

AutoCodeEval: A Web-Based Automatic Programming Assignment Evaluator

Kancherla Santoshi^{#1}, Dabbeeru Priyanka^{#2}, Y. YesuJyothi^{#3}, Ramesh Yajjala^{#4}, Kaki Leela Prasad^{#5}, Pallantla Sravya^{#6}

^{#1}Assistant Professor, Dept of Information Technology, GMR Institute of Technology, Razam, Andhra Pradesh-532127.

^{#2}Assistant Professor, Dept of Computer Science and Engineering, Aditya Institute of Technology and Management (AITAM), Tekkali, Andhra Pradesh-532201.

^{#3}Assistant Professor, Dept of Information Technology, Shri Vishnu Engineering College for Women, Vishnupur, Bhimavaram, Andhra Pradesh-534202.

^{#4}Assistant Professor, Dept of Computer Science and Engineering, Rajiv Gandhi University of knowledge Technologies, Srikakulam, SM Puram Etcherla Srikakulam-532402.

^{#5}Assistant Professor, Dept of Computer Science and Engineering, Maharaj Vijayaram Gajapathi Raj College of Engineering (Autonomous), Andhra Pradesh-535005.

^{#6}Assistant Professor, Dept of Computer Science and Engineering, GVPCE College, Visakhapatnam, Andhra Pradesh-530048.

Abstract—Courses in computer science are becoming more and more popular every day. As a result, more students are registering for this course. The faculties give students a variety of programming-related assignments to help them perform better, but the evaluation procedure is not simple. Assignment evaluation has grown to be a hassle for teachers. The process of compiling and testing programs with various inputs takes a lot of time. This project proposes a web platform for such assignments' automatic evaluation and online submission. It has a decreased error rate and can quickly and effectively produce student assignments. The Submit program can make courses, manage enrolled students, make assignments and corresponding test cases, and grade student submissions automatically. The entry can be seen, graded, and comments added by the graders. Different web-based technologies, including HTML, JavaScript, and PHP, can be used to construct this.

Keywords:-Student Assignment, JavaScript, PHP, Programming Assignments, Web-based Technology.

1. Introduction

Nowadays, a lot of students sign up for computer-based courses. They will learn languages like C, C++, Java, Python, and others in these classes. The assignments must be completed everyday by the pupils if they are to advance in these languages. These programming assignments are automatically evaluated using the online evaluator created for this project. With the use of numerous tools and web applications, users' programming skills are evaluated. However, there isn't yet a tool online for assessing Scala programming problems. One of the programs' shortcomings is the fixed set of programming problems. It takes time-consuming steps to compile the answers and test them against the different inputs. An automatic grader that runs on the web can be helpful for programmers learning programming languages. Users have the option to supplement the current issue set with their own programming projects.

Users receive immediate feedback on their responses. If a user doesn't succeed on the first try, accurate and comprehensive feedback encourages him to try again and again until he finds the appropriate solution. As a result, programmers' programming abilities and desire in solving new problem statements both increase.

A web-based automatic grader that provides to programmers looking to advance in this language is essential given the growing significance of Scala in contemporary software development. By providing thorough support for Scala programming issues, AutoCodeEval is intended to close this gap, enabling students to improve their coding abilities and fully utilize Scala's capabilities. The days of predetermined sets of programming issues, which impeded creativity and constrained learning possibilities, are long gone. Users can add their own programming projects to the existing issue set using AutoCodeEval, resulting in a dynamic and

unique learning environment. Users receive immediate feedback through the platform's lightning-fast assessment process, which aggregates answers and compares them to a variety of inputs, enabling them to iterate and improve their solutions without having to wait long periods of time. AutoCodeEval's dedication to offering accurate, thorough and constructive real-time feedback is one of its main advantages. This ongoing feedback loop acts as a potent motivator, pushing programmers to persevere in tackling difficult problem statements until they obtain the desired outcomes. We at AutoCodeEval are committed to enhancing programmers' skills and igniting their enthusiasm for tackling brand-new issue statements. Our objective is to provide students with the resources and assistance they need to succeed in the Scala programming environment. By joining us on this adventure, you will realize your full potential and lay the groundwork for a fruitful and fulfilling career in programming. Therefore, AutoCodeEval is your ultimate destination for honing your programming skills and mastering the art of Scala, whether you are an experienced developer or a newcomer eager to embrace Scala's power. Let's start this life-changing learning journey together. Welcome to AutoCodeEval, the intersection of your programming skills and creativity drive.

2. Literature Review

In this section, we attempt to define a list of many models or strategies that are discussed in relation to proposed work and how to evaluate the student's assignments.

The system that was designed to make it easier for instructors to evaluate programming assignments is the subject of this paper, which is a part of the project. This is about a simple tool that helps to solve more problems on programming assignments easily. It reused the course management functionality from the Moodle system that is already in place. It has also examined the student responses to assess how well the system is being used. The Moodle tool is the primary topic of this paper. Thanks to this, teachers can easily create their own questions. The Moodle is can generate the detail report on the student's performance. It also executes java

programs effectively. The main drawback is the students must use their own IDE to execute the programs. There are no inbuilt compilers [1].

The 2TSW system, which employs a test-based methodology in a web context, is described in this article. Students may access assignment checklists in 2TSW and submit, test, and score their own solutions. It's an instructional setting that makes use of a few different gaming mechanics and game design concepts. For instance, levels, leader boards, events, and accomplishments. In this system, results are declared with some medals by student performance in the tasks. This paper aims at increasing motivation learning of course and improving student skills. Providing a competitive environment will make student to work hard and score well than their peers. This gamification method will attract the students feel this system interactive and interesting. This paper also includes plagiarism check for the codes so that mal-practicing will be avoided. In this paper a technique was introduced which boosts up the skills of a learner to learn and solve mor number of programming assignments. It includes a dashboard which consists of a profile of the student and his progress and grades. The badges will be allocated to the solvers according to their performances. Finally, analysis of the students who attempted or not attempted the problem statements will be provided to the instructors. They can download the scorecards of the learners who have access to the websites. The student and the teacher have access to varying degrees of student information via the dashboard, based on their rights. Teachers may get a full presentation of each answer, however students can only receive the most basic information about another student[2].

This paper describes an automated web-based system for grading Java assignments and provides reports on the assessment outcomes for a real programming course. This system receives student-submitted Java application programs as input, and it promptly delivers the assignment results. Compiler verification, JUnit testing, and result verification make up the assessment approaches. The kids can greatly advance their coding abilities thanks to this. By submitting their programs numerous more times, many students caught their errors and made corrections. The

MVC architecture of Struts serves as the system's foundation. As a model, the MySQL DB holds data about students and assignments. The student-submitted programs are received by the server, evaluated, and grades are assigned. This system was used to describe how many students used the system, what kind of problems in them are unsolved, so they can improve themselves. There is not applicable to other programming languages except JAVA[3].

The TF-IDF and cosine similarity algorithms were combined by the author of this research to create an automated assessment system. The connection between students and instructors is simpler on the e-assessment platform than it is during traditional learning, according to the author, who recognized the value of it. The issue with e-learning platforms, according to the author, is that it takes a long time and is ineffective for the teacher to review a large number of evaluations. So the author proposed an architecture where he uses TF-IDF and cosine similarity. Using TF-IDF he tokenizes all possible words, filter the unnecessary words and finally a matrix which is called submission matrix will be generated. To evaluate the effectiveness of the approach, the author employed 105 submitted programs. Among them, 63% of the programs were correctly scored like experts, and 33% were incorrectly graded. Given that the entire evaluation process was carried out by computer, this kind of evaluation is quite effective. Compared to other ML techniques, TF-IDF was extremely quick. To evaluate the effectiveness of the approach, the author employed 105 submitted programs. By using this algorithm, 33% programs were mis-graded[4].

The author developed a web based interface called submit! Which provide student's feedback about the program they write. By providing the feedback students will make use of this system and develop to do better in assignments. The author developed an automated critiquing tool which allows the students to get a critical feedback for the assignment before final submission. Traditionally critiquing was done manually for student to student manually. Lecturers general study the work, run the program, test with a manual data and make comments according to their work. When it comes to for a large number of students

traditional methods will fail as it will be time consuming and inefficient. So author made a programming critique tool which will provide feedback on the submission.

The major objectives of Submit! Project are:

- To create a set of tools that are especially designed to facilitate program criticism;
- To give each tool used in the project a consistent user interface.
- Making sure that usability must be considered in the design of the tools.

The main overview of the project is the construction of an automatic evaluation system for computer programs, which is implemented in selected computing units, and the evaluation of the effectiveness of the system. It is a user-friendly system for students that identified the strengths and weaknesses of students and was able to determine the level of intuition. The assessment process consists of heuristic assessment, observation and questioning of students taking the predetermined tests. Submit! Project was integrated to many universities as this tool works perfectly for the student feedback. Using comments students will get to know about their performance and improve at the areas where needed. Sometimes critiques may not be relevant as these are done automatically by the system[5].

This paper illustrates a technique to assess the student's programming skills. The important benefits that offered by this system are: immediate feedback, consistency of the evaluation of the assignments. This paper had introduced CS2 programming tools course. It also shows how Mooshak can be used to help in the evaluation process of a programming task. This article contains a tutorial on programming tools. PT includes two distinct parts: the first is a theoretical part that deals with testing, debugging, and program and administration. Second part is practical part. Plagiarism detection and program testing are the main methodologies included in this paper. This makes the evaluating the programming assignments automatic. Generate the grades automatically and instructor can download them. The purpose of this paper is to compare the effects of an automated rating system and face-to-face rating. By using this student can perform tasks like Testing, Debugging,

Deployment, and Versioning. It promotes student ability to learn programming tools by gaining knowledge[6].

