# Part 2 – Project

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| Title: Automated Task Assessment for Computer Science (Future Marker) |
| What general areas does your project fall under? Computer and Information Science Education, Human Factors, Cloud Applications, Machine Learning. |
| What specific areas does your project fall under? Cross-platform mobile application, Web Application, and Assessment Automation. |
| What is the main problem that you are solving? Computer Science degrees are very popular study programs worldwide. A core topic in computer science is to learn programming skills. Programming is also related to several fields of technology, hence many university students -in various programs- study it. Novice programming students require to practice as much as possible to enhance their problem solving and programming skills. A key tool for instructors is setting assignment for students to encourage them to practice more. However, to gain the most required result from such assignments, quick and detailed feedback is required.  The main problem with the traditional manual assignments marking is that the instructor usually need to spend a lot of time and efforts to check and mark every student's code and to write a report for every student on each assignment to give feedback for the submission that inform him that his submission was good enough or not, and advise students about the mistakes that they did and what points they have missed. Instructors also need to set a clear grading policy and give students a breakdown of the grading criteria [1]. The time required to achieve this would usually mean late feedback delivery to students, it may take days and sometime weeks for a student to know his/her marks. furthermore, the accuracy of the marking or writing feedback may decrease as the number of students increase, in addition to that some students may plagiaries code from the internet or from their friends [2], and it is hard to check plagiarism for each student manually. In addition, student can submit the assignment only once, without being able to submit it again after the feedback he receives with his grade. |
| What is the importance of this problem? By 2020 all the Educational sectors are working hard to improve themselves by using new tools and technologies or improving the old ones [3], Today we can see the importance of following up with the students as fast as possible by monitoring their level, as the instructors can evaluate them by giving them assignment and marking them, but if we are going to talk about the coding and computing we have to admit that evaluating the students by the instructor is not easy and it requires more efforts and time to check the coding level and give them a feedback for every single task, hence providing instructors with easy to use automated code assessment tool that can evaluate assignment in no time with minimum setup, and giving instant feedback to student and send a report for the instructor about each student and what grade they take and what points they miss [4], This will help student to enhance their programming skills vastly through learning from their mistakes, it will also enable instructors to set more assignments without the worry of the time they need to mark it. In addition, it will save a lot of time for the instructors and professors so that they can be more creative with their teaching with the students. |
| What are the current solutions? For many decades automatic assessment has been applied in many forms even before personal computers existed. Automatic assessment had already been suggested by Hollingsworth in 1960 [5].  In many programming courses at tertiary institutions the use of automated assessment has been proved useful through the use of systems like:   * The CourseMaster Automated Assessment System (2001) [6] * The BOSS Online Submission and Assessment System (2005) [7] * Individualized exercises for self-assessment of programming knowledge: An evaluation of Quiz PACK (2005) [8] * ALOHA - A Grading Tool for Semi-Automatic Assessment of Mass Programming Courses (2006) [9] * Easy Accept: a tool to easily create, run and drive development with automated acceptance tests (2006) [10] * PASS - Programming Assignment assessment System (2006) [11] * Automatic marking with Sakai (2008) [12] * Web-CAT: Automatically Grading Programming Assignments (2008) [13] * Programming Task Packages: Peach Exchange Format (2008) [14] * PROGTEST: An Environment for the Submission and Evaluation of Programming Assignments based on Testing Activities (2011) [15] * A System to Grade Computer Programming Skills using Machine Learning (2014) [16] |
| Although many of these systems have showed promising results, the development of most of these systems have discontinued. Hence, they hardly benefitted from the recent technological advancement such as in cloud computing and machine learning. In addition, these systems have been used mostly as on premise solutions within a limited number of institutions without the ability to easily apply them on a wide scale. |
| How will your solution solve the problem? What is new? This project introduces Future Marker (Automated Task Assessment Cloud based System). It will reduce the effort and time consumed by instructors when they assess submitted tasks from students. It will assess tasks in one of two ways. The first one is by using logical technique which begin with compile the code to check for runtime errors, then evaluating typographic layout which is checking for the layout and indentation, besides the identifiers’ name and length and the written comments, then checking code efficiency by running multi dynamic test cases. The second one is by utilizing machine learning and natural language processing to make it even more easy to instructors to setup assignments.  Future Marker will solve many problems for students. It will allow students to submit assignments a number of times customized by the instructor to improve their grades and learn from their mistakes by getting instant feedback from the system. Future Marker will also check and report any plagiarized work through comparing submitted students’ assignments to each other. It will also compare submissions with previous years submissions for similar assignments and automatically search for and report similar solutions online.  Future Marker aims to utilize the recent technological advancement in both cloud computing and artificial intelligence to provide a smart, accessible, and easy to use system for programming instructors worldwide. |
| What is the expected impact of your solution from various perspectives (social, commercial, environmental, etc.)? Our project is going to make a Huge impact in the field of education specially the school of programming, it will help in improving the student performance, and will save time for instructors to improve their teaching material and be more creative in delivering their lessons for the students, furthermore our solution will reduce human efforts which leads to reduce the cost for the organization |
| First Experiment After finishing three main functions from our project which are checking comments in the code, Code indentation and identifiers name and length, we had decided that we have to test it with second year computer science students at Future Academy in a specific programming course which is CSC211 - Programming Language (2).  This experiment consisted of two submissions, after first submission we provide them with grade report showing them how the program evaluate their comments, indentation, identifiers, and after the students see their grade report for each java class, they try to modify and edit their code again for the second submission.  Points scoredThe following graphs shows the improvements in grades for some teams in each section (Comments, Indentation, and Identifiers) in the first and the second submission.  Points scored  Points scored  In addition, we asked them to fill online survey we have created it to see if they are satisfied of this experiment and what is their opinion about our project idea. And here is the result:  Forms response chart. Question title: Do you see your score on FutureMarker  is fair ?. Number of responses: 45 responses.Forms response chart. Question title: Have you ever heard about automated assessment for programming before ?. Number of responses: 45 responses.Forms response chart. Question title: From 1 to 5 what is your opinion about the program in general?. Number of responses: 45 responses.Forms response chart. Question title: Do you see that FutureMarker can help for improving the student's coding skills ?. Number of responses: 45 responses. |
| Give a high-level functional description of your solution. How will it be used? Future Marker has two interfaces one for the instructor and the other for the students contain multi-functional  such as :   * Instructors can create assignments and quizzes * Students can submit assignments * Automated assessment for programming assignment * The system sends automated feedback to students instantly * Instructor can edit assignment grade * The system can check for plagiarism * The system creates report for instructors for each assignment * The system assessments programming code by running multi test cases |
| Give a high level technical description of your solution: architecture, technology, integration, innovative components, etc.\* Future Marker is a 3-tier application architecture that consists of a presentation tier, an application tier and a data tier.   * Presentation tier - This tier consists of web application and mobile application. The web application will be programmed using HTML5, cascading style sheets (CSS) and JavaScript. The mobile application will be programmed using flutter framework to provide mobile app for android and IOS * Application tier - Contains the business logic of the system. It will be programmed using PHP, java and python, also it will be hosted on distributed servers in the cloud. Application tier communicates with the other tiers through application program interface (API) calls. * Data tier – In this tier we will use Firebase as a database for the system because it’s a cloud-hosted NoSQL database that lets you store and sync between your users in real time. |
