COMS 6901: Project Proposal

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SAGE Scratch: Parson's Puzzles and Mission Management

1. Abstract

This paper aims to outline the goals for development on the Gameful Direct Instruction and the Gameful Affinity Space epics as part of the SAGE project. Specifically it will focus on parts of the Parson's Puzzle 1.1 feature and the Mission Management 1.1 as well. The primary goal will be to complete the Parson's Puzzle Creation and Parson's Puzzle Edit user stories. As a stretch goal this project will attempt to complete parts of the Mission Assignment user story as well. This project aims to add functionality to the SAGE Scratch development fork which will enable teachers to create and save new Parson's Puzzles. It will also enable instructors to edit existing Parson's Puzzle games while providing students with a way to play these games interactively and intuitively with two modes of difficulty.

2. Introduction

The Social Addictive Gameful Engineering (SAGE) research project extends the popular drag and drop based programming language, Scratch, which allows developers to create games, puzzles, animations and stories through an interactive interface. SAGE builds on top of Scratch by adding functionality that allows teachers to create puzzles and exercises to promote game based learning for 6-8 grade students. These features are aimed at motivating computational thinking in students at an early age which develops logical, analytical, creative, recursive and algorithmic skills.

Specifically, there has been an increased interest in Parson's Puzzles over the past few years. These are a type of code construction assignments where students are given blocks of code and the challenge is to form the solution by correctly selecting, re-ordering and arranging these blocks to form the desired solution [1]. They provide practice with basic programming principles in an entertaining puzzle-like format [2] which keeps students motivated with the gameful interface. This project aims at adding functionality to SAGE Scratch that allows instructors to create Parson's Puzzles while allowing students to solve them while in PLAY mode.

3. Related Works

There have been several implementations of Parson's Puzzles through frameworks like Hot Potatoes, ViLLE, CORT and js-parsons, which provide a drag and drop interface similar to Scratch. The images below show an example of what a Parson's programming puzzle may look like using some of the existing frameworks.
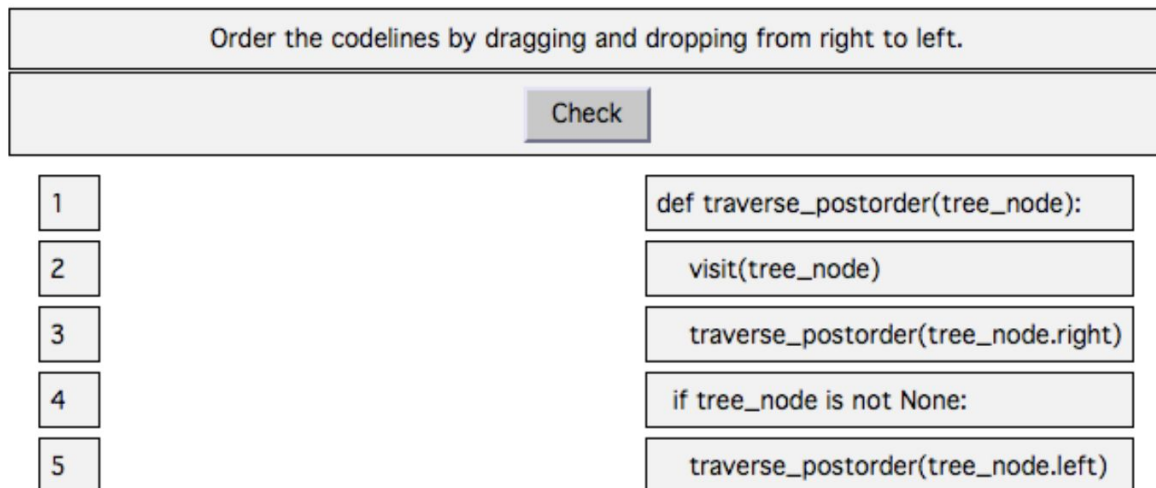