Drop project mainly concentrated on points like increasing no. of enrolled student's year over year which results on getting grading process harder and consumes more time. The main criteria of this project are submission flexibility. In this teacher can create assignments. Some plugins are required additional files so that they can reduce the possible errors. The task is stored in a Git repository to which DP is connected using standard access keys. Any changes made can be updated with a simple update button. This application is primarily developed using Kotlin and uses the Spring Boot framework. The software functionalities used in this application are standard assignment format, Individual and group submissions, Programming languages, cool-off period, Access- control lists, Test matrix, Mark submission as final, Rebuild submission. This application has a method that is report of submission which generates a page consists of project structure, code quality, compilation, student unit tests and teacher unit tests which is in the perspective of the student. It's architecture is based on MVC architecture. JacocoResultsParser handles parsing student test results, and Junit Test manages the results of each submission. This program's report includes information on how many hidden test cases were completed and how much the student's own tests achieved with the code. In this application, they presented DP, an open-source AAT with a wide range of functions that can support complex. This tool reduces the evaluation effort. Improve grading consistency and increase project difficulty. This allows teachers to understand student problems and reduce their workload. The grading process has become more efficient and consistent across teachers. Finally, it asks for student's feedback to know about the difficulties of students faced during solving the problems. The drawbacks of this project can be eliminated by increasing the range of projects that can be done with this application, and DP can use more languages. The goal is to increase the level of student feedback and optimizes the professor's time[7].

Examines a number of established and recent technologies for automatically grading programming assignments obtaining and displaying important data there will be a comparison and analysis presented to determine the state of the industry now. Then a characterization of the grading metrics is suggested. The Final part includes recommendations for further development. The primary objective of creating or utilizing these kinds of tools is to increase programming abilities in the pupils, devoting particular attention to those who are beginners. Solving problems will help you develop your talents. Various exercises in programming. The students can advance to other tasks as soon as they perform well feedback. They might learn from their errors and develop their abilities with its assistance. A large number of students attend regular engineering classes, and there are a significant exercise in programming, manual grading is not practical. Coding language that was used to create the tool when an institution has a set of policies regarding the software it uses, this feature is extremely important. It would be a useful feature to be able to select a tool for modification or maintenance. Logical structure When a tool is being modified, it is a crucial feature. This architecture will demonstrate the degree of flexibility, scalability, and modularity. It demonstrates the workings of the tool's hardware. It is beneficial to determine if a given environment will permit the use of a tool. The worst-case scenario will provide information on the resources required, which will help determine how much an implementation. The Scalability, maintainability, and security are seen as the key benefits. The provided Java and C++ are the programming languages used for grading, and Java was used in its development [8].

This paper presents the design and implementation of an automatic evaluation system for university programming functions. The main task of counterfeiting is to detect whether the presented software is a stolen copy. Software testing is performed by running a series of test cases on the subject software, which can be generated manually or automatically. Longest Common Sequential (LCS) algorithm. This LCS-based detector attempts to detect plagiarism in

short programs such as programming tasks. For all algorithms, we assume that p_1 and p_2 are the two programs to be compared, ignore all identifiers, and use the number of characters, words, and lines as metrics to detect plagiarism. Calculate and compare the flowcharts (graphs) corresponding to programs p_1 and p_2 . The similarity index is calculated by running the longest common suffix (LCS) algorithm with the programs P_1 and P_2 as inputs, treating the program as a sequence and the words {id, keyword, special symbol} as characters of the sequence. The LCS algorithm computes a graph that again makes one pass, i.e. linear time. The time complexity of LCS using dynamic programming is $O(m * n)$, where m and n are the number of words in programs P_1 and P_2 . The problem is limited to generating test cases. Depending on the method chosen, there are two main categories: manual and automatic. In automatic test case creation, when the author (teacher) submits a programming problem with its model solution, it is taken offline. After automatically creating the test case, actual comparison of the automatic test case output with the software presented in online mode is done[9].

Programming of the presentation and evaluation system (PASS) It was developed for collaborative use by the students and staff. PASS is used to provide C programming tasks, mainly using PHP/ MYSQL to develop server-side functions and front-end technologies such as: HTML / JavaScript to develop interfaces that interact with users. PASS IDEONE makes use of the API most effective for the compilation method the usage of the SOAP protocol. For developing and compiling pupil code,

offerings along with IDEONE.com provide online compilation and debugging offerings. IDEONE is used to offer preferred input and may be taken into consideration as a actual interactive input. Simple Object Access Protocol (SOAP) is a protocol specification for replacing dependent information while imposing net offerings. It makes use of XML Information Set for its message format, and is based on different utility layer protocols often via way of means of HTTP. IDEONE makes use of SOAP specification for having access to the methods. PASS calls for every pupil to login with their Student credentials via way of means of the usage of those credentials are given to the pupil upon registration for his or her program of take a look at which will use IDEONE compiler, college students are required to check in on IDEONE to achieve API credential get admission to which later could be utilized in PASS to call the API compilation/debugging methods. PASS has been advanced primarily based totally the usage of Object-Oriented Programming (OOPS) approach, according to the author in this paperwork[10].

3. Related Work

An automatic grader that may be used online is helpful for programmers learning programming languages. It enables users to add their own programming exercises to the current collection of issues. Users immediately receive feedback on their responses. Even if a user is unable to solve an issue on the first try, precise and thorough feedback motivates him to try again and again until he finds the right answer.

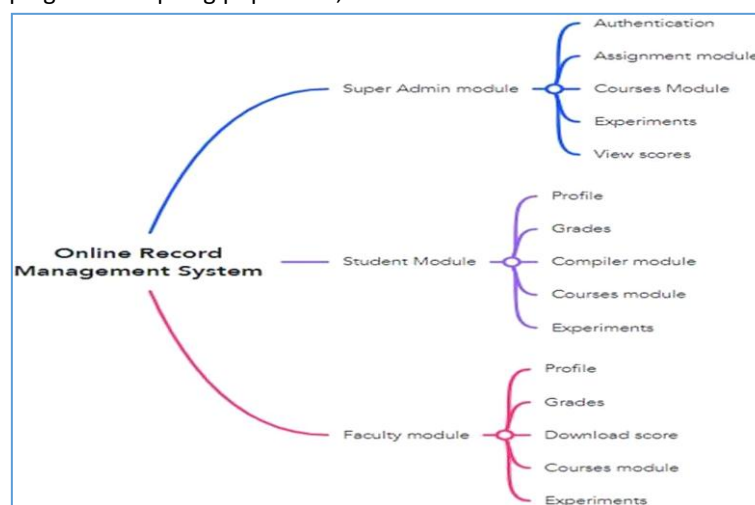


Fig.1: Represent the Mind map

Table 1. Comparison Table

Title of the paper	Methodology Followed	Merits	Demerits
Automatic grading of programming assignments: an approach based on formal semantics.[1]	<ul style="list-style-type: none"> • Labrat and WebLabrat are used for java grading and a web interface. • Enhances for labrat Javabrat is used and a Moodle plugin is used to facilitate instructors to grade the scala assignments. 	The Moodle is can generate the detail reports on the student's performance. It also executes java programmes effectively.	The main drawback is the students must use their own IDE to execute the programs. There is no inbuilt compilers.
2tsw:Automated assessment of computer programming assignments, in a gamified web-based system.[2]	<ul style="list-style-type: none"> • The programming assignments in this case are tested using the 2TSW system. • Gamification technique is used to design game play features. 	Providing a competitive environment will make student to work hard and score well than their peers. This gamification method will attract the students feel this system interactive and interesting. This paper also includes plagiarism check for the codes so that malpracticing -will be avoided.	The student and the instructor can access different levels of student information through the dashboard, based on their access rights. Teachers have access to a full presentation of each answer, however students can only obtain basic information about another student.
Design and evaluation of automated scoring of Java programming assignments.[3]	<ul style="list-style-type: none"> • Compiler Check perform the checking of testcases. • Junit test and result test are used to assess the programming outputs and improve the students programming skills by providing the repeated submissions through the compiler. 	This system was used to describe how many students used the system, what kind of problems in them are un-solved, so they can improve themselves	There is not applicable to other programming languages except JAVA.
Automatic evaluation of programming assignments using information retrieval techniques.[4]	Checking for plagiarism is done using TFIDF. Another method for creating an evaluation platform for the automatic evaluation of programming assignments is cosine similarity.	This is very efficient way of evaluation as the whole evaluation was done by computer itself. TFIDF was a very fast ML algorithm than any other ML algorithms.	To evaluate the effectiveness of the approach, the author employed 105 Submitted programs. This method led to 33% of programs receiving incorrect grades.
Submit! a web-based system for automatic program critiquing.[5]	A web-interface called submit! is used to provide the feedback students will make use of this system.	Submit! Project was Integrated to many universities as this tool works perfectly for the student feedback. Using comments students will get to know about their	Sometimes critiques may not be relevant as these are done automatically by the system.

		performance and improve at the areas where needed.	
Automated evaluation of programming assignments.[6]	Plagiarism detection and program testing are the main methodologies included in this paper.	This makes the evaluating the programming assignments automatic. Generate the grades automatically and instructor can download them.	The limitation is can include methodologies like gamification to create more interest in solving problems.
Drop Project: An automatic assessment tool for programming assignments.[7]	A DP, an open-source AAT with a variety of capabilities, is presented in this study.	The evaluation effort is lightened by this technology. increases the project's difficulty and enhances grading uniformity.	The drawback of this project is that only a few projects can manage it, and only a few languages can be utilized with DP.
Programming assignments automatic grading: review of tools and implementations.[8]	This review paper consists of many tools and implementations for programming assignments for Automatic grading.	This paper focuses mainly on beginner students. Plagiarism is the important module inside this paper.	The main disadvantage of this paper is many tools are used for performing several functionalities.
Automated assessment in programming tools course.[9]	In this case, Mooshak is utilized to assess the issues and support the evaluation of the student's responses.	The benefits of this system are: immediate feedback, objectivity and consistency of the evaluation.	Lack of a proper sample size calculation, which affected the results, is the main restriction.
PASS—A programming assignment submission system.[10]	1. In this paper the PASS components are used to submit the assignments. Developed mostly using PHP for the server side and HTML/JavaScript for the front end.	It benefits both the and instructors. Reduces evaluation and time management problems.	There is no plagiarism checker included.

4. Methodology

1) Online Records Management Module

Online Records Management Module consists of functionalities like executing the problem statements in different programming languages like C, C++, Java, Python. This module will be handled by the super-admin. The admin will update the new questions that should be solved by the students which are included in lab courses. The student will get linked to the courses available in their syllabus and get to know

all the experiments available in dashboard. The entire module handled by the super admin session variable. So, he needs to authenticate to access the records module. The query box is available to resolve all the queries asked by students. This is also helpful for faculty; they can directly download the marks-sheet of the students. The students can improve their skills by learning from their mistakes.

2) Admin Module

Admin module consists of various functionalities like managing faculty and student modules, by updating the assignments and the faults in the interface. All CRUD operations will be done at the admin module. Admin will have full authority on the database. Admin can create database and upload the data and create new data if required. Admin can view and search the data which is existing database. Admin need to upload data from pre-defined structured CSV file. Faculty will send requests to the admin, and he responds to the admin request.

3) Student Module

Student module consists of various features like dashboard, progress bar, assignment, results and basic a profile. Students can check his progress in the dashboard. There will be an assignment link to the student module where he can complete his assignments and get evaluated. After the evaluation the marks will be shown to the student and those marks will also be updated in the backend as well as dashboard. By showing the student progress he will get to know about his faults and he will improve next time. He can edit his secondary details like address, phone number, alternative email id etc., There will be a score board for all his classmates. By seeing that competitiveness will be increased in the student.

4) Faculty Module

Faculty Module consists of various functionalities like Assignment creation, Results viewing, Updating the new questions. Faculty can create a test and pass the link to the students to take the test. Faculty can also view the results of the test and can also download the excel sheet. Faculty can view the grades assigned to the students. Faculty

can make sure that the students are learning the programming skills without errors. Faculty can give suggestions to the students based on their performance. Faculty can have their own credentials to login to the website.

5) Courses Module

Courses Module consists of various functionalities like No. of Courses registered, No. Of Courses available. It consists of a sub-module:

Assignments module.

Assignment Module consists of functionalities like Teacher:

- Creating and scheduling the assignment.
- Downloading the Assignment Results.
- Deleting the assignment which was scheduled.

Student:

1. Taking assignment in the scheduled time.

This module gives immediate results after the submission of test. It has the functionality of auto submission of assignment after the scheduled time gets completed. It has the functionality that which does not allow (ctrl + c) which will not allow coping the question and if more than three times user tries to copy the question the test automatically gets submitted.

6) Compiler Module

Student will submit his assignment; the code gets compiled in this module and it gets evaluated against the test cases. The student score will get calculated as per the criteria and the result will be reflected in the student dashboard. The grade will be assigned automatically based the testcases. ML techniques like gamification is used to give some rewards and points. He can do as many as submissions until the code get compiled, so that he can learn by himself. This makes easier evaluation for instructor. The accurate results will be acquired.

5. Results And Discussions

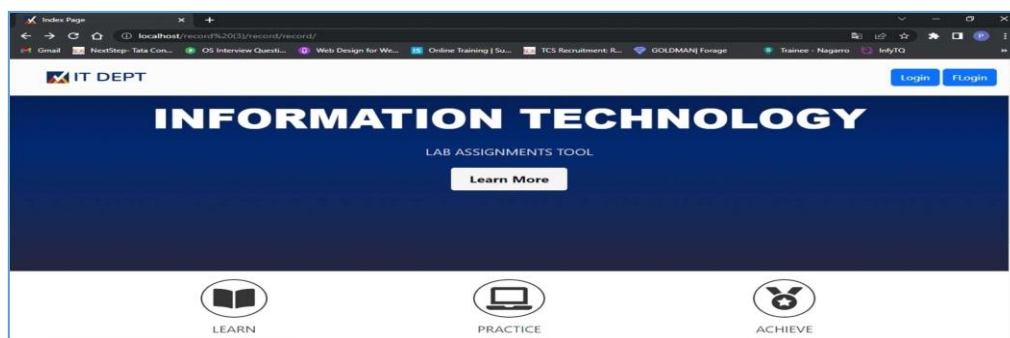


Fig 2. Represents the Homepage

Explanation: From the above figure 2, we can represent about the first interface of Website. Through this interface student and faculty members can easily login into their respective dashboards.

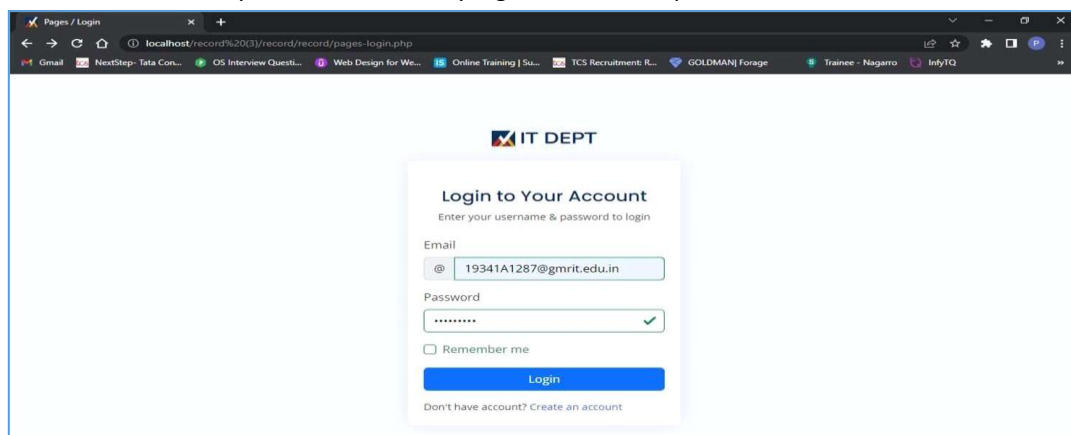


Fig 3. Represents the Login Page

Explanation: It represents about the login page of a student. Based on the login credentials of the student, they can easily get access to that website and take programming assignments.

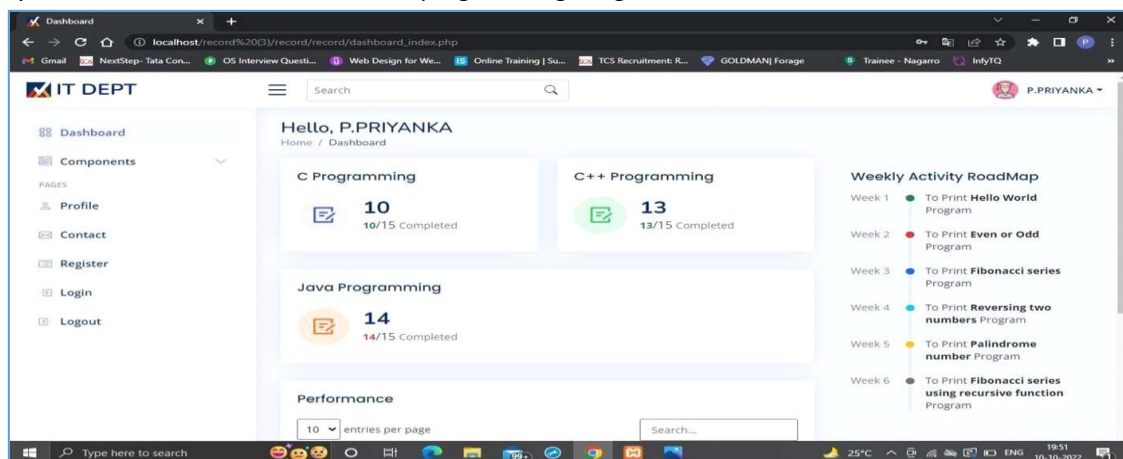


Fig:4 Represents the HomePage of User

Explanation This is the Student dashboard. It contains different features like dashboard, progress of assignment Result and basic profile of student. By showing the student progress he will get to know the Mistakes and easily rectify it.

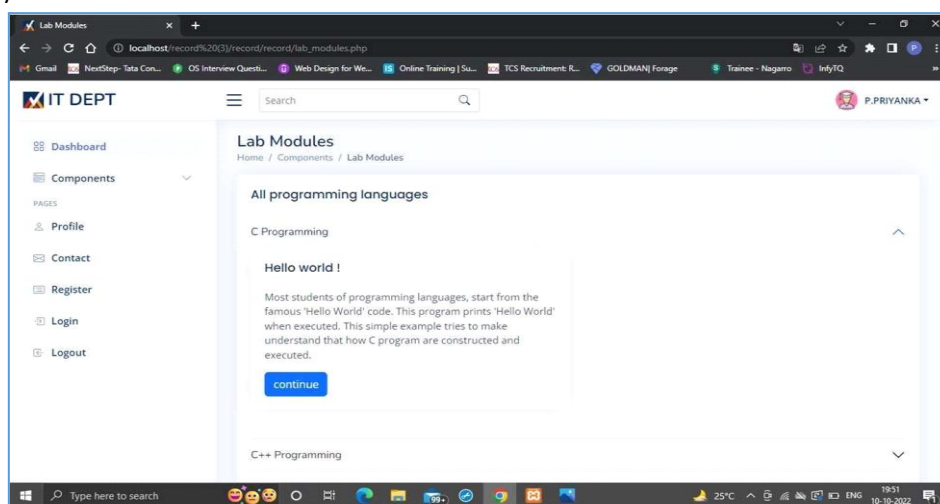


Fig 5. Represents the Modules Description

Explanation: By this Lab module student can easily take the assignment by understanding the given description of question.

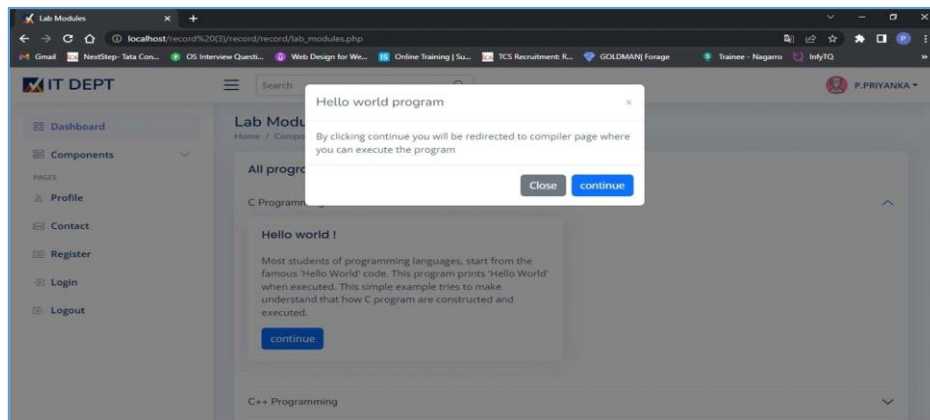


Fig 6. Represent the Question Description Module

Explanation: It contains the question description. By clicking on Continue button student will be re-directed to compiler page

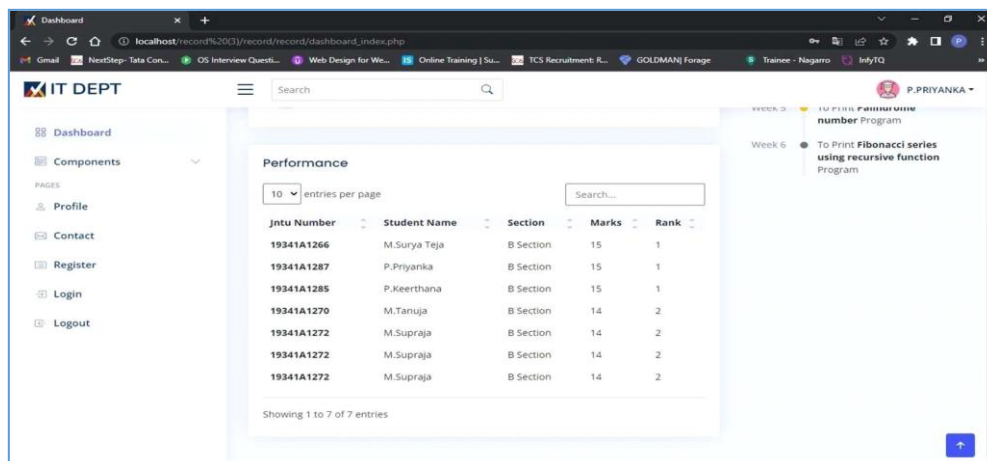


Fig 7. Represents the Performance

Explanation: This is the student performance board. Where the faculty members can see the performance of the student. By seeing this competitiveness will be increased.

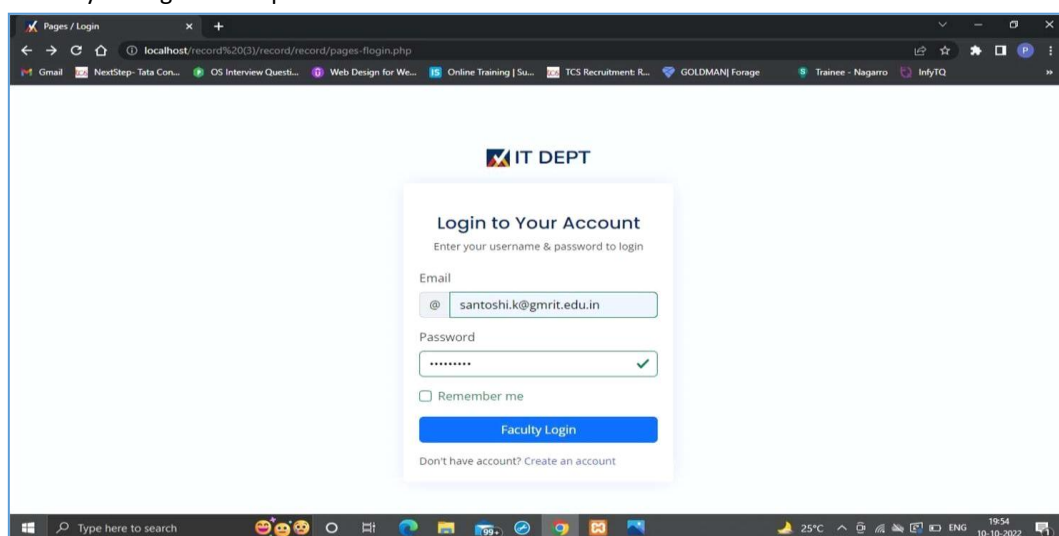


Fig 8. Represent the Faculty Login Page

Explanation: This is the faculty login page where they can login by using respective credentials.