| Give a high-level description of your solution development environment, platform, tools, etc. We decided to implement FutureMarker with web application hosted on cloud and mobile application using flutter framework by the following programing languages:  - Java  - Python  - JavaScript  - PHP  - Dart |
| What is your planned project methodology? How will you manage your product development cycle, your quality assurance process, your solution deployment logistics, etc.? We will use agile methodology with incremental plan because it is easier to change the process to reflect changing customer requirements and the process works well when not all requirements are known.    We will use scrum method because that focuses on managing iterative development, users see on-time delivery of increments and gain feedback that will help us to improve our system. We will have the flexibility to change anything while working on the system. |
| Quality assurance will consist of several stages:  * Review of requirements * Test planning / writing test cases * Unit testing * Integration testing * System testing * Performance testing * Security testing * Cross-browser testing / cross-platform testing * Updating test cases * Regression testing |
| Give the most relevant plans that you have developed for your project  |  |  |  |  | | --- | --- | --- | --- | | Product Backlog | | | | | ID | **User Story** | **Estimate** | **Priority** | | 1 | As an instructor, I want automated task assessment so I can save time and effort. | 30 | 1 | | 2 | As an instructor, I want to login so I can upload course material. | 5 | 2 | | 3 | As an instructor, I want to create tasks so the students solve it. | 15 | 3 | | 4 | As a student, I want to log in so I can submit my assignment. | 5 | 4 | | 5 | As a student, I want to submit my task so I get the mark. | 4 | 5 | | 6 | As a student, I want to get feedback and grade so I can know my performance. | 15 | 6 | | 7 | As an instructor, I want to get a report for each task so I can know students’ performance. | 10 | 7 | | 8 | As a student, I want profile so I present my personal details. | 8 | 8 | | 9 | As an instructor, I want to create a course so the students get enrolled. | 10 | 9 | | 10 | As a student, I want to enrol in courses so I can follow up the courses. | 7 | 10 | | 11 | As an instructor, I want to upload the course’s material so the students can reach it. | 7 | 11 | | 12 | As an instructor, I want to edit task assessment so I can edit the grade. | 7 | 12 | | 13 | As a student, I want to text the instructor so I can get answers for my enquiries. | 7 | 13 | | 14 | As an instructor, I want to text students so I follow up with any student questions. | 7 | 14 | |
| |  |  |  |  |  | | --- | --- | --- | --- | --- | | Story ID | Task ID | Task | Estimate | Priority | | 1 | 1 | Create courses and tasks database | 2 | 1 | | 2 | Make an API that compile the code | 4 | 2 | | 3 | Make an API that check for the layout and indentation | 4 | 3 | | 4 | Make an API that check for identifiers’ name and length | 4 | 4 | | 5 | Make an API that check for written comments | 4 | 5 | | 6 | Make an API that generate test cases | 4 | 6 | | 7 | Make an API that run the test cases | 4 | 7 | | 8 | Finishing APIs | 4 | 8 | | 2 | 9 | Create instructor database table | 2 | 9 | | 10 | Create instructor registration page (frontend) | 1 | 10 | | 11 | Create instructor login page (frontend) | 1 | 11 | | 12 | Manage instructor login logic | 3 | 12 | | 3 | 13 | Create add Task Page (frontend) | 7 | 13 | | 14 | Create backend logic for creating assignment | 7 | 14 | | 4 | 15 | Create student database table | 2 | 15 | | 16 | Create student registration page (frontend) | 1 | 16 | | 17 | Create student login page (frontend) | 1 | 17 | | 18 | Manage student login logic | 3 | 18 | | 5 | 19 | Create task page (frontend) | 2 | 19 | | 20 | Create assignment submission page (frontend) | 1 | 20 | | 21 | Create backend logic for Submitting assignment | 1 | 21 | | 6 | 22 | Make an API that return feedback | 6 | 22 | | 23 | Manage return feedback logic | 4 | 23 | | 24 | Testing feedback | 5 | 24 | | 7 | 25 | Create an API that makes a report for every assignment | 7 | 25 | | 26 | Manage report API calls | 3 | 26 | | 8 | 27 | Create profile page (frontend) | 3 | 27 | | 27 | Manage editing profile page information | 5 | 28 | | 9 | 29 | Create course creation page (frontend) | 5 | 29 | | 28 | Manage creating task logic | 5 | 30 | | 10 | 31 | Manage course enroll logic | 7 | 31 | | 11 | 32 | Create instructor course page (frontend) | 2 | 32 | | 33 | Create upload material page (frontend) | 2 | 33 | | 34 | Manage uploading material logic | 3 | 34 | | 12 | 35 | Manage edit task assignment grade logic | 7 | 35 | | 13 | 36 | create student chat page (frontend) | 4 | 36 | | 37 | create chat database | 3 | 37 | | 14 | 38 | create instructor chat page (frontend) | 7 | 38 | |

# References

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