

Affinity Space
Mission Management
Final Report

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1. Introduction

This report describes our contributions to the Social Addictive Gameful Engineering (SAGE) project. Our primary motivation during this project was to take previous researcher's work in Gameful Affinity Space and add a higher degree of gamification for the students. Gamification is the buzzword for adding gaming elements such as points or badges to learning experiences to make them more engaging and to increase motivation[1]. We wanted to introduce Missions, Games and Quests as a step in this direction[2]. The gameful affinity space that we envision will have ways for teachers to create and assign Missions to the students. Each mission has multiple Games where student learns the new concepts and at the end appears for a Quest which is a gamified version of assessments. Teachers will be easily able to create missions, games and quests; and we wanted to set up a system so that they can maintain them effectively in their respective libraries.

Education for children is a topic that has been widely researched and debated. It involves the mingling of numerous disciplines like psychology, human behaviour, technology etc. With the advents in science and technology, experimenting numerous options and styles in education system to perfect it has become a trend. One of the major areas of education research is towards development of proper formats of teaching computer science and computational thinking concepts as these fundamental concepts are generally challenging to be taught in a regular classroom environment. Computational thinking involves solving problems, designing systems, and understanding human behavior, by drawing on the concepts fundamental to computer science. Computational thinking includes a range of mental tools that reflect the breadth of the field of computer science [3]. Visual interaction methods of studying with the addition of some kind of incentivised approach have been widely acclaimed as a constructive tool in helping students learn. There are numerous experiments to corroborate this. Also, simple educational games have been shown to be both efficient in capturing the attention of students and teaching them in an engrossing and enjoyable manner. While these visual interactive techniques are in general a useful instrument for education, they are especially helpful in teaching computational concepts and computer science fundamentals.

Designing a Collaborative Game-Based Learning System to Infuse Computational Thinking [4] discusses how gamification in the teaching of computer science concepts to people from different backgrounds has proven very efficient. For

efficient education, a platform is required which in addition to gamification provides a similar level of interactive interface to the traditional education system. An interface that is intuitive enough for both students and teachers for an effective learning of CT concepts for the students. An interface where the student not just learns, but receives valuable feedbacks, badges as incentives, recommendations and hints during numerous stages of his Mission, formerly known as learning path. An interface where the teacher can monitor students' progress, provide feedbacks, assign missions, create new games and quests. SAGE (Socially Addictive Gameful Engineering)[5] intends to create the perfect platform by combining all these elements to form a collaborative game-based learning system which infuses computational thinking into young students in a highly intuitive and integrated manner.

We built upon the work done by previous researchers in the domain of gameful affinity space [6] to create the aforementioned platform. We changed the formerly known learning paths to missions, which will contain games and quests. Also, our focus has been on the ease of creation and maintenance of each of these components for the teacher.

2. Related Work

The following section discusses previous work and research that guided and influenced our understanding and direction of the project.

2.1 GradeCraft

GradeCraft (Holman, C., Fishman, B., Aguilar, S. 2013) is a game-inspired learning management system. It has two dashboards: one for students and one for teachers. The motive behind GradeCraft research is that the game-inspired courses are developed in an effort to increase student engagement, and to provide students with more personalized learning experiences. At the same time, it gives instructors new insight into student engagement, and provides data-driven ideas about how to tailor their course to student needs.

2.1.1 Student Dashboard

The paper discusses two perspectives, one each for the student and the teacher. A screenshot of the Student Dashboard is displayed below. It is showing numerous details about the progress of the student. It also shows the badges that student has won, points in various assignments, predicted points using which student can actually

model his/her grade. This information has a motivational effect on the students, as preliminary research indicates that this type of display boosts user motivation to complete tasks (Kohler, Niebuhr, & Hassenzahl, 2007).

The dashboard also shows a to-do list for upcoming assignments, assignments that could be re-submitted to improved performance, progress towards achieving the course learning objectives, and distribution of student's own performance against his/her own peers.



2.1.2 Instructor Dashboard

The second perspective is the instructor perspective. When initially setting up a course in GradeCraft, instructors can declare the overarching learning objectives. As they create assignment types and badges, each one can be tagged with the relevant learning objectives. Instructors can create badges and each badge has varying level of difficulty to achieve it. This is similar to our approach of implementing quests, where students can complete various quests and win badges.

A screenshot of Instructor Dashboard is shared below. It provides comprehensive details about the class within a single view. GradeCraft equips the instructors with tools and metrics to better manage the gameful structure of the class itself. It shows the top and bottom percentile of the class in form of the stacked bar charts. This assists instructors to identify the students in need earlier. A box and

whisker plot is used to capture the overall class performance, displaying the range of achievement as well as situating how the majority of students are doing.



2.2 MOOC Platforms

MOOC (Massive Open Online Courses) platforms, are proving to be the game changers for higher education and employee skill-set development. By offering free online courses on number of topics, through quality instructors and universities, they are providing learning and development to virtually everyone, anytime, anywhere in the world with internet access. One of the things that MOOC platforms, like Coursera, are really efficient at, is the ability to recommend courses based on participants' features, such as past courses and interests.

For example, if a participant is shown to pursue Computer Science courses in the past, he or she is more likely to get a recommendation of CS courses. We see an opportunity to use a similar recommendation system described later in the following sections. These platforms also provide excellent learning paths for "degrees" in particular topics. These topics often contain several related courses, modeled in way to advance from beginner to higher levels. MOOC like Khan Academy provides gamification through a knowledge map, which shows the user a map of all the videos that he/she needs to watch to learn each subtopic of a course. This is similar to concept of a mission and games. A mission contain multiple games, may be one inspiration we can draw from this is to implement a similar kind of map for each mission which provides a higher degree of gamification to students.

2.3 Canvas

Canvas is the new version of Courseworks, and currently used in numerous universities for course tracking. It provides a beautiful and interactive interface for tutors. They can upload various reading materials, make creative assignments and interact with the students in a clear and concise manner.

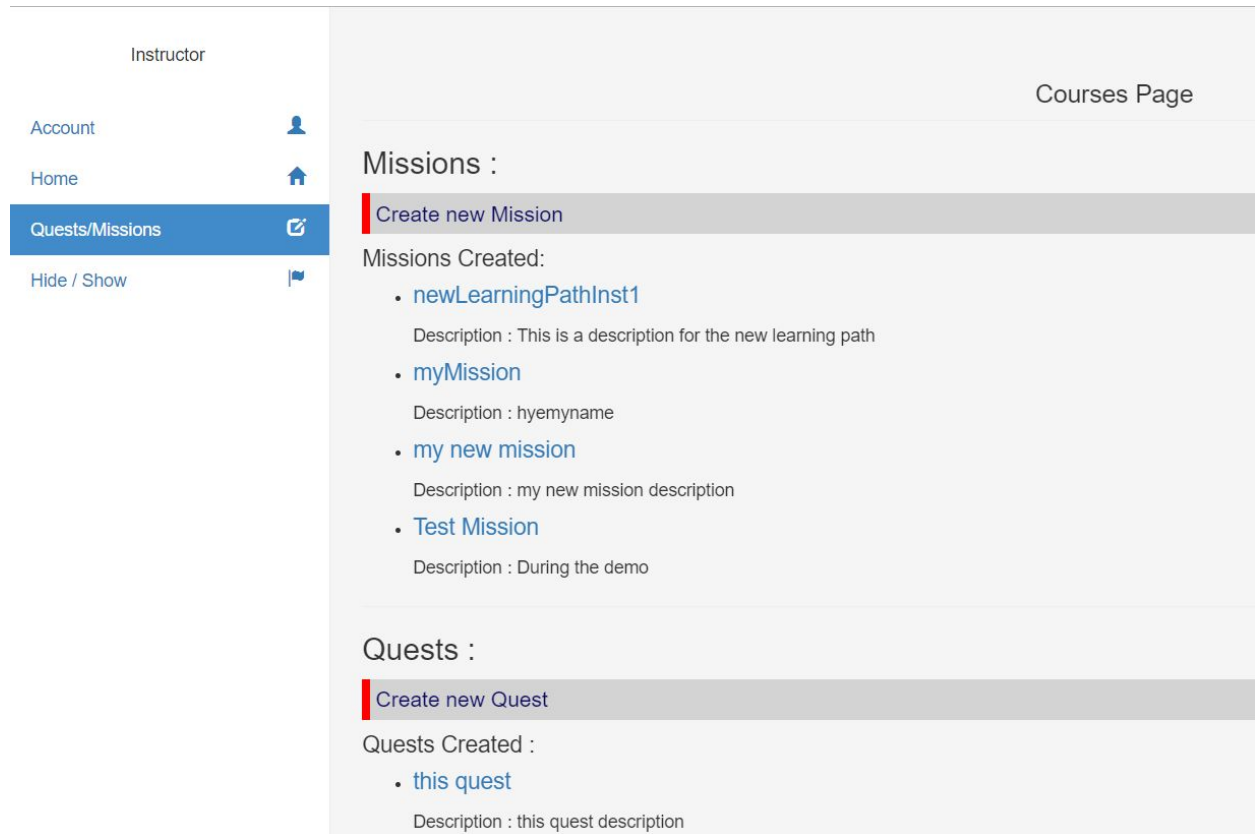
3. Implementation

3.1 Features

The project will include the development of three different libraries along with improvements of the partially implemented assessment creation. The libraries are Teacher Mission Library, Teacher Quest Library, and Teacher Game Library. For each of these libraries, the teachers will be able to browse and search through the missions, quests, and games created by the community respectively.

3.2 Instructor Dashboard

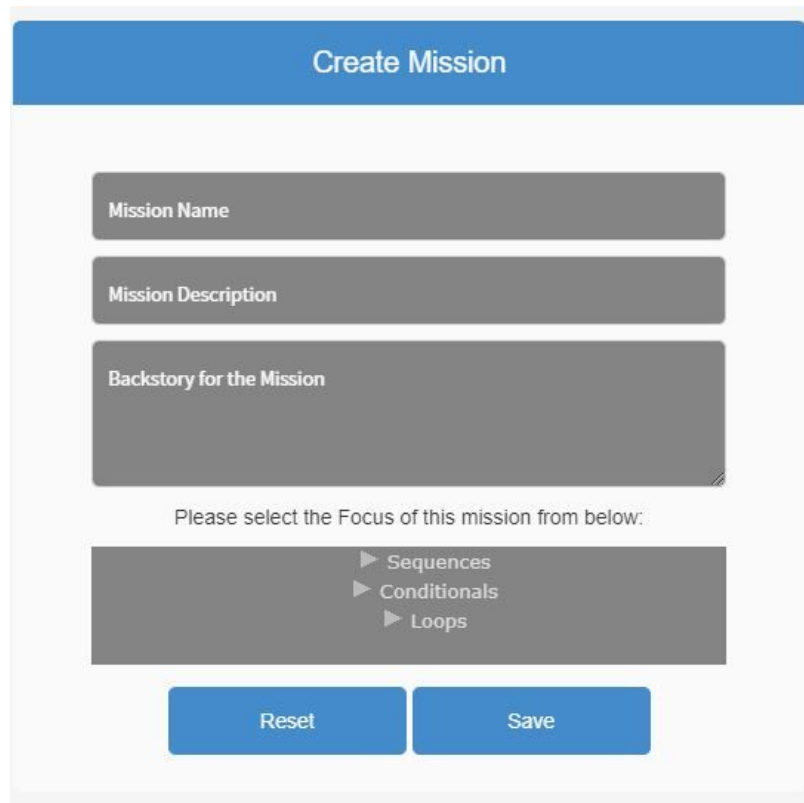
The instructor dashboard is the primary interface for the teacher and instructors to interact with SAGE. The instructor dashboard provides the performance of the class within a single view and an interactive environment where instructors can login, create courses, missions, and design assignments as well as assessments for other students.



The features of browsing and searching Missions, Quests, and Games are next to be implemented. To accomplish this, a collection of Missions, Quests, and Games will be available for the instructors to simply scroll through and be able to filter out and find something that works best for their classroom.

3.2.1 Creation of Mission

Mission creation screen currently looks as below. A teacher can create a mission from here, which will be later available for students to enroll and for other teachers in the community to see in the Mission Library. Apart from the basic details, the teacher needs to select Curricula Items from the tree-like structure that is visible in the screen. It indicates the curricular items covered by this particular mission.



The image shows a 'Create Mission' form with a blue header. Below the header are three text input fields: 'Mission Name', 'Mission Description', and 'Backstory for the Mission'. Below these fields is a label 'Please select the Focus of this mission from below:' followed by a list of three options: 'Sequences', 'Conditionals', and 'Loops', each preceded by a right-pointing triangle. At the bottom of the form are two blue buttons: 'Reset' and 'Save'.

Create Mission

Mission Name

Mission Description

Backstory for the Mission

Please select the Focus of this mission from below:

- ▶ Sequences
- ▶ Conditionals
- ▶ Loops

Reset Save

3.2.2 Editing of Mission

A mission editing screen looks something like the shown on the next page. On this screen, a teacher can add various quests to the mission that he/she created. Also, the teacher could create an ordering of the quests within the mission, so that the student can learn from various quests in a predefined order suggested by the teacher. Mission editing screen also provides the facility to edit the ordering of the quests within that mission, which can be really helpful when the teacher decides to add some new quests in the mission or feels like changing the existing ordering.

Mission : Test12

This is a mission now.

Backstory : Backstory for Test1 mission.

Quests in the Mission:

- **Recursion**
Quest Learning Order : 1 ▾
Description : Concepts of recursion and applications
- **Algorithmic Thinking**
Quest Learning Order : 1 ▾
Description : Ways to solve problems by algorithms
- **Abstraction**
Quest Learning Order : 2 ▾
Description : Teaching ways to think about abstraction and its intuition
- **Inheritance Concepts**
Quest Learning Order : 3 ▾
Description : Basic overview of inheritance

Update
Order

3.2.3 Creation of Quest

Quest creation screen currently looks as below. A teacher can create a quest from here, which will be later available for students who are enrolled in a missions for which the certain quest has been added. After the creation of the quest, it will also be available for other teachers in the community to see in the Quest Library and for other teachers to add to their own missions. Apart from the basic details, the teacher needs to select Curricula Items from the tree-like structure that is visible in the screen. It indicates the specific curricular items covered by this particular quest. A badge of completion can also be uploaded for the quest which students will be able to see once they complete the specific quest.

Create Quest

Quest Name

Quest Story

Please select the Focus of this quest from below:

▶ Sequences

▶ Conditionals

▶ Loops

Please upload an image for Badge of Completion

Choose File

No file chosen

Other features (separated by comma):

Reset

Save

3.2.4 Editing of Quest

A quest editing screen looks something like the shown below. On this screen, a teacher can add and remove games from the particular quest. The games can also be ordered and reordered within the quest, which can be really helpful when the teacher decides to add a new game in the mission or decides to change the existing ordering. Also, a teacher can create a new game to add to the quest. Quest editing screen also provides the instructors to edit the name and description of quests.

Quest: this quest

Name:

this quest

Description:

this quest description

Update Quest Details

Games

<div>×</div> <div>▼</div>	Game	Assessments here Assessments here Assessments here Assessments here Assessments here
<div>×</div> <div>▼</div>	Game new assignment	Assessments here Assessments here Assessments here Assessments here Assessments here
<div>×</div> <div>▼</div>	Game my new game again	Assessments here Assessments here Assessments here Assessments here Assessments here

Create new Game

Update Order

3.2.5 Creation of Assessment

Assessments are a unit of education in SAGE. Each assessment tests a subject at a particular mastery level. The creation of assessments are done by instructors. Instructors can choose to create an assessment based on other assessments previously created by others in the SAGE community.

The creation of Automatic Assessments has been discussed in previous semesters. It was mentioned of using Visual Assessment Editor that lets the instructor design assessments for the assignments. The VAE was earlier a separate component that the instructors had to access with a different server. However, now with the

dashboard integration, they can create these assessments in VAE from the platform itself.

Clicking on any course takes us to the course page with all the assignments under that course clearly listed. Clicking on any of these assignments takes us to the VAE where instructors could design assessments. This needs to be improved so that instructors could more clearly understand that each assessment created is associated with an Assignment when saved.

In addition, the feature of game type to be specified on creation will allow instructors to specify the type of game they are about to create as a Parson's Puzzle, Constructionist Game, or Boss Game. Hence, the appropriate SAGE features will be enabled. This will be a drop down list in the instructor game creation that they will be able to choose from. The addition of this feature will allow instructors to more quickly create various types of games from scratch.

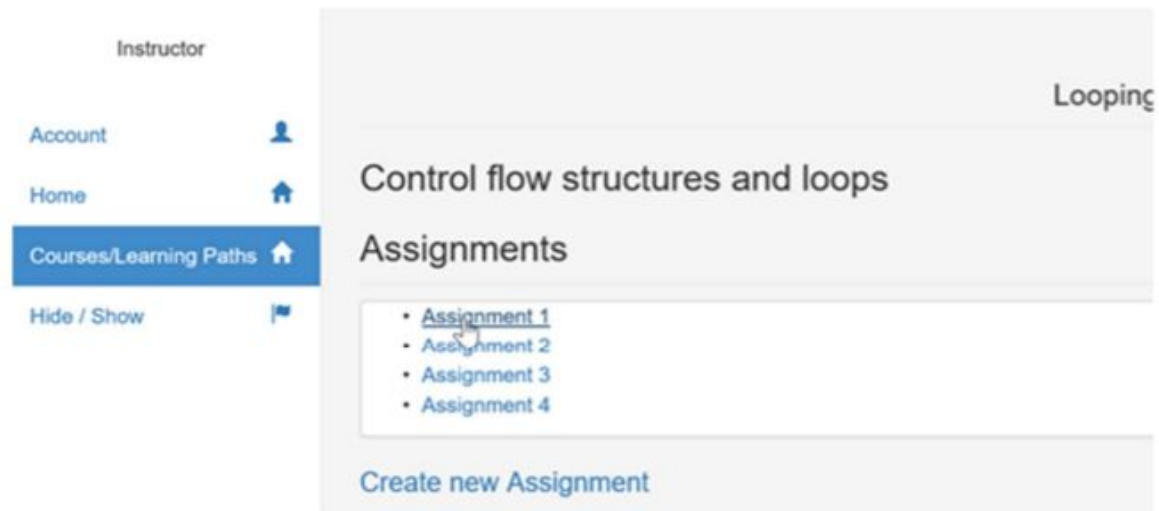


Figure 13. List of Assignments under a course

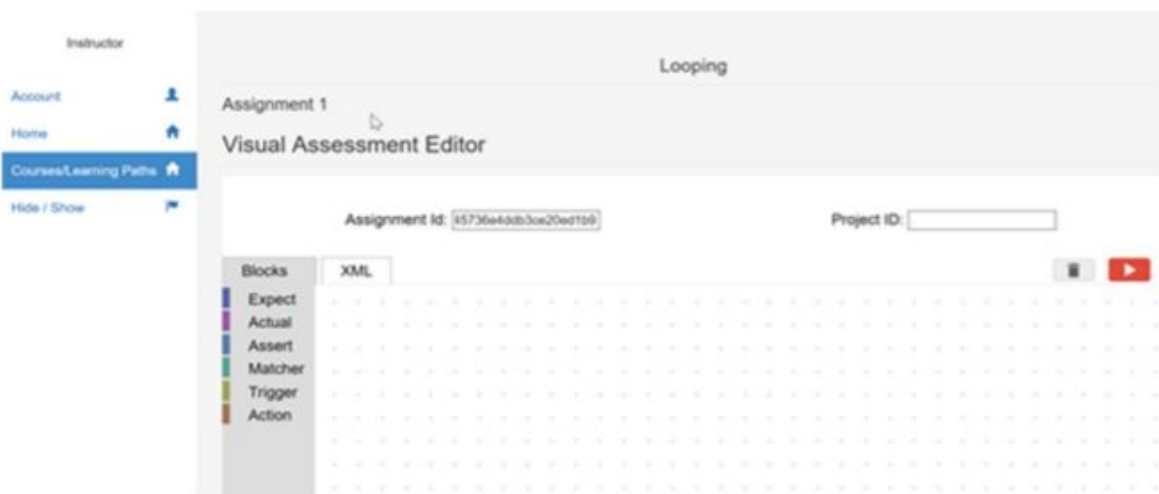


Figure 14. VAE integrated into dashboard

3.2.6 Mission Library

A mission library is a collection of all the missions within the community, created by different teachers. It is available to all the teachers to view.

Mission Library

- Computational Thinking
- Test1
- Parallel Thinking
- An1
- newLearningPathInst1
- LearningPathTest
- Test12
- Mission to Mars
- myMission
- my new mission
- Test New
- Test Mission

3.2.7 Quest Library

A quest library is something similar to a mission library, but it instead contains all the quests available in the entire community. It is available to all the teachers to view.