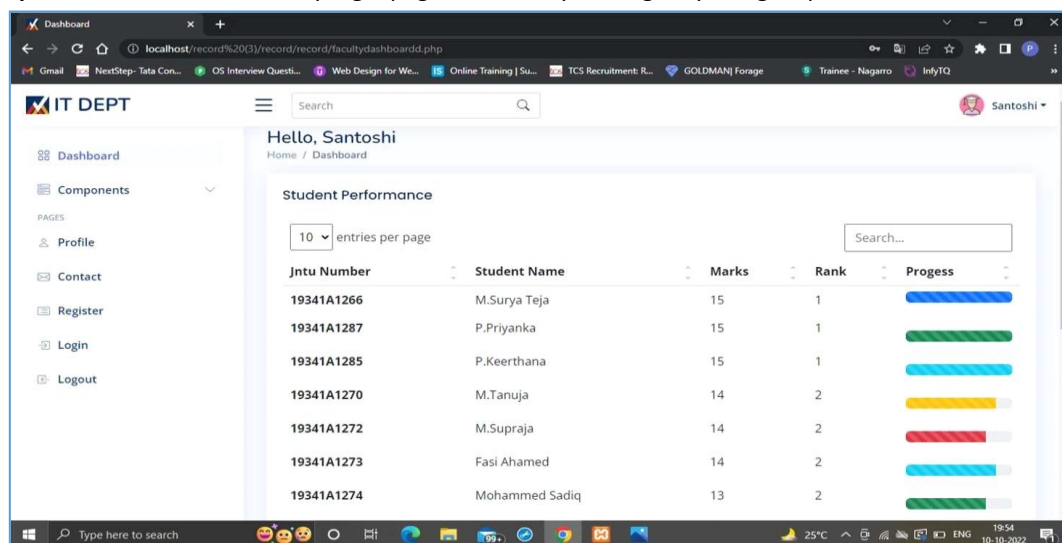


Fig 9. Represent the Students Performance

Explanation: Faculty members can track the progress of the students by seeing this progress dashboard

6. Conclusion And Future Scope

Finally, we draw the conclusion that our approach of assessment frees instructors from having to manually grade student-submitted programs in a course that is program-based. By receiving immediate feedback about the assignment results and rankings based on student performance in the task, this is very beneficial to students in helping them improve their programming skills. It also helps students make better overall progress because the detailed feedback encourages him to try the problem again until he finds the right answer. By submitting their programs again and again, many students caught their errors and fixed them. This project's cap of 50 submissions is one restriction. By purchasing subscriptions based on our needs and the number of pupils, this may be enhanced.

Conflict Of Interest

The author declares there is no conflict of interest.

7. References

- [1] Liu, Xiao, et al. "Automatic grading of programming assignments: an approach based on formal semantics." 2019 IEEE/ACM 41st International Conference on Software Engineering: Software Engineering Education and Training (ICSE-SEET). IEEE, 2019.
- [2] Polito, Giuseppina, Marco Temperini, and Andrea Sterbini. "2tsw: Automated

assessment of computer programming assignments, in a gamified web based system." 2019 18th International Conference on Information Technology Based Higher Education and Training (ITHET). IEEE, 2019.

- [3] Akahane, Yuki, Hiroki Kitaya, and Ushio Inoue. "Design and evaluation of automated scoring Java programming assignments." 2015 IEEE/ACIS 16th International Conference on Software Engineering, Artificial Intelligence, Networking and Parallel/Distributed Computing (SNPD). IEEE, 2015.
- [4] Rahaman, Md, and Abu Sayed Md Latiful Hoque. "Automatic evaluation of programming assignments using information retrieval techniques." Proceedings of International Conference on Computational Intelligence and Data Engineering. Springer, Singapore, 2019.
- [5] Pisan, Yusuf, et al. "Submit! a web-based system for automatic program critiquing." Proceedings of the fifth Australasian conference on Computing education-Volume 20. 2003.
- [6] Kaushal, Rishabh, and Ankita Singh. "Automated evaluation of programming assignments." 2012 IEEE International Conference on Engineering Education: Innovative Practices and Future Trends (AICERA). IEEE, 2012.

- [7] Cipriano, Bruno Pereira, Nuno Fachada, and Pedro Alves. "Drop Project: An automatic assessment tool for programming assignments." *SoftwareX* 18 (2022): 101079.
- [8] Caiza, Julio C., and José María del Álamo Ramiro. "Programming assignments automatic grading: review of tools and implementations." (2013): 5691-5700.
- [9] Alemán, José Luis Fernández. "Automated assessment in a programming tools course." *IEEE Transactions on Education* 54.4 (2010): 576-581.
- [10] Domenach, Florent, and George Portides. "PASS—A programming assignment submission system." 2015 International Conference on Interactive Mobile Communication Technologies and Learning (IMCL). IEEE, 2015.