between the views for users, group masters, and administrators in Figure 4.8

4.2.4 Problem Set

In this page, all public problems and any private problems belonging to joined groups are displayed, as shown in Figure 4.9.

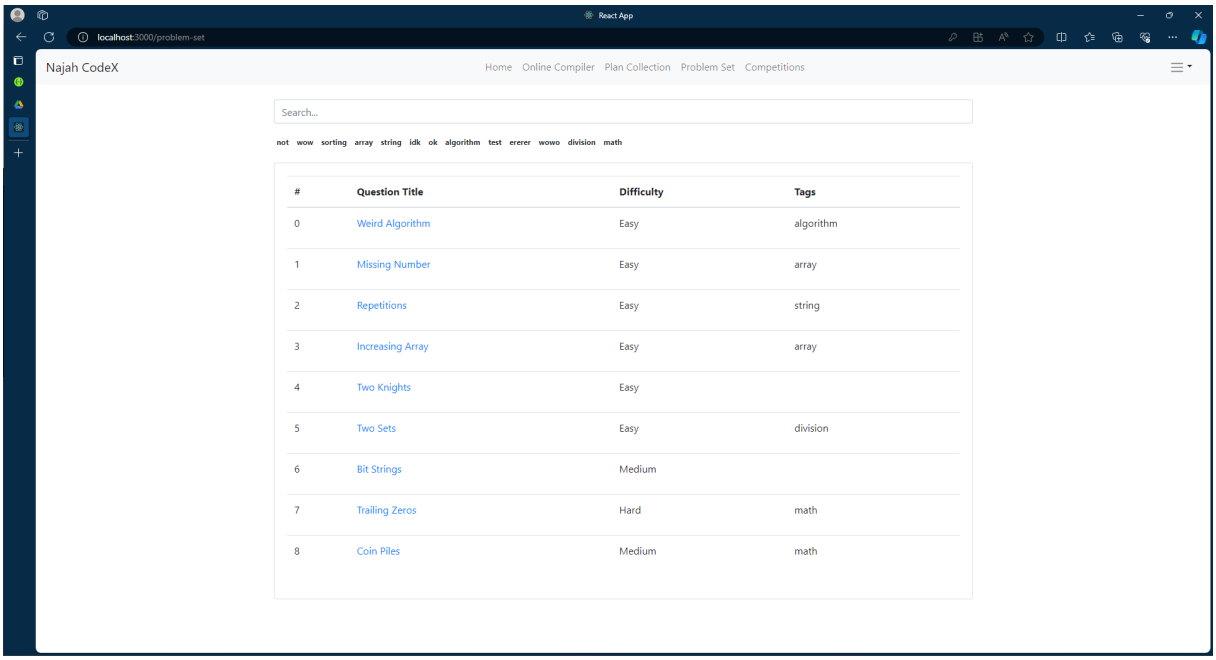
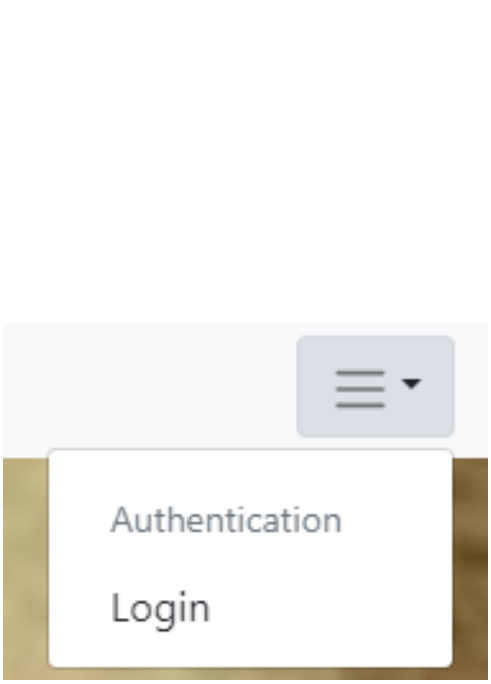
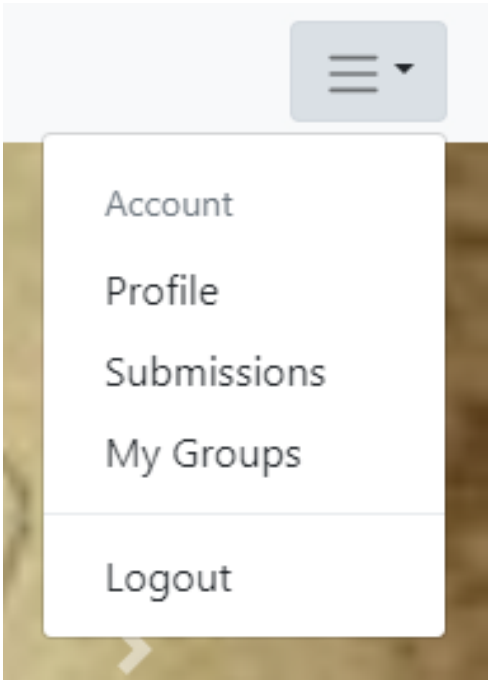


Figure 4.9: Problem Set Page

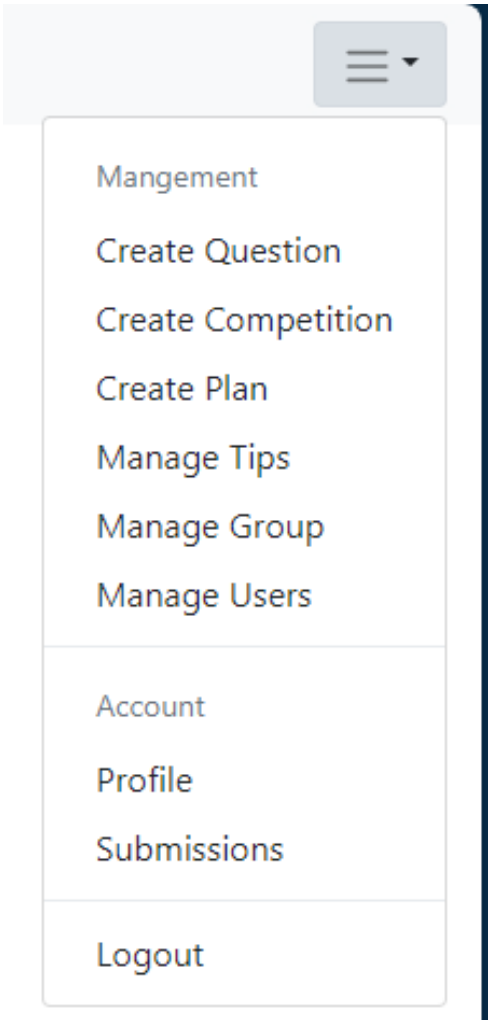
It is possible to search for a problem by its name or the tag it belongs to, as shown in Figure 4.10.



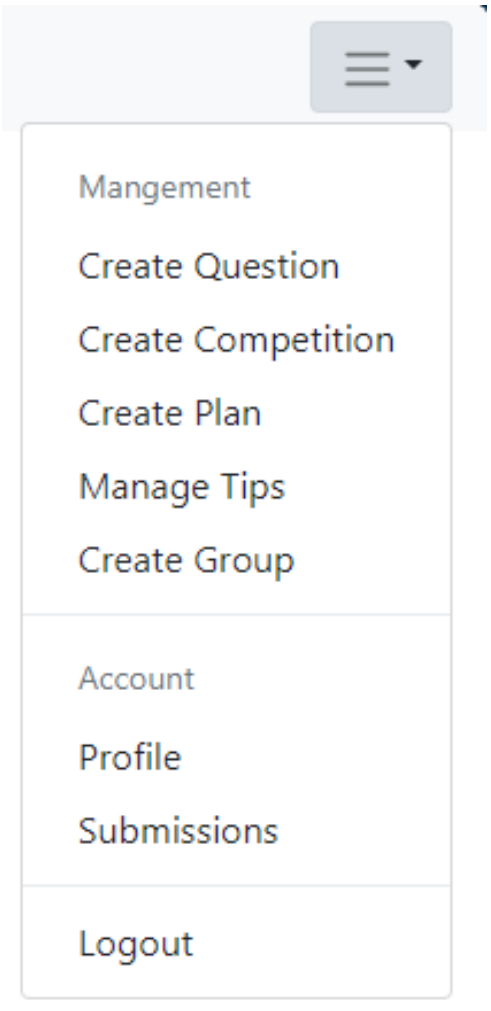
(a) For Not Logged In Users



(b) For Regular Users



(c) For Administrators



(d) For Group Masters

Figure 4.8: Side bar

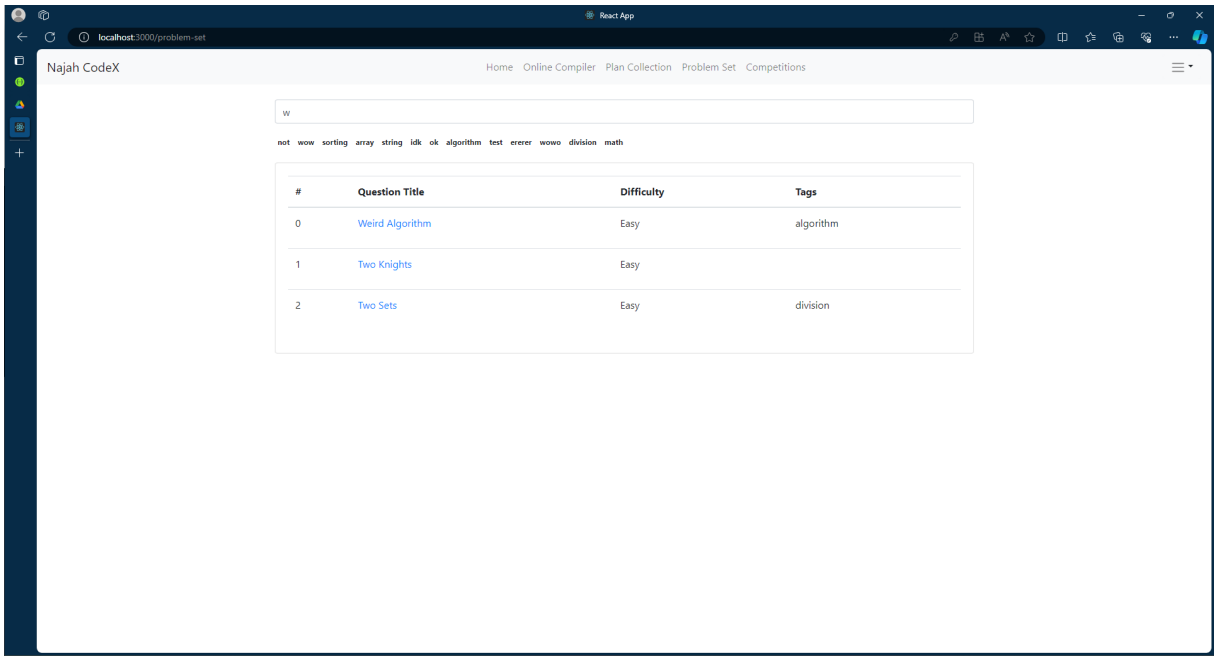


Figure 4.10: Searching for problems

4.2.5 Problem

The template displayed in Figure 4.11 is the layout for presenting problems. It includes the problem title, description, and some test cases. At the top right, users can select the programming language, attach solution files, and submit their code. If the problem is part of a competition, related questions will be listed at the bottom right.

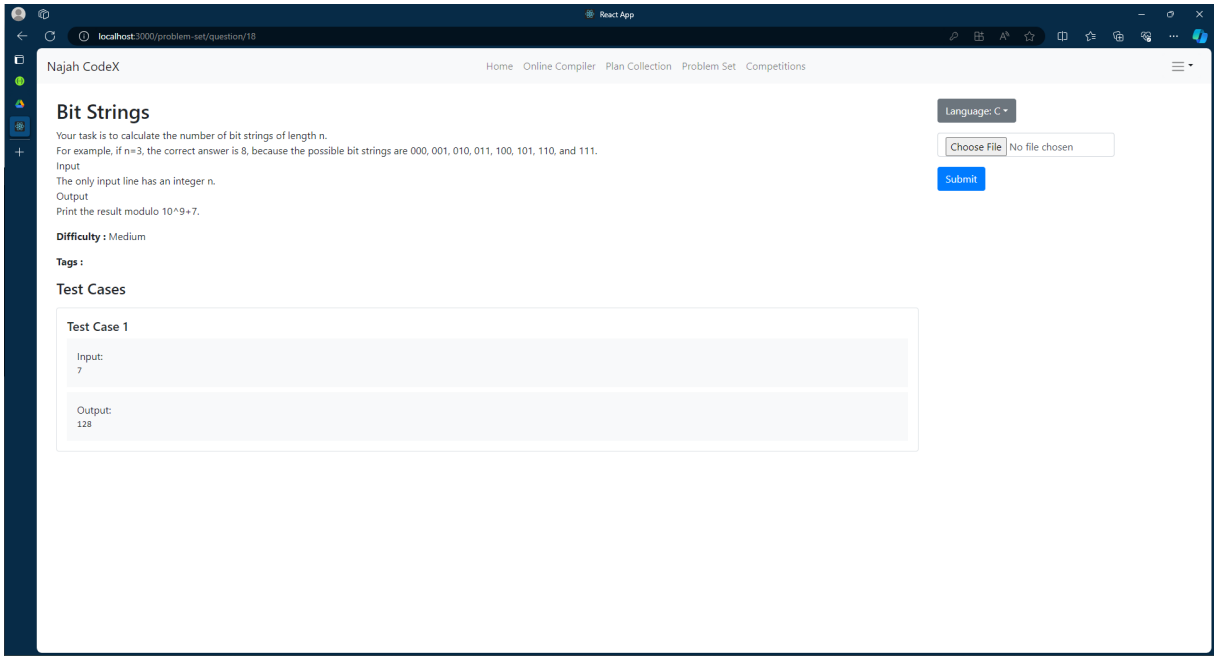


Figure 4.11: Problem Template

4.2.6 Add Problem

Figure 4.12 illustrates a dedicated page designed for administrators and group owners. This page facilitates the addition of new problems to the platform. Administrators and group owners can input various details such as the problem's title, description, difficulty level, and assigned points. They also have the option to set the problem as hidden, meaning it won't be visible to users, which can be useful for organizing competitions. Additionally, the 'private' setting ensures that the problem is only accessible to members of a specific group.

The page also presents the parameters for comparing the output of submitted code with the expected output:

- **Line-by-line comparison:** Compares lines of output data.
- **Trim Whitespaces:** Ignores leading and trailing spaces in the output.
- **Case Sensitivity:** Considers differences in letter case when comparing output.

Furthermore, the interface allows users to add test cases by uploading input and output files (.txt) as needed as shown in Figure (4.13 and 4.14) .

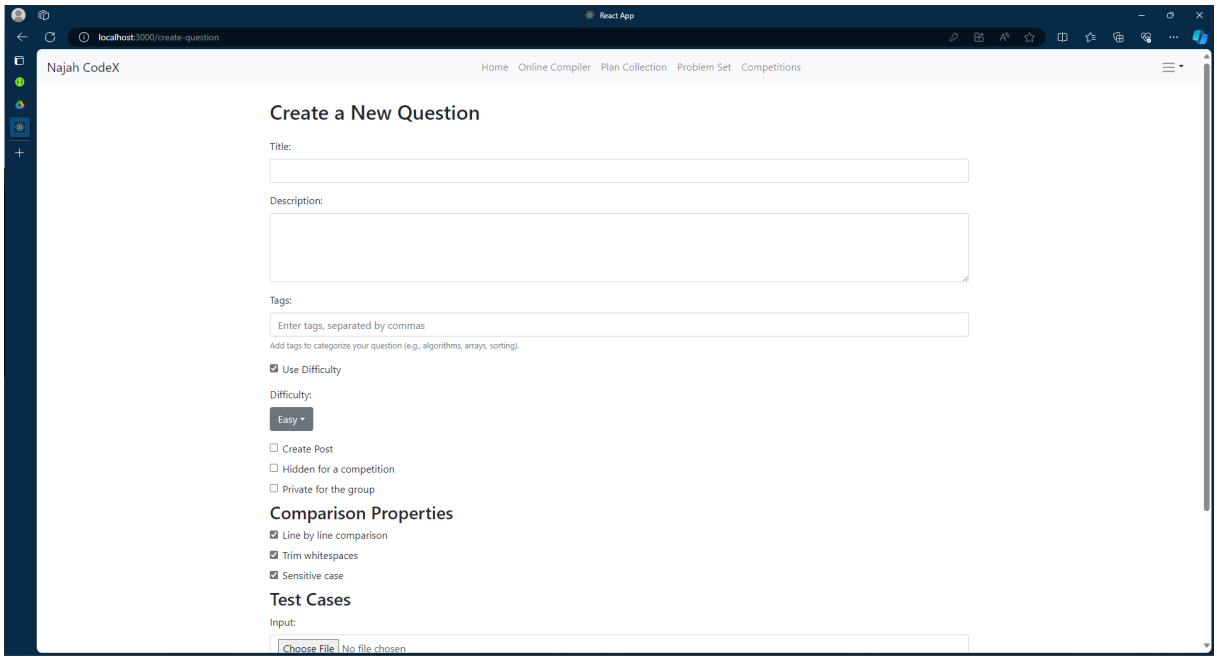


Figure 4.12: Add Problem Page

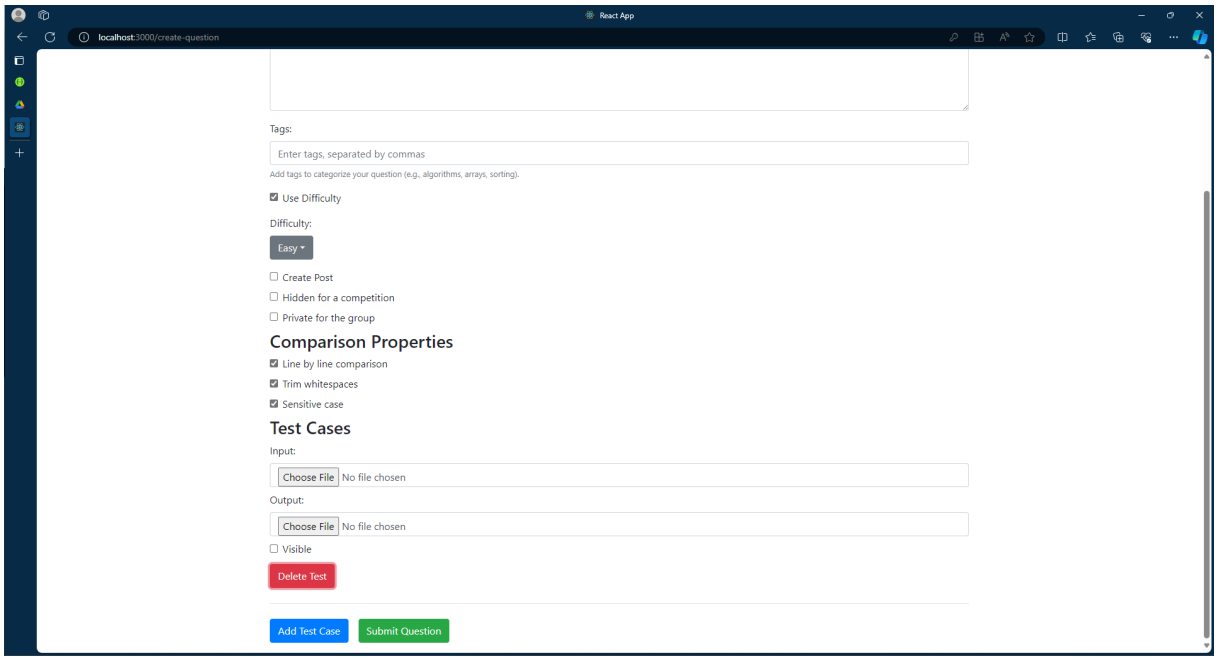


Figure 4.13: Add Test Cases

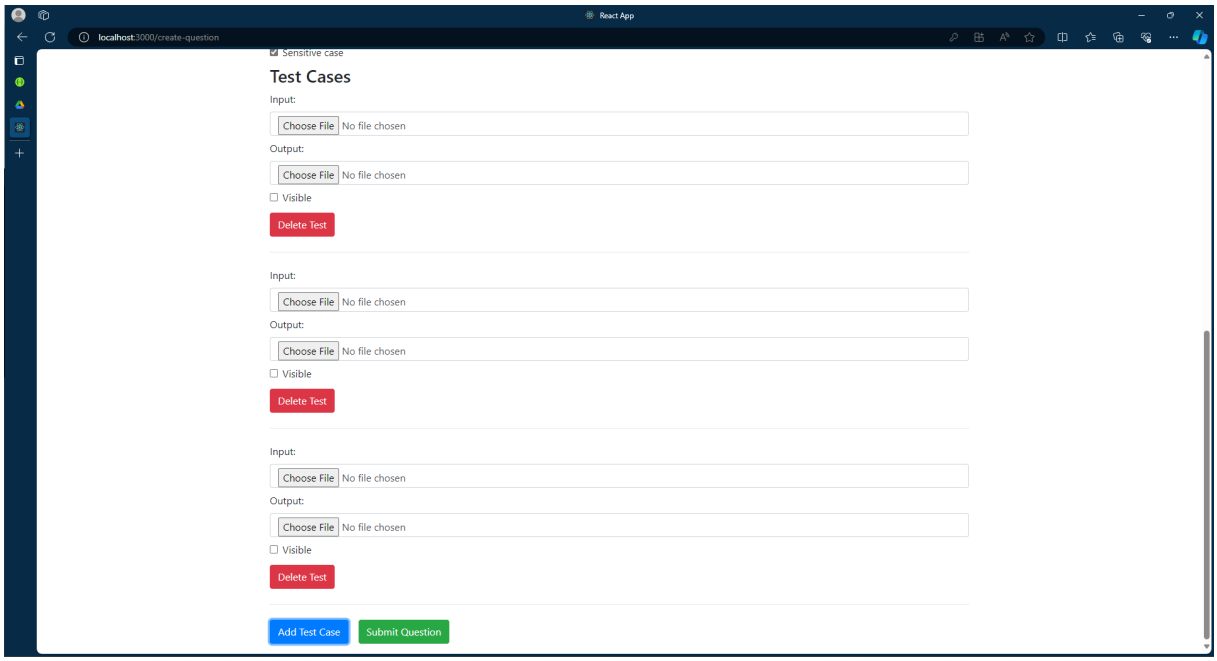


Figure 4.14: Multiple Test Case

4.2.7 Edit Problem

This page offers functionality similar to the 'Add Problem' page, but it is specifically designed for editing existing problems. Figure 4.15 illustrates the interface for editing problems.

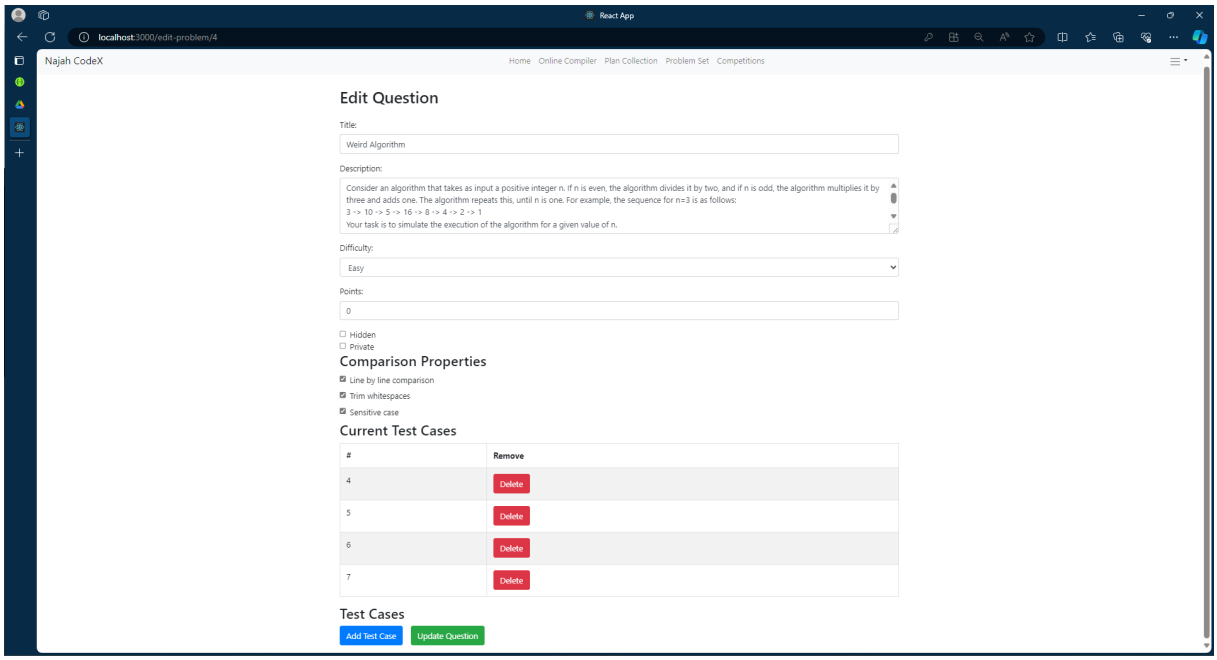


Figure 4.15: Edit Problem Page

4.2.8 Plan Collection

This page allows users to view all plans associated with the groups they have joined, as depicted in Figure **??**.

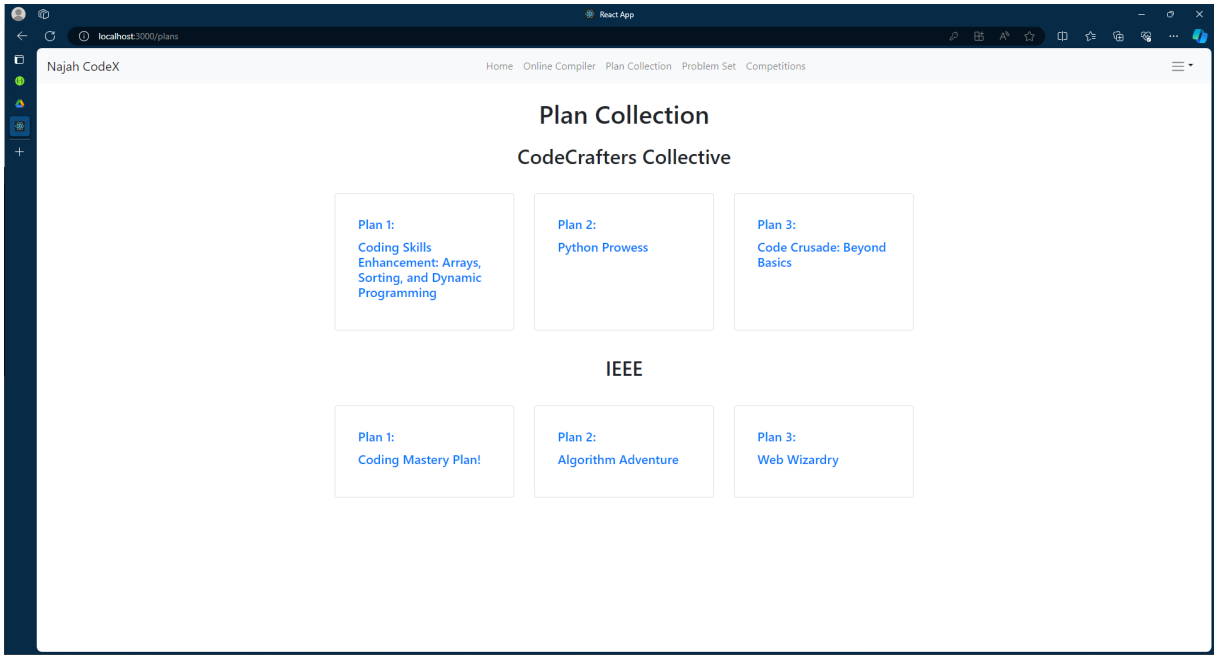


Figure 4.16: Plan Collection

4.2.9 Plan Page

In Figure 4.17, the plan is displayed along with a link to a tutorial or explanation related to the problem's topic.

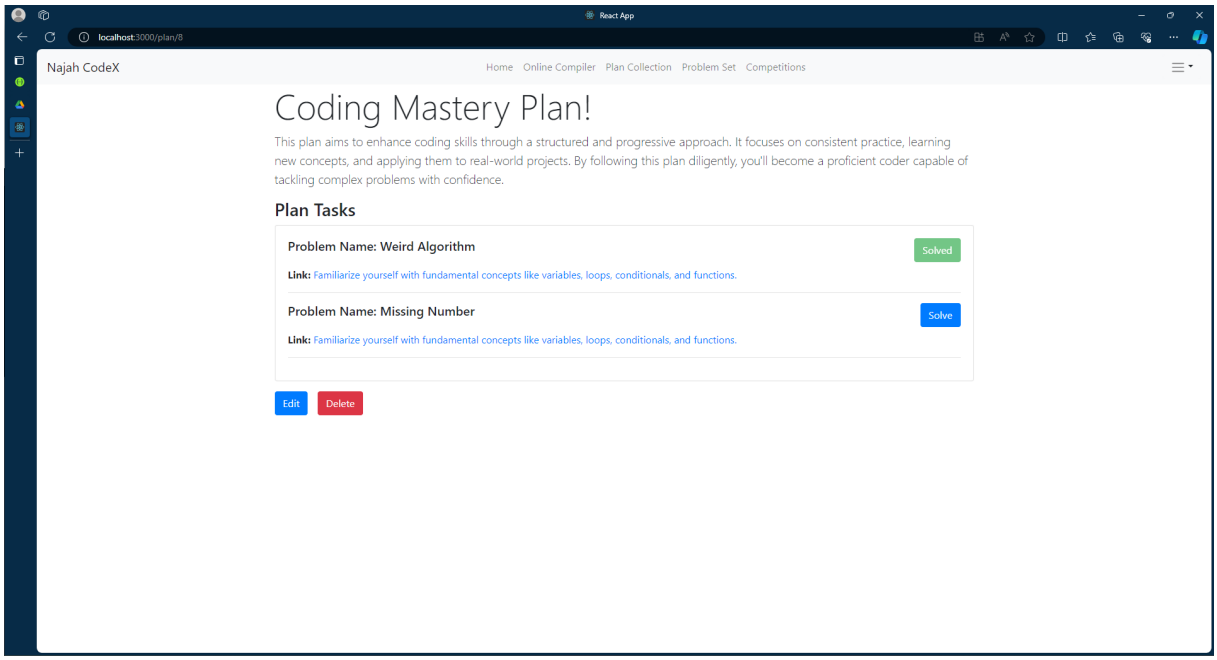


Figure 4.17: Plan Page

4.2.10 Add Plan

This page is specialized for group masters to create a new plan. As shown in Figure 4.18, group masters can add problems along with tutorial links for each problem added to the plan.

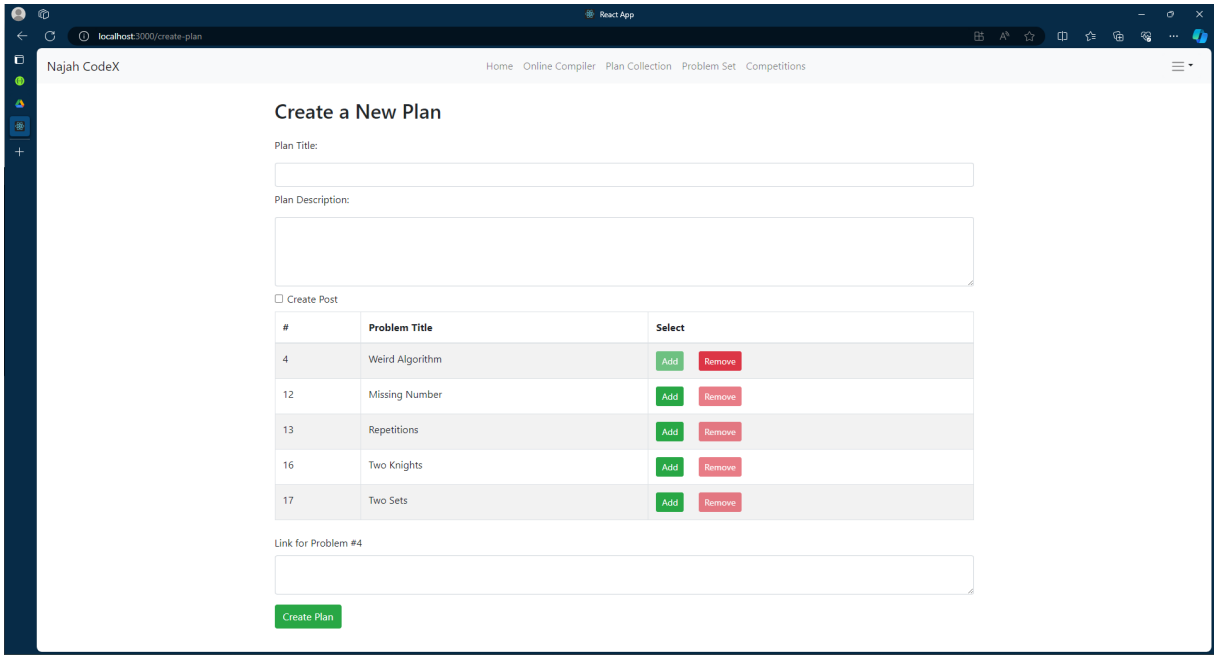


Figure 4.18: Add Plan Page

4.2.11 Edit Plan

This page offers functionality similar to the 'Add Plan' page, but it is specifically designed for editing existing plans. Figure 4.19 illustrates the interface for editing plans.

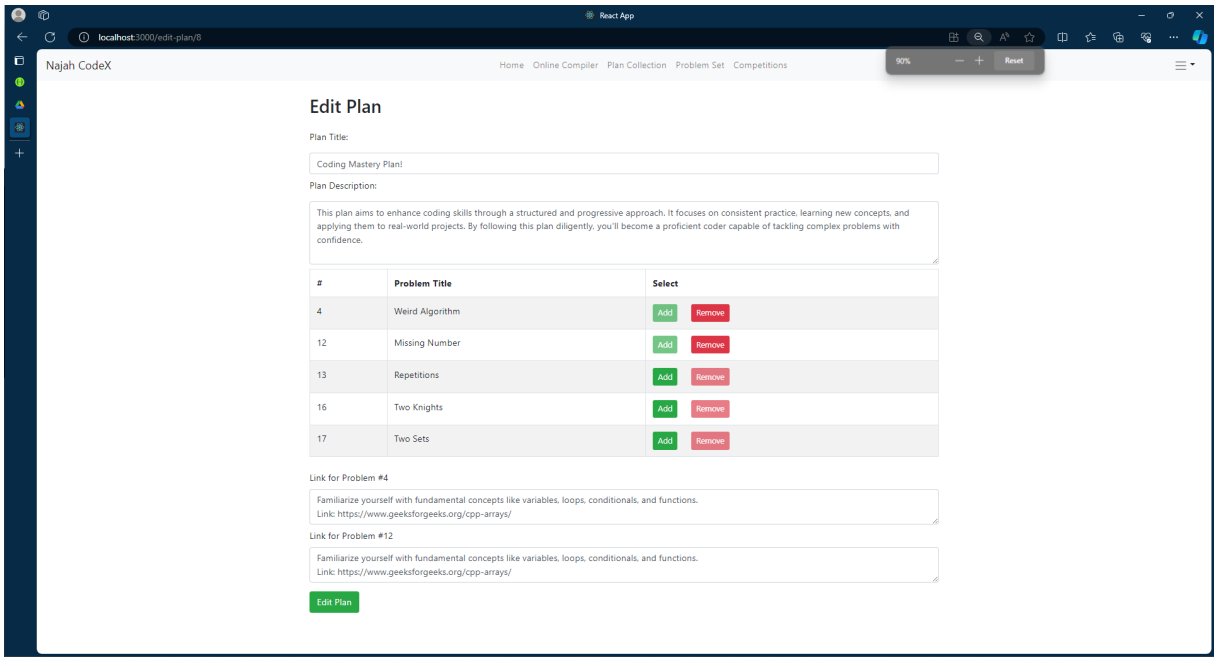


Figure 4.19: Edit Plan Page

4.2.12 Competitions

In this page, all competitions available for participation are displayed, whether they belong to a group or are public competitions and the state of competition. This is depicted in Figure 4.20. Users can also search for competitions using the competition title or filter them according to the group.

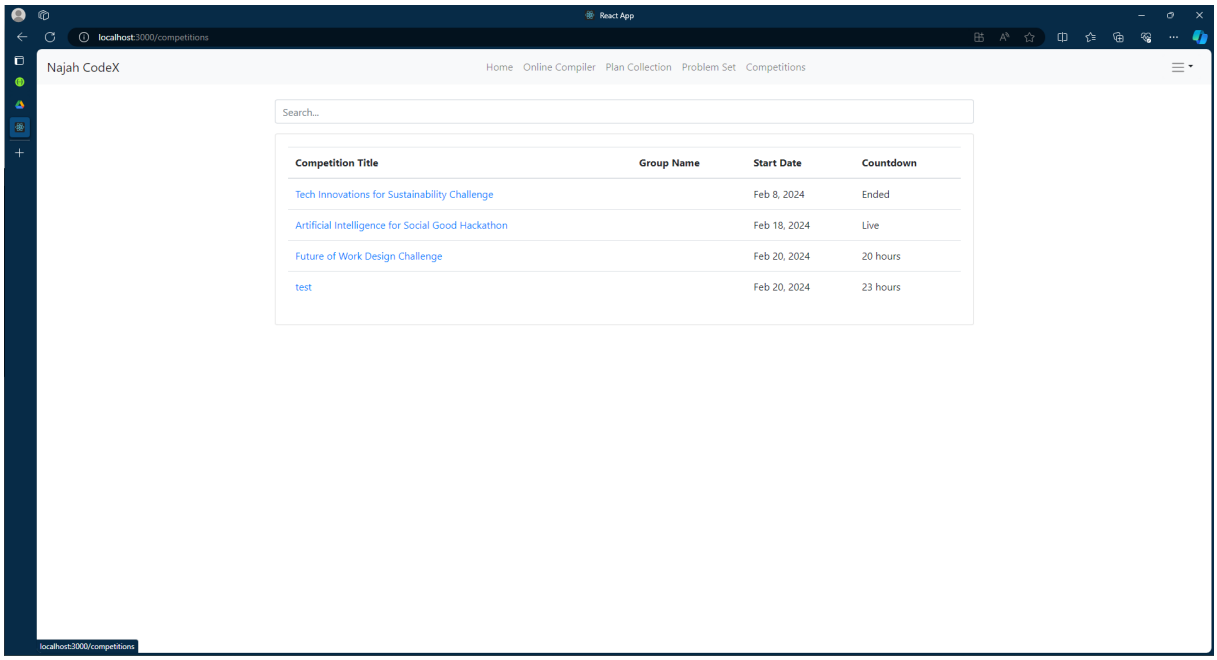


Figure 4.20: Competitions Page

4.2.13 Competition

On this page, competitions that have started are displayed along with the remaining time until completion, as well as all the problems associated with the competition. This is illustrated in Figure 4.21.

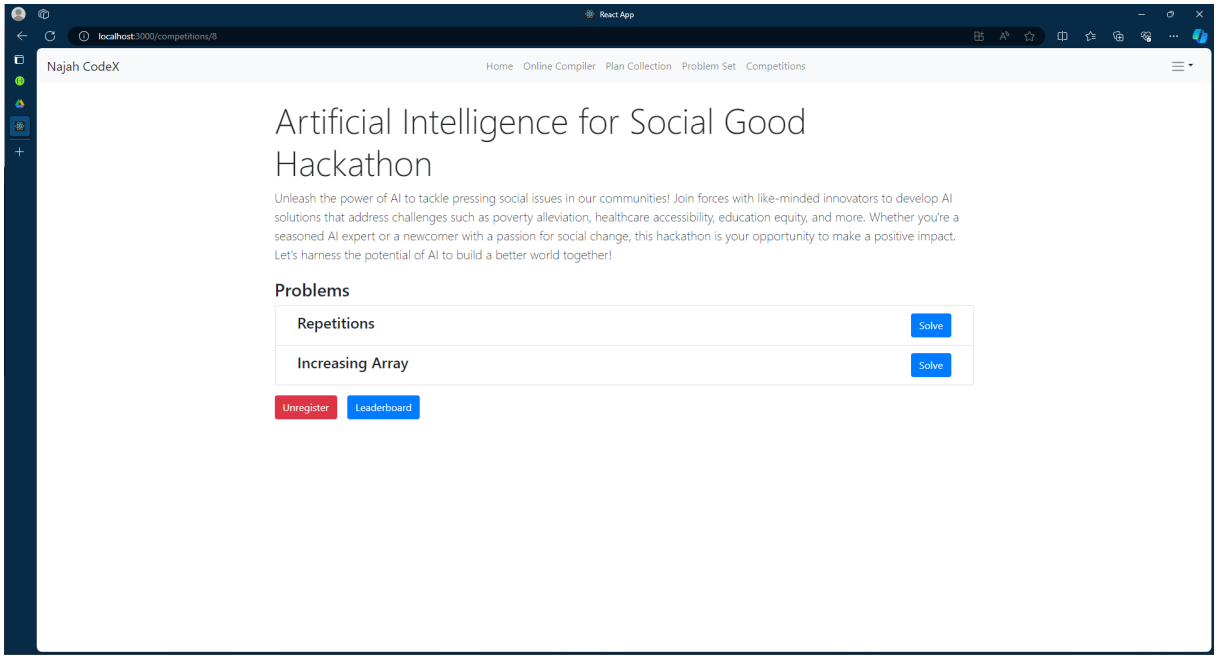


Figure 4.21: Competition Template Page

4.2.14 Add Competition

On this page, administrator and group masters can create a new competition. They can enter the title, description, start time, end time, and select whether the competition is private to the group or global. Additionally, they can select problems from their own set of problems, as shown in Figure 4.22.

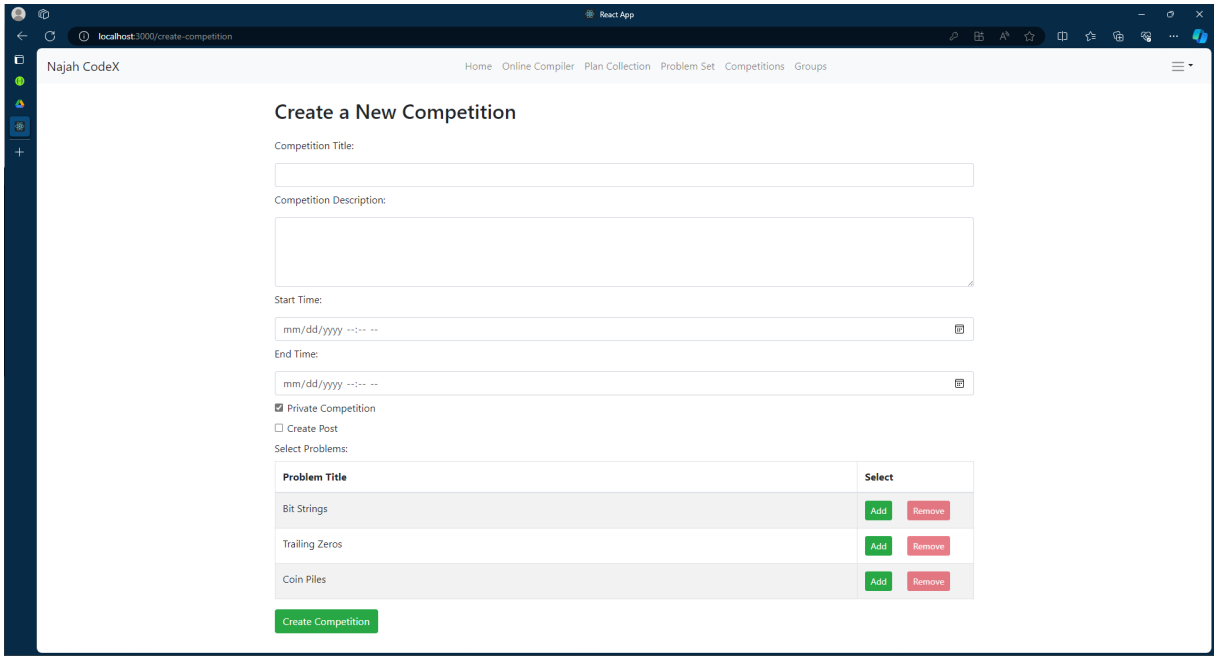


Figure 4.22: Add Competition Page

4.2.15 Edit Competition

This page is similar to the Add Competition page, but it is specifically designed for editing existing competitions, rather than creating new ones, as shown in Figure 4.23.

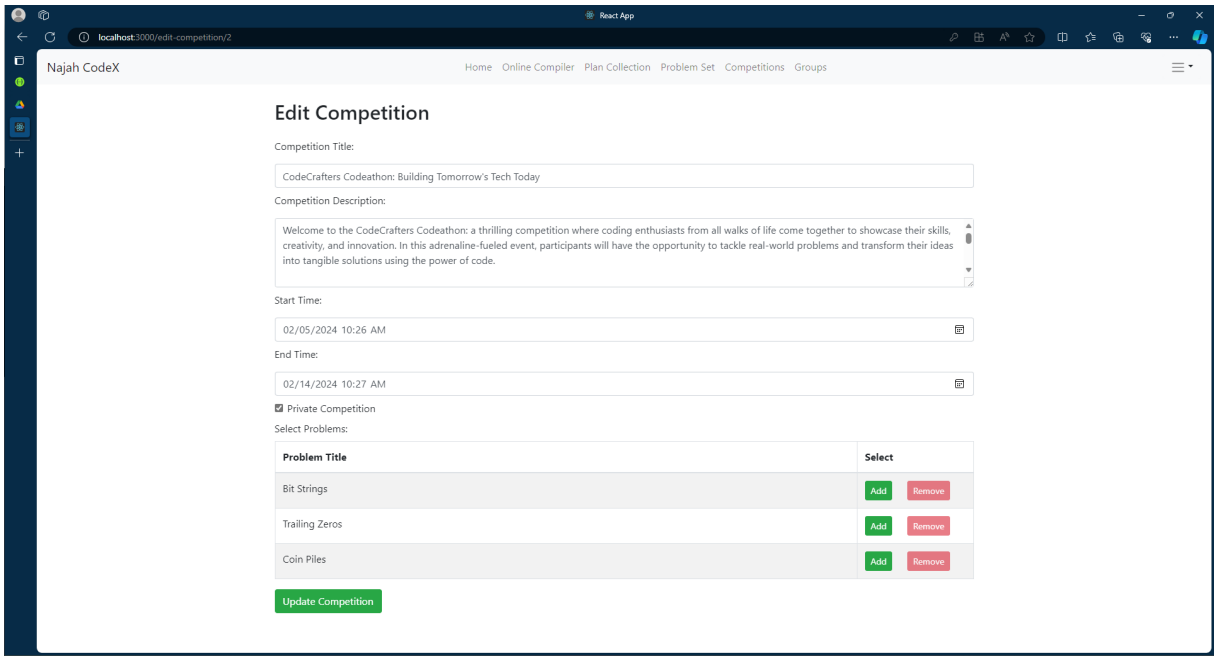


Figure 4.23: Edit Competition Page

4.2.16 Groups

This page to enable users to shows all groups and can join it through this page as shown in Figure 4.24.

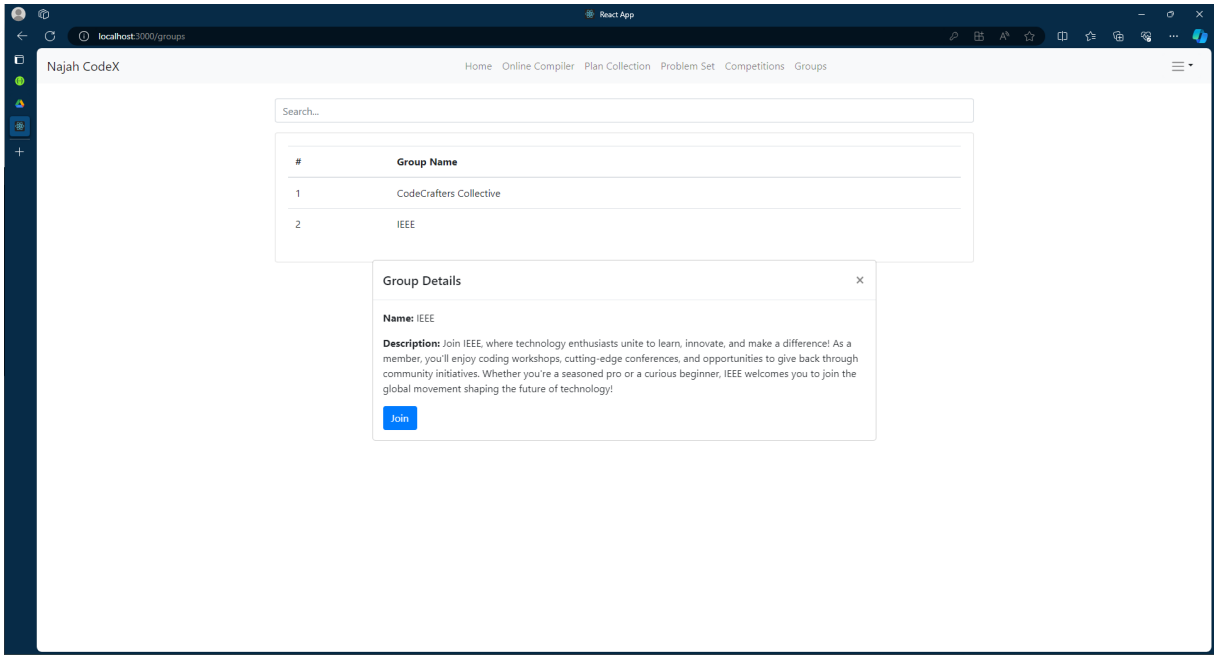


Figure 4.24: Groups Page

4.2.17 Group Page

This page serves as the hub for our group, offering users the ability to gracefully exit the group and view other members currently involved as shown in Figure 4.25

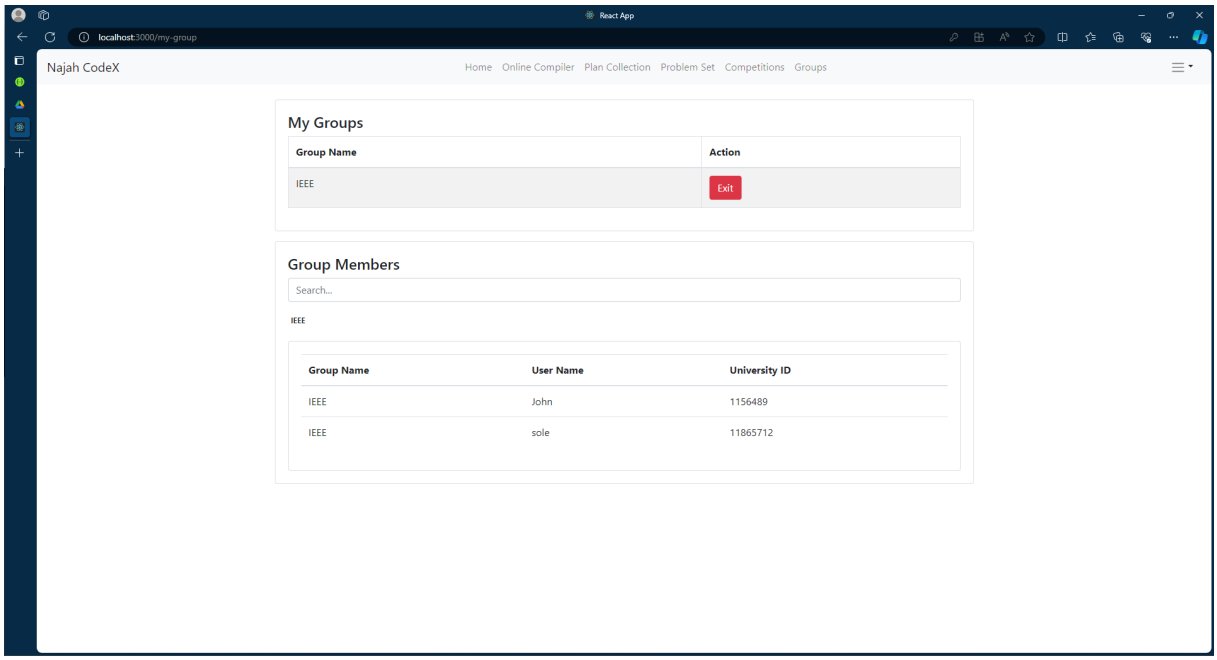


Figure 4.25: My Groups Page

4.2.18 Create Group

This page enables users to view all groups and join them. Users can join groups directly through this page, as shown in Figure 4.26

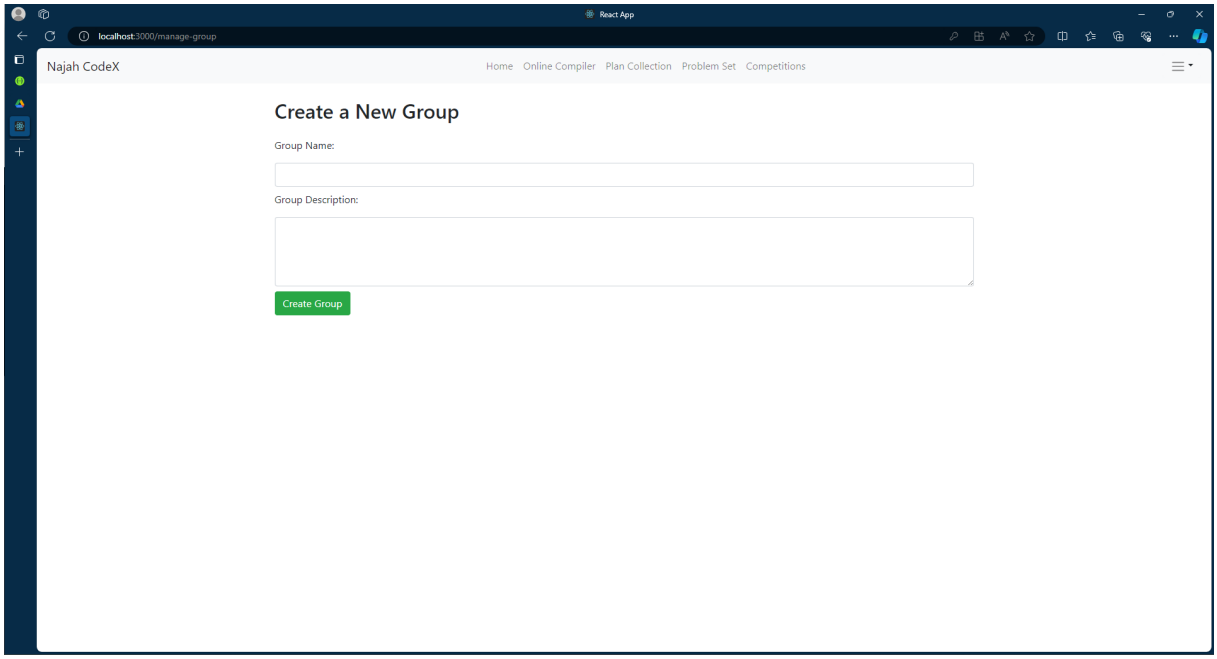


Figure 4.26: Create Group Page

4.2.19 Group Master Page

On this page, users can edit competitions, problems, and group information. Additionally, they have the ability to admit members, as shown in Figure4.27 and 4.28.

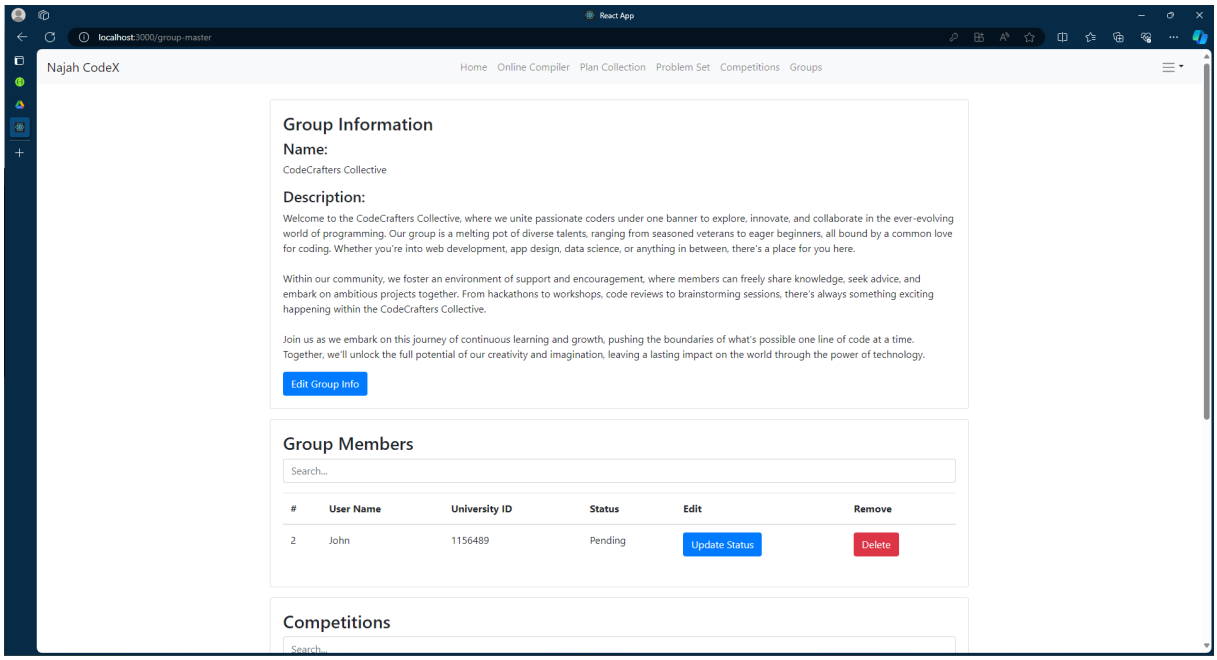


Figure 4.27: Group Master Page 1

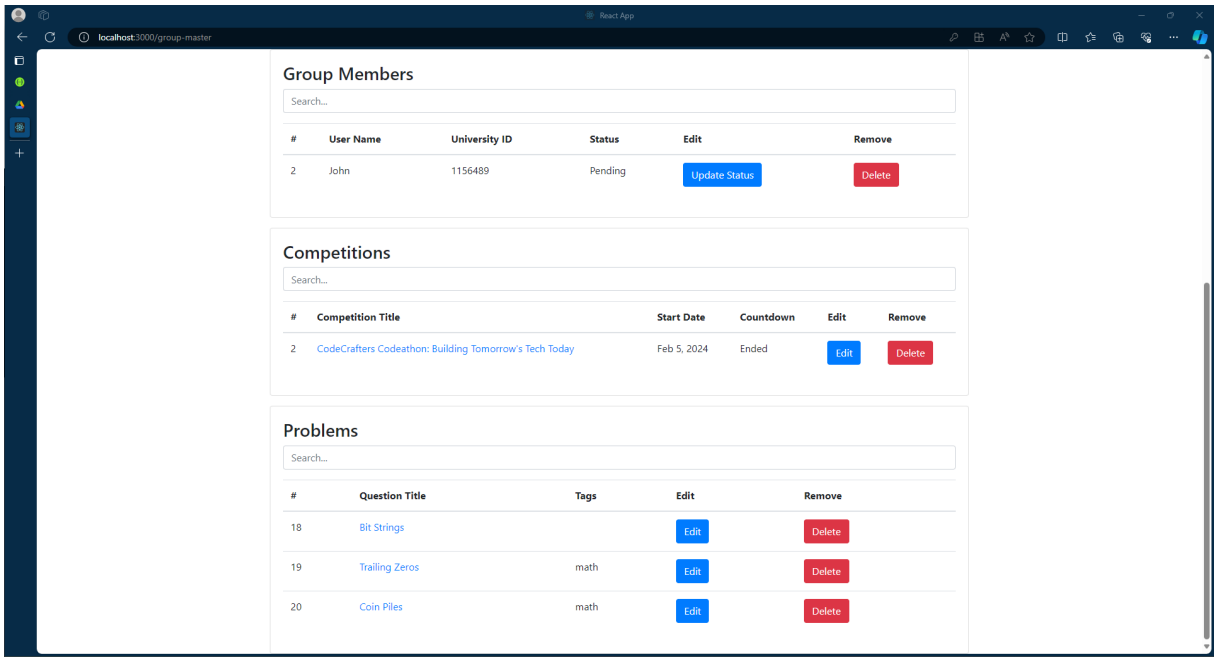


Figure 4.28: Group Master Page 2

4.2.20 Edit Group Information

Only the group master can edit the group title and descriptions on this page, as shown in Figure 4.29.

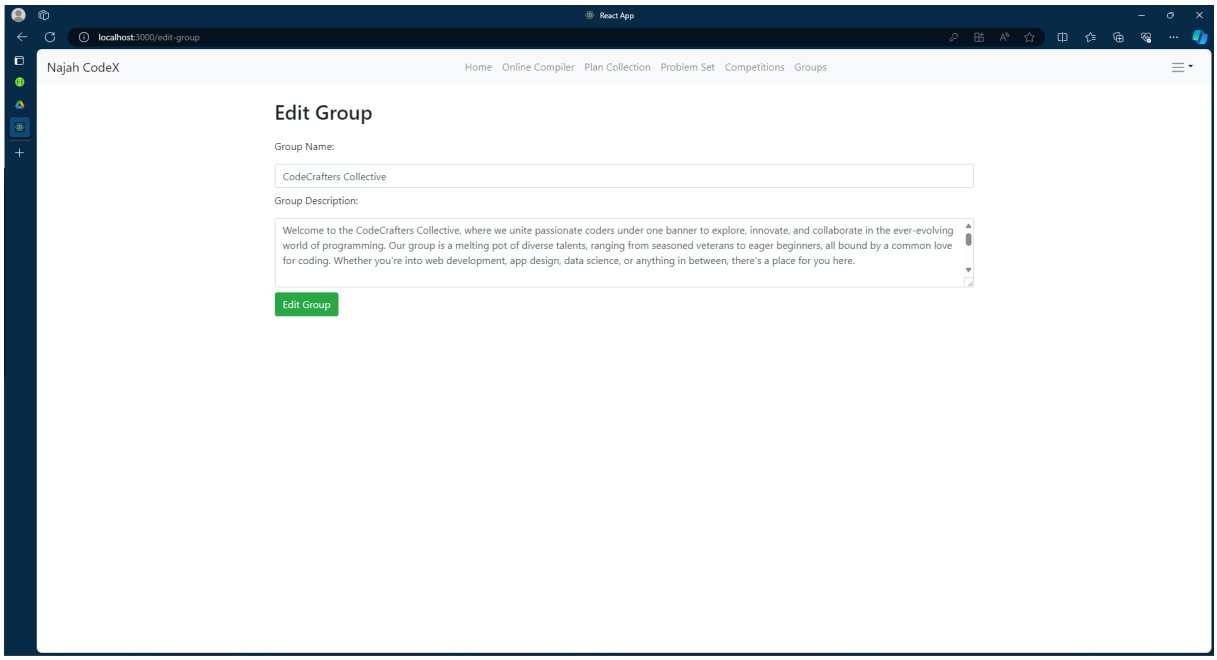


Figure 4.29: Edit Group Information

4.2.21 Mange Users

On this page, the administrator can edit the roles and status of the users, as shown in the Figure 4.30.

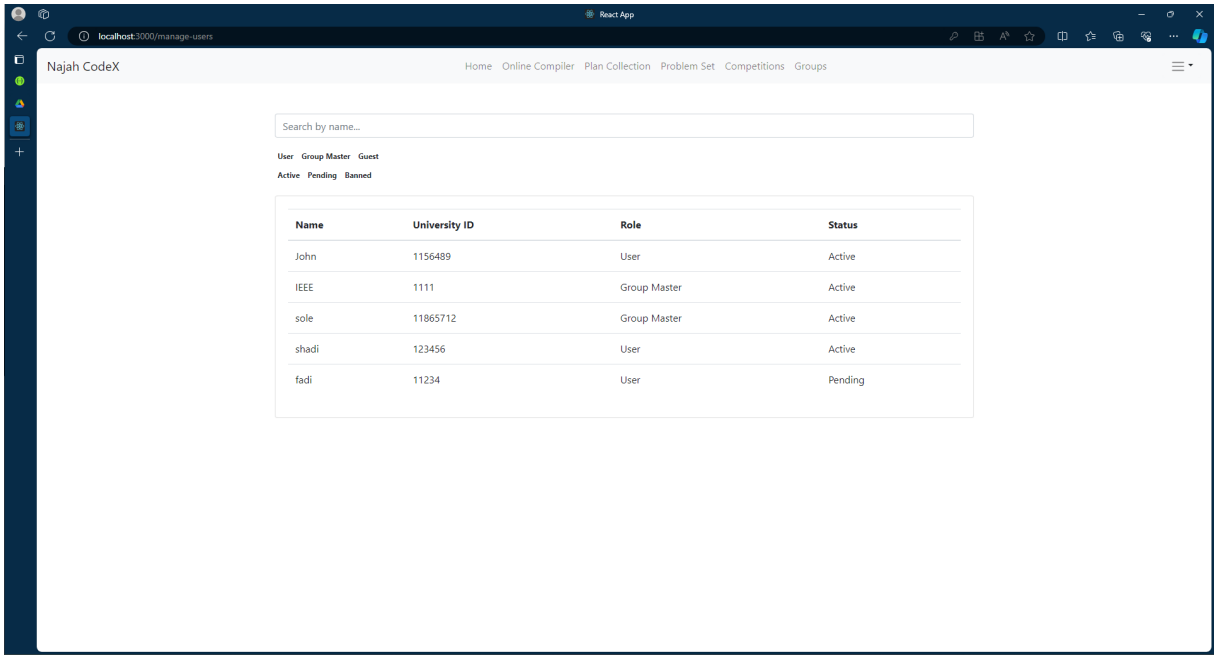


Figure 4.30: Mange Users

4.2.22 Mange Tips

On this page, administrators and group masters can add tips, as shown in Figure 4.31.

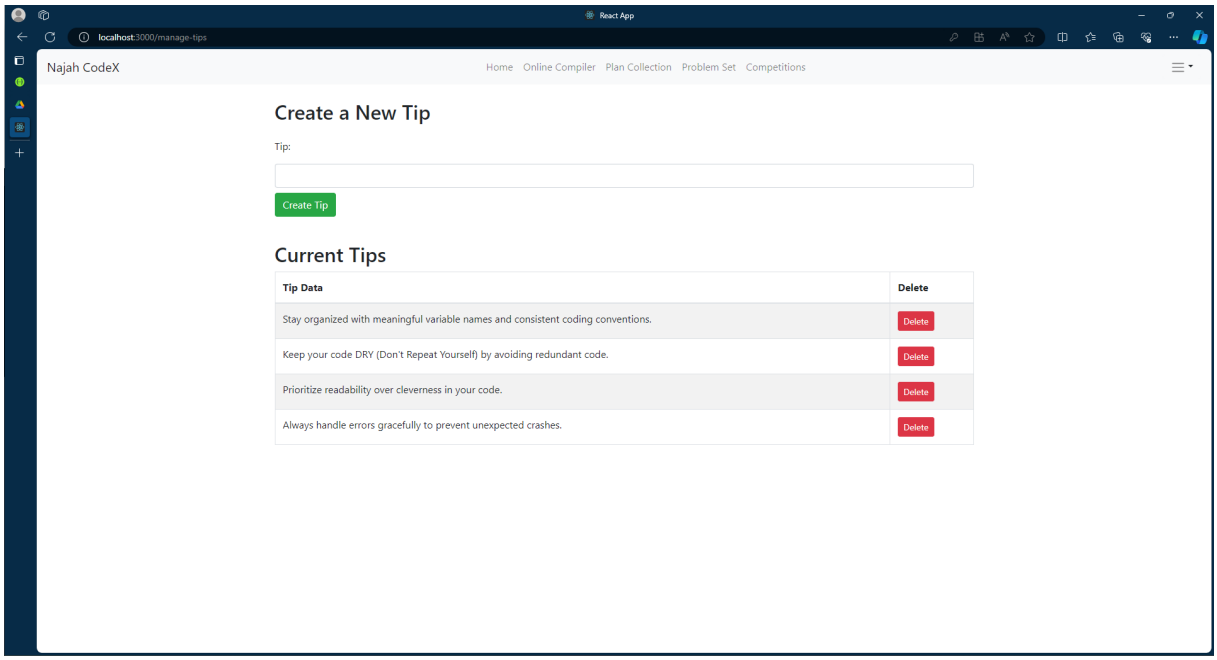


Figure 4.31: Mange Tips Page

4.2.23 Online Compiler Page

This page enables users to test their code. Users can write their code, input the data, select the programming language, and then click 'Run Code' to see the output result and execution time as shown in Figure 4.32.

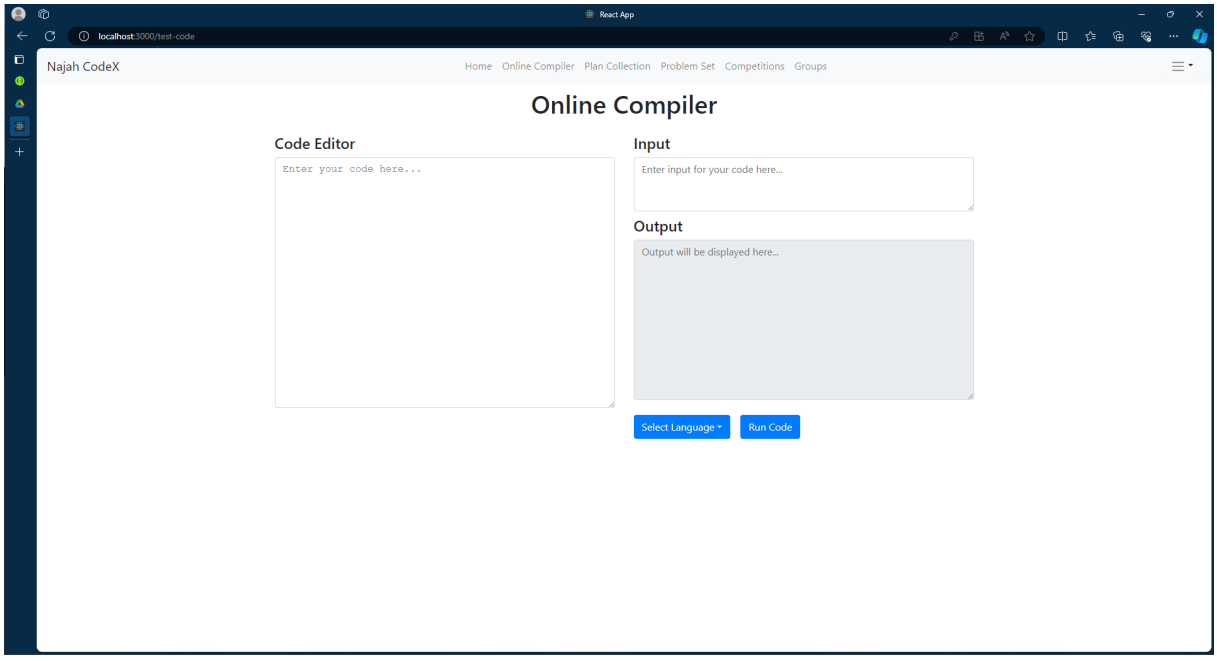


Figure 4.32: Online Compiler Page

Figure 4.33 illustrates the output obtained from executing the code that prints 'Hello, world!' 't' times using the C++ language on the online compiler.

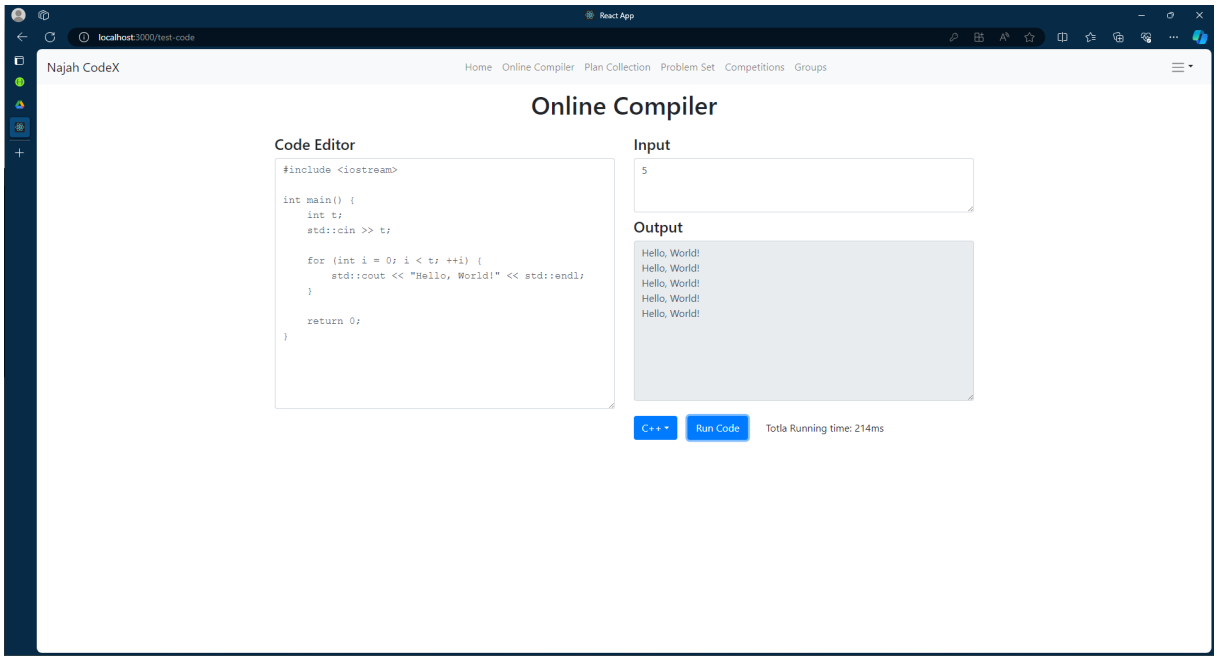


Figure 4.33: C++ code print 'Hello World!' 't' times

Figure 4.34 shows the various programming languages provided by the online compiler for use.

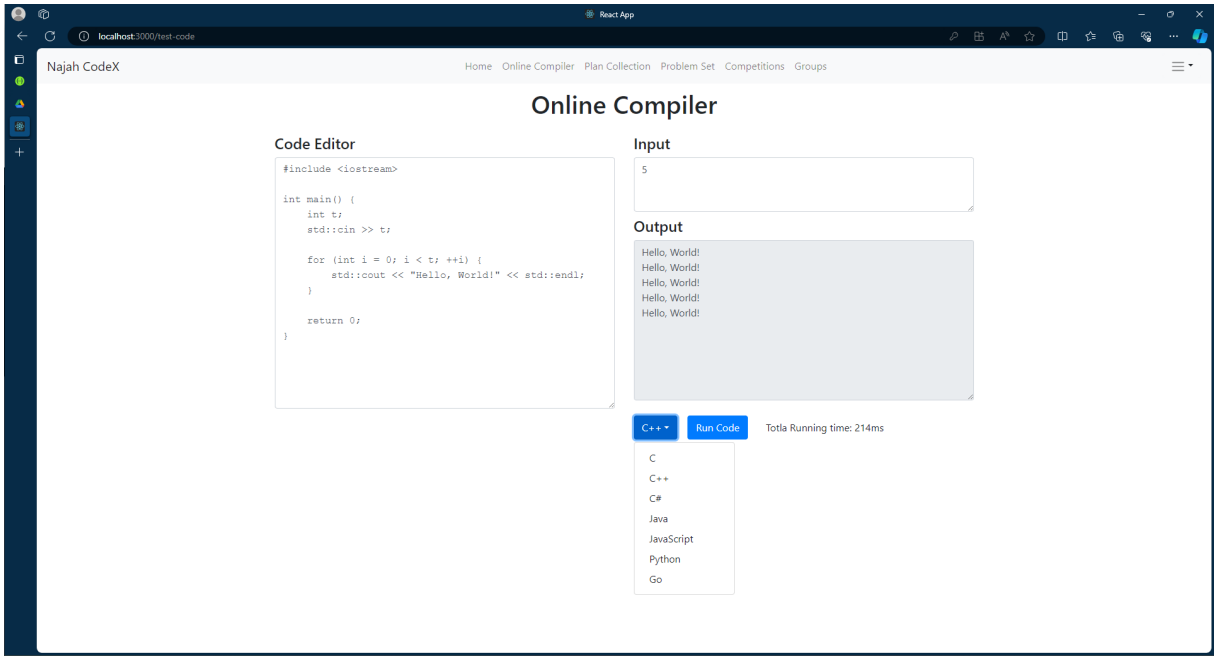


Figure 4.34: Select language drop-down

Chapter 5

Results & Discussion

5.1 Results

NajahCodeX is a platform dedicated to An-Najah University, featuring a website that allows users to perform the following actions:

1. **Enrolling in Plans**: Students can enroll in various plans.
2. **Participating in Competitions and Problem Solving:** Students can enroll in competitions and solve problems. T
3. **Testing Code:** Students can test code through the online compiler page, supporting various programming languages.
4. **Joining Different Groups:** Students can join different groups.
5. **Group Management:** Group masters can create groups, manage them, and follow their progress.
6. **Administration Tasks** Group masters can admit users to groups, create problems, competitions, and plans, and publish posts.

5.2 Discussion

NajahCodeX offers several key features that cater to the needs of its users:

1. **User-Friendly Registration:** The platform provides a seamless registration process, enabling users to sign up quickly and efficiently. This ease of registration enhances user experience and encourages active participation on the website.
2. **Support for Popular Programming Languages:** NajahCodeX supports a wide range of programming languages, including C, C++, Java, and Python. These languages are commonly used in competitive programming and are essential for students to develop proficiency in. By offering support for these languages, NajahCodeX facilitates skill development and prepares users for real-world programming challenges.

Chapter 6

Conclusion & Future Work

6.1 Conclusion

In conclusion, NajahCodeX offers a comprehensive platform tailored to the needs of An-Najah University students. With features such as enrollment in various plans, participation in competitions and problem-solving activities, and the ability to test code in multiple programming languages, NajahCodeX empowers students to enhance their programming skills and engage in collaborative learning environments. Additionally, the platform facilitates group formation and management, allowing group masters to oversee group activities and administer tasks such as admitting users, creating challenges, and publishing posts. Overall, NajahCodeX serves as a valuable resource for students and group masters alike, fostering a dynamic and supportive community for learning and growth.

6.2 Future Work

NajahCodeX has potential for further enhancement in several areas:

1. **Notification System:** Implementing a notification system to alert users about new posts, announcements regarding competitions, and other relevant updates can improve user engagement and communication efficiency.
2. **Language Coverage:** Covering most programming languages.
3. **Security Enhancements:** Introducing additional security measures and features to safeguard user data and ensure the integrity of the platform will enhance user trust and confidence in NajahCodeX.