Quest Library

- Abstraction
- Parallelism
- Algorithmic Thinking
- Inheritance Concepts
- Looping
- Recursion
- Abc
- this quest
- cname
- course3
- no name
- my quest
- newQuest
- firstQuest
- parth again

3.2.8 Games Library

A games library is a collection of all the games within the community, created by different teachers. It is available to all the teachers to view as seen below.

Games Library

- Basic Looping
- Intermediate Looping
- Advance Looping
- Basic Recursion
- Intermediate Recursion
- Advance Recursion

3.3 Student Dashboard

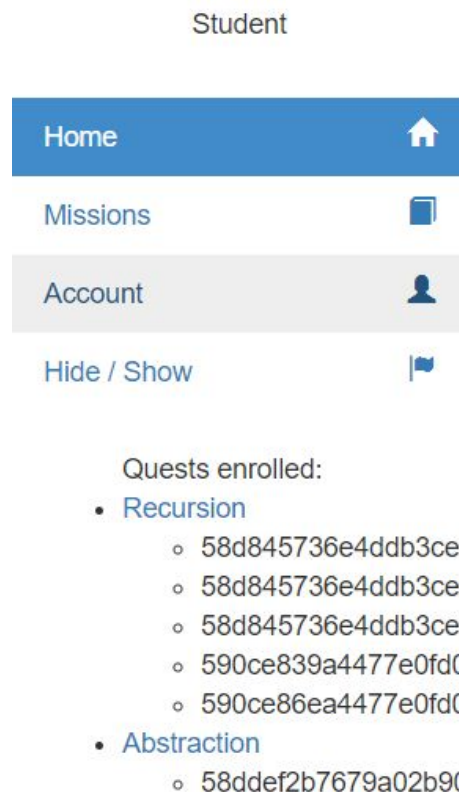
The student dashboard is the primary interface for a student to interact with SAGE. The student dashboard provides missions and quests for students to enroll in. It also provides interactive ways for the students to see descriptions of different missions. Students are also able to open up assessments within a game and try to solve them.

The screenshot displays the Student Dashboard. On the left is a sidebar with a student profile icon and the label 'Student'. Below this is a navigation menu with 'Home' (selected), 'Missions', 'Account', and a 'Hide / Show' toggle. Under 'Missions', a list of 'Quests enrolled:' is shown, including 'Recursion' and 'Abstraction' with their respective IDs. The main area is titled 'Recent Courses' and contains a 3x4 grid of course cards. The cards are: Row 1: Abstraction, Parallelism, Algorithmic Thinking, Inheritance Concepts; Row 2: Recursion, Abc (highlighted with a dark border), this quest, cname; Row 3: no name, my quest, newQuest, firstQuest.

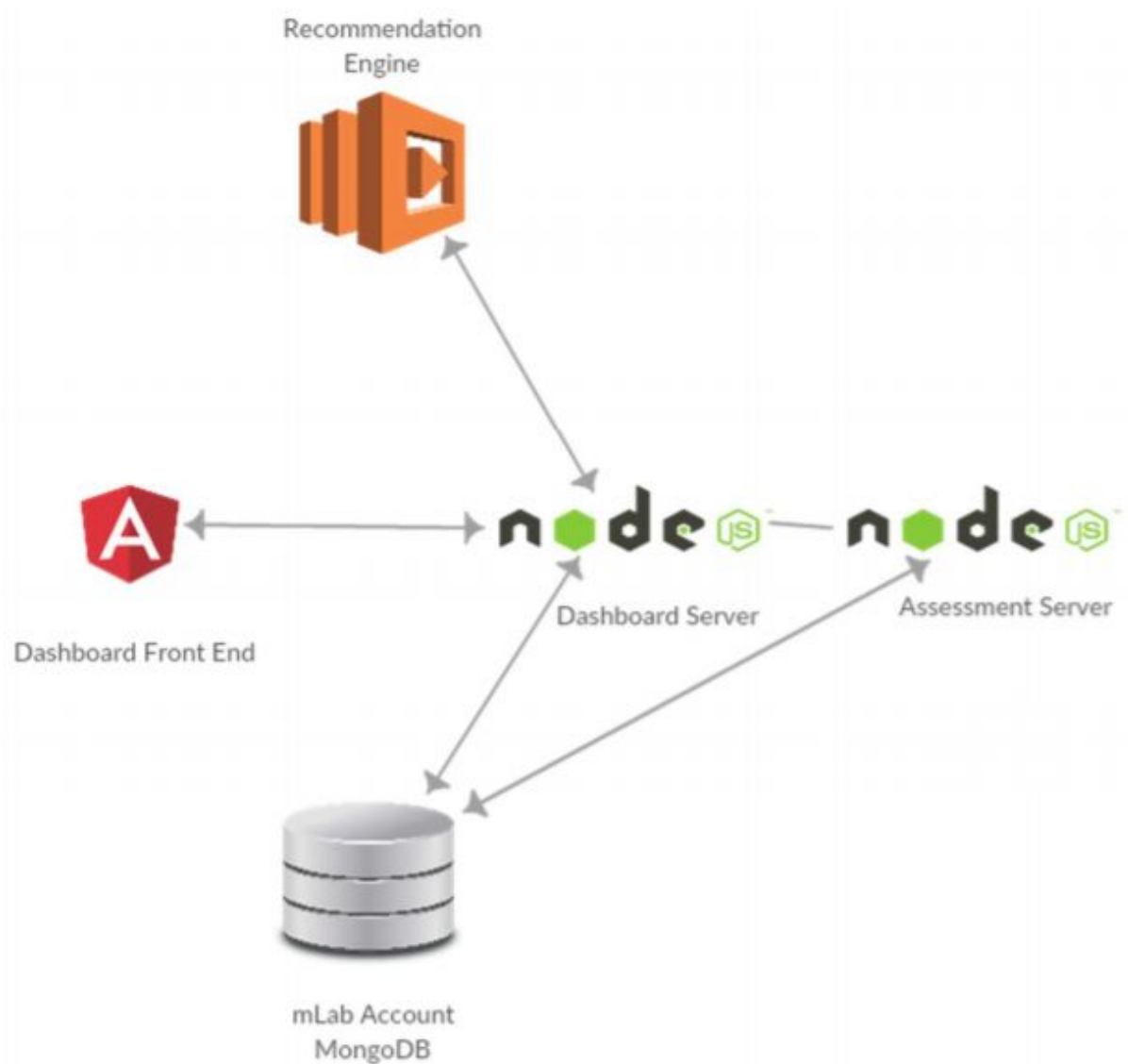
Recent Courses			
Abstraction	Parallelism	Algorithmic Thinking	Inheritance Concepts
Recursion	Abc	this quest	cname
no name	my quest	newQuest	firstQuest

3.3.1 Student Mission Navigation

The student mission navigation is created to aid the student in navigating through the student dashboard. The student sees a full view of their enrolled courses/ missions as well as the games within their enrolled courses/ missions. As the data is cleaned and all games will correspond to game names, and be shown in the student mission navigation seen below.



3.4 Architecture



The diagram above depicts a high level architectural diagram of the Computational Thinking Platform. It is a single page web application with front end developed in AngularJS. It receives the data in JSON format from Dashboard NodeJS server through series of AJAX calls REST APIs. The Assessment Server microservice handles the data associated with storing the files related to assignments' creation and design and students' progresses, and running evaluations using the Hairball plugin. Dashboard server receives the recommendations to through a separate Recommendation Engine deployed on AWS Lambda. All the structured data is stored in MongoDB.

4. Future Work

After working on the project this semester, we saw some significant work that would be useful for future development. One improvement we suggest is that extensive documentation of features would be provided, especially since different students work on features on different semesters and need to be able to understand the code fairly quickly within the semester.

We also suggest that the code would be cleaned up relative to the variable naming. For example, this semester naming changes have been made (missions - LP, quests - courses, games - assignments) though on the front end these are seen as missions, quests, games. In the code, these variables are still learning paths, courses, and assignments. We propose that this would be done carefully with the use of an IDE.

Existing work on the libraries is that of creating a framework on which the future researchers can build upon. For better accessibility, pagination can be added on the page displaying various libraries. Also, searching options based on the curricula type, name, created by etc. could be provided in order to have a better navigation across the library.

5. Conclusion

From the work in the learning phase as well as our contributions, we set a system for instructors to collaborate by browsing through missions, quests, and games. Now that missions, quests, and games can be created and edited by instructors, the SAGE instructor dashboard has progressed. We hope that the work we laid out during this semester helps future students working with the instructor and student dashboards to hit the ground running and quickly be able to work with our implementations to create a fully operational SAGE system.

6. References

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