

Competitive Programming Website

Syed Qaseem Hasan, Anika Bisht, Shashank Dwivedi, Saurav Pratap Singh, Shivansh Srivastava

Dept. of Computer Science

Babu Banarasi Das Institute of Technology and Management.

Lucknow, Uttar Pradesh, India

Abstract -- As a final year student, we have come to comprehend that coding rounds and tech interviews require competitive coding, however a whole lot of college students conflict with finding right guidance or sources to clear these rounds, although they find some helpful articles or tutorials, they depart from it after a while because of various reasons a number of them being: Absence of a proper guide/support, no community they are able to depend on or be a part of, as well as, lack of competition which can elevate them. Students around me struggle to apply their DSA knowledge practically because there's a lack of hands-on coding. Due to the pandemic situation that arose, there was lack of interaction between seniors and juniors. No way to pass on the interview experiences and what not. Also, another thing that matters is finding friends that share the same interest as we do. A group of people with a common purpose helping each other, competing with each other, and ultimately driving each other's motivation to get placed into their dream agency. Our project aims to accomplish such tasks.

I. INTRODUCTION

This project at its core would be a cloud-based code submission and evaluation website for competitive programming alongside community support. This website would primarily be for learning data structures and algorithms and practicing hands-on programming to crack difficult coding rounds of tech-based companies. Other purposes would be sharing interview experiences (of course by alumni), hosting weekly or monthly coding contests, writing technical articles or blogs, among other

related stuff. This website would have an ONLINE JUDGE for evaluating submitted code. It would also have video lectures and coding question archive for different categories like graphs, arrays, binary search, etc. so they can hone their learning and keep practicing questions. Online Judge (OJ) that we will be using would take help from HackerRank API for source code compilation in the language preference of the user. The HackerRank for Work API is organized around REST. The API has predictable, resource-oriented URLs, and uses HTTP response codes to point API errors. It uses intrinsic HTTP options, like HTTP authentication and HTTP verbs, which are understood by off the-shelf HTTP clients. It supports cross-origin resource sharing, allowing us to interact securely with their API from a client-side web application (though we should never expose our secret API key in any public website's client-side code). JSON file is returned by all API responses, together with errors. This Project would perform as a full-fledged Competitive coding website much like HackerRank however with additional features to make it better. The end-product will be a web application which an administrator can utilize to set problems and create DSA learning resources with the help of seniors and masters of the field. The application will be developed using: ReactJS in the front-end, the database will be MongoDB and the back-end will be composed of ExpressJS and NodeJS entities. Thus, MERN is the technology stack on which the web application will be built because most of the operations in the project will be I/O based and NodeJS is the best tool to handle asynchronous calls. The data will be transferred in the form of a JSON contract for simple and easy interpretation. Thus, this web application will solve the critical need for skills that are to be possessed by the individuals graduating out of the college as demanded by the IT industry.

This paper is organized as follows. After this introduction, we will concisely discuss some other connected programming websites and related work in this field. After these reviews, we move to the proposed work and methodology used in our project. In the end, we lightly discuss some conclusive and future works.

II. LITERATURE REVIEW

A. Existing web applications

The following are the observations based on our review of the existing systems.

a. HackerRank: HackerRank is a coding platform that enables programmers from all over the world to solve coding challenges. HackerRank supports a range of programming languages (including Java, C++, PHP) and span over a variety of computer science domains. Once the website user submits a solution to a programming challenge, the submission is scored based on the accuracy of the output. Users are then ranked globally on the HackerRank leaderboard. Additionally, HackerRank also hosts contests (often stated by HackerRank as "Code Sprints") where programmers compete on a specific set of programming challenges through a brief period of time and are then ranked at the conclusion of the event. HackerRank also permit organizations to recruit programmers based on their performance. HackerRank is seen as a market leader in the growing competitive trend within the computer programming side, while the user-side of their website is free for learning and to practice to code.

b. CodeChef: It is a worldwide known competitive programming platform which supports over fifty programming languages and includes a massive community of programmers that helps students and other computer professionals test and enhance their coding skills. Its objective is to provide a platform for implementation, execution, competition and improvement for both students and professional software developers alike. Codechef conducts regular practice contests for

ACM-ICPC and conjointly conducts monthly contests to giveaway prizes. Apart from this, it aims to reach out to students while they are young and drill a culture of programming in India.

c. LeetCode: LeetCode is one of the foremost well-known online judge platforms that you can use to practice your programming skills by solving coding questions. It has over 1,100 different problems, support for over 18 programming languages, and a lively community that is always there to assist you with the solutions you come up with. If your intention is to hone your coding skills for getting placed, then this online judge platform is one of the best that you can use. It also makes it even more effective if you're using it to prepare for technical interviews, as it permits you access to any company-specific programming questions that you can use to have a better grasp of what you can expect from the questions you'll face in interviews with companies like **Google, Facebook, and Microsoft**, making it the ideal online judge to use if your sights are set on one of these FAANG companies. However, as a tool for interview preparation, it's lacking in certain areas. One of the cons that LeetCode has is that, while you can see the solution to problems, they don't have an in-depth explanation of the DSA or systems design concepts you're using to solve these programming questions, which is a crucial part of the learning process.

Table 1. Comparison of different Competitive Programming Websites on the Internet

HackerRank	Codechef	LeetCode
Beginners and people interested to start programming use this system.	Experts in programming would prefer using this system.	People with intermediate skill set use this system.
The difficulty level of the problem given in this system increases gradually.	The given problems are complex.	The problems are for preparation purpose, hence, varies in difficulty
HackerRank specializes in providing various categories of problems to solve.	Codechef is more of a competitive environment focused with lots of contests every week.	While leetcode is suited more for self-learning purpose and for testing ones abilities to solve common interview problems.

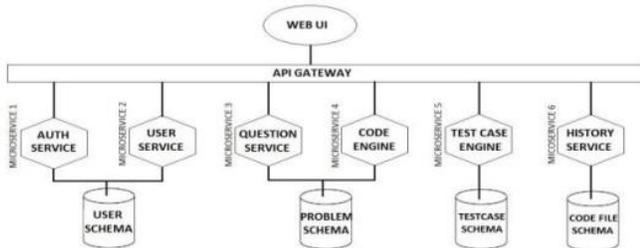
The drawback of this system is that it has editorial section to view several solved solution to a problem and thus test cases can be solved easily.	Codechef has no options to view the test cases like that of HackerRank and has a good standard of questions to solve.	A major drawback is lack of tutorials and helpful code.
Large Community of People and Students use this system, mainly, to learn and hone their programming.	Has huge number of International active users and is used for hosting national as well as international contests.	Students usually go for leetcode in the final stretch of the student life to prepare for IT jobs.

III. PROPOSED SYSTEM

A. Coding platform is a technology that focuses on competitive programming tasks for college students and IT professionals alike. C, C++, Python, and Java are among the various coding languages that can be used to deal with programming questions. When a student submits a solution to a programming assignment, their submission is graded based on how accurate their output solution is. Students are then ranked on the leaderboard and given badges for their achievements, in order to encourage competitiveness among them. The most essential aspect of this approach is that it identifies students' strengths and weaknesses based on their performance, allowing them to improve accordingly. Faculty can update problems with test cases at any time, assign tasks to students, and hold semester practical exams with this system. During placement

season, we can request recruiters to conduct coding rounds in this platform which might impress the recruiters.

Fig 1. Module Diagram



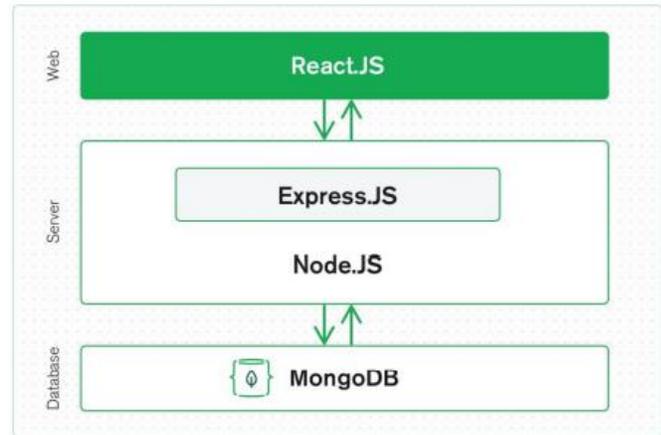
Technology Stack Used

We chose MERN stack for our project because of its incredible versatility, ease of usage, and cost effectiveness. MERN is one of various variants of the MEAN stack (MongoDB Express Angular Node), where React.js replaces the usual Angular.js frontend framework. MEVN (MongoDB, Express, Vue, Node) is another variation, and any frontend JavaScript framework can be used. After the four major technologies that make up the stack, MERN stands for MongoDB, Express, React, and Node for the four key technologies that make up the stack.

- MongoDB - document database
- Express(.js) - Node.js web framework
- React(.js) - a client-side JavaScript framework
- Node(.js) - the premier JavaScript web server

The MERN architecture allows us to easily construct a 3-tier architecture (frontend, backend, database) entirely using JavaScript and JSON.

Fig 2. Technology Stack Used



The Three Tier Architecture We Are Gonna Follow Is:-

- React.js Front End** React.js, a declarative JavaScript framework for generating dynamic client-side apps in HTML, sits at the top of the MERN stack. React allows us to create complicated interfaces by connecting them to data on our backend server and rendering them as HTML. React excels at handling stateful, data-driven interfaces with minimal code and effort, and it comes with all the bells and whistles we'd expect from a modern web framework, including excellent support for forms, error handling, events, lists, and more.
- Express.js and Node.js Backend tier** The Express.js server-side framework, which runs inside a Node.js server, is the next step down. Express.js describes itself as a "quick, unopinionated, minimalist web framework for Node.js," and it is precisely that. For URL routing (matching an incoming URL with a server function) and handling HTTP requests and responses, Express.js includes strong models. We can connect to Express.js functions that power our application by sending XML HTTP Requests

(XHRs), GETs, or POSTs from our React.js front-end. To access and change data in our MongoDB database, those functions use MongoDB's Node.js drivers, either via callbacks or promises.

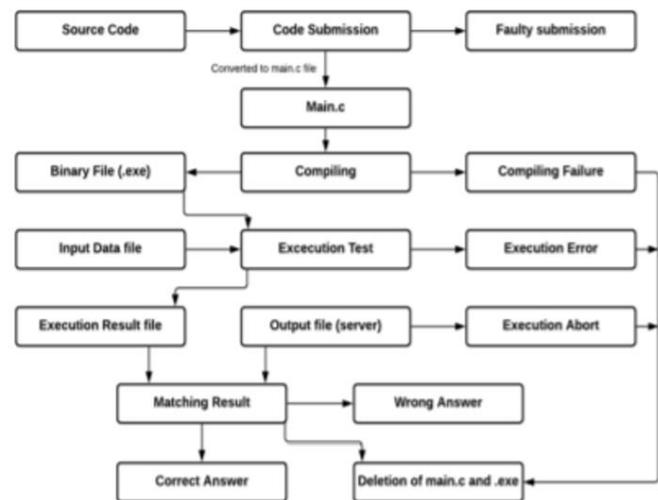
- iii. **MongoDB Database Tier** If our app saves any data (user profiles, content, comments, uploads, events, and so on), we'll need a database that's as simple to use as React, Express, and Node. JSON documents created in our React.js front end may be transmitted to the Express.js server, where they can be processed and (if they're valid) stored straight in MongoDB for subsequent retrieval.

IV. PROPOSED APPROACH

A programming contest is a competition in which participants strive to solve a set of programming tasks, commonly known as problems, in a predetermined period of time and under certain time and space constraints. A single task can be split into subtasks of increasing complexity: some of the subtasks are most complex, requiring very particular algorithmic approaches and data structures to accomplish within the given time and/or space constraints; others are the easiest, requiring only fundamental techniques. Among the programming contest, we mention 1. The International Olympiads in Informatics (IOI), that is an annual programming competition for secondary school students patronized by UNESCO. <http://www.ioinformatics.org/> 2. Google Code Jam is based on multiple online rounds that conclude in the World Finals. <https://code.google.com/codejam/>. 3. Facebook Hacker Cup, that is an annual worldwide programming competition where hackers compete against each other for fame, fortune, glory, and a shot at the coveted Hacker Cup. <https://www.facebook.com/hackercup/>. 4. The ACM International Collegiate Programming Contest (ICPC) is a multitier, team-based, programming competition operating under the auspices of ACM. <https://icpc.baylor.edu/> In general, students participating in programming contests

have at disposal several programming contest platforms, including Codeforces, USACO, COCI, TopCoder, Codechef, and HackerEarth, which run contests with different periodicity. The programming languages allowed in the competitions vary considerably: for example, IOI and IIOT accept only C, C++, and Pascal; ICPC adds to the list also Python (both 2 and 3), Java, and Kotlin. The system we will be implementing would have the option to chose among C, C++, Python (2 & 3), Java, JavaScript, and other languages that HackerRank supports. Since we will be using Hackerrank's developed compilation tool through its API. It would only require giving the api information about the language and the source code itself to get the compiled code which we can run and compare the result against predetermined tests. After entering a contest, the problem list page displays the problem's headline information. Each problem page includes a title, description, code editor, and input editor, as well as a display section. Inner frame approach to preserve the same page without a page transition.

Fig 3. Judgement Process Flowchat



Sample data, implementation hints, and an input form for uploading source code as an answer are all shown in the Problem description. The implementation is divided into two parts: the compiler page, where the user simply codes and runs it with no problem statement, and the problem statement page, where the user is presented with a list of problems to solve, and when the user selects a problem to solve, the user output is compared to the actual output on the server. Here when the user will submit code it will be converted to a file on the server-side which will be named as for c language main.c for Java language main.java and same as for python. That generated file will be converted to a machine code file with the help of compilers and executors for the C language. It will be .exe for Java it will be a class file. If there is an error in the code that error will be push on a user side and if the code compiles successfully then executing the compiled file will produce an output file that output file will be compared with the actual output file which was embedded with problem statement output file if both the output file get match successfully with no any differences then it is a correct verdict otherwise it is a wrong verdict and this message will be e shown to the user as a response of his submission code and as the response has sent to the user then all server-side generated file that is compiled file and the executable file will be get deleted then the process has been completed. Based on the successful completion of the task that is with the correct verdict the user will be rewarded with scores. The sole website administrator has the authority to add a problem statement on the server-side and to inspect a list of problems on the problem statement page. The description of a problem statement and its output will be in the form of a file.txt, and there will be a form with fields such as the title of the problem, its description, a field to submit the description of the problem statement file, and the output of problems (file).. There will be a profile page where the user can see their activities list examples like solved problems and their credential. MongoDB database handle all user credential, user activity (submission), problem statement database MD5 algorithm is used to encrypt the user credential like password mail, etc.

V. CONCLUSION

This brings us to the end of our suggested approach for developing our online judging system. Aside from that, we'll build a points system and a dynamic scoreboard to recognise the best coders on the site. To earn points, daily/biweekly competitive rounds would be held. Introducing an alumni feature and an instructional forum with various DSA lectures and articles would be additional features. All of this would be accomplished with the help of the Reactjs framework and front-end programming. We'd like to point out that competitive programming contests emphasise problem-solving and contribute to development of coding abilities. We conducted a literature review and gathered data in order to acquire the desired results. The results of a programming competition will be stored in a database system. We've put it to the test and it delivers competitive results. It can examine and handle prospective programming contests. We have designed many activities that provide training for online programming contests. We're also considering expanding the scope of this project. We've spoken about introducing an Interview Experience zone in the long term so that our college graduates can share their company interview experiences with the juniors. We can include an archive of interview questions asked in various product-based companies for student preparations later in the work. Students will gain a lot of knowledge about placement procedures and will be capable to ace most technical interviews this way. Another potential future collaboration would be with our college's training and placement department, which might advertise the companies coming for placements on our website's placement tab. Finally, we'll include integration with a user's progress on various CP websites, as well as Github. This means they can see all of their achievements on one page and use them in their resume. Because employers visiting our campus will be checking their CodeFrat profiles through the Tnp department, this will help them stand out.

It's become a cliché that computers excel at mundane, repetitive activities. Reviewing students' homework is one

of those tedious, repetitive duties for teachers, especially when there are many students and assignments. Here, any computer assistance is greatly appreciated. However, computers are not up to the task in many disciplines, at least not yet, but we are fortunate that we can utilise tools like those used to manage programming competitions to take care of that chore in programming. Automatic judges have been designed mostly for imperative languages; they tradition-ally work by inspecting the input-output behavior of programs. Yet, we have been using them with Haskell and Prolog, which are not imperative, and for which input and out-put is not a technique that is learned in the earlier stages. For making automatic judges work with Haskell and Prolog we had to adapt them and in the process we discovered that, avoiding the complications of input and output, we were able to start using automatic evaluation much earlier in the courses. This potential encourages a new teaching strategy in which all exercises and assignments are submitted to the judge from the beginning, with prompt feedback to the students. Students' productivity, as measured by programmes produced and submitted, increases dramatically in this manner. Furthermore, making everyone's achievements and failures visible helps to foster a challenging working environment and a strong feeling of community. Learning becomes more fun and gratifying as a result of this. Students become familiar with competitive programming as a result of the techniques used to evaluate their programmes. Many people like being in the top spots in the automatic judge's rankings, even if they have little bearing on the course. We can expect that some of them will have been bitten by the competitive programming bug and will now create teams to participate in real programming tournaments.

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