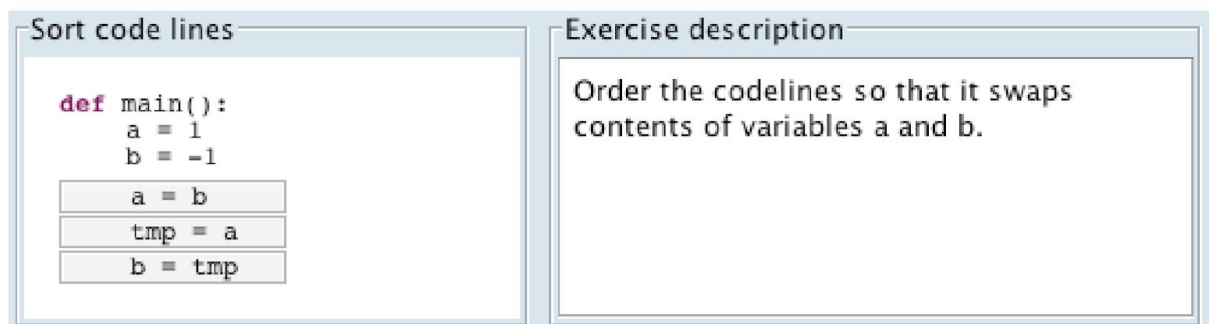*Figure 1: Parson's Puzzle for post order tree traversal using Hot Potatoes*

Figure 2: Parson's Puzzle for swapping variables using ViLLE

While the functionality added by this proposal will be similar to that offered by the frameworks above, the value it adds above and beyond the existing research will be integrating with the rest of the SAGE ecosystem which includes the SAGE front end, intelligent hinting system and the web application. This will provide a well integrated learning system that uses Parson's Puzzles to meet the needs of students, teachers as well as instructors.

4. Proposal

4.1. Parson's Creation

This project will build on the work done to create the Parson's Puzzle MVP built on top of Scratch in previous semesters [3]. Currently, teachers and instructors can use the edit mode to select blocks that should be allowed for the Parson's Puzzle they are creating. The auto-save functionality added in previous semesters ensures that the configuration set up by the instructor is saved automatically ensuring that the puzzle is updated and ready to play the next time it is opened. However, there is some key functionality that is currently missing.

While the instructor can select the blocks that are allowed during the Parson's Puzzle and arrange them to indicate the desired solution, there is no clear way to specify the instructions that point students towards the goal they are trying to achieve. Other than the puzzle name very little direction is available. This project will aim to make this workflow more intuitive, both for teachers while creating these puzzles and specifying the goals, as well as for students while solving them in PLAY mode.

This will be linked directly to the SAGE front-end so that when teachers attempt to create a new Parson's Puzzle from the dashboard, Scratch will automatically launch in the Parson's puzzle tab with edit mode selected. This will allow teachers to quickly select the blocks needed to create the new puzzle and potentially add distractors as well to make it more challenging. Instructors will then be able to rearrange their selected blocks into the desired solution and this will automatically get saved as a new puzzle that will be accessible to students.

4.2. Parson's Edit

This feature will build on top of the Parson's puzzle creation work above. The goal is to allow teachers to modify existing Parson's Puzzles in order to update either the solution, the goal, or the allowed blocks for the puzzle. The updated puzzle will be automatically saved and overwrite the puzzle that was chosen for editing from the front-end. It will ensure that Scratch opens in EDIT mode when an instructor chooses to edit a Parson's Puzzle from the SAGE front-end. This will involve integrating with the SAGE affinity space when Scratch is opened to overwrite the correct puzzle as well as to open in Parson's Puzzle edit mode as intended by the instructor.

4.3. Parson's Play Palette

SAGE Scratch in its current form can be quite confusing to use. Students currently have access to all the palettes while in PLAY mode. This includes palettes that are meant for Gameful

Constructionism use cases and not in any way limited to those being used for the Parson's puzzles. This can make the interface confusing for students while they attempt to solve any programming puzzles created by the instructors.

This goal will aim to make the student experience as distraction free as possible. When students select a Parson's Puzzle to play from the SAGE Affinity Space, Scratch will automatically open in PLAY mode with only the blocks from the puzzle available to use. While opening in PLAY mode, the solution indicated by the instructor will not be displayed since this is what students are expected to strive to achieve. All other palettes will be hidden or made inaccessible to make the workflow easier for students and less confusing. This will allow them to focus on solving the puzzle instead of accidentally using blocks from any of the other palettes.

4.4. Mission Assignment

This is a stretch goal for this project. I will aim to work on this if the above three tasks are complete. In the [Gameful Affinity Space](#) students can enrolled into a class can also enroll into missions. This is confusing since missions should instead be assigned to students by the instructor. The goal of this feature is to add the ability for teachers to assign a mission to an entire class of students. Students enrolled in that class should then be able to access the mission that was assigned to them and work on its quests and games. This will also involve removing or hiding the existing functionality that allows students to directly enroll in a mission.

5. Timeline

Date	Milestone
06/16/2018	Development environment setup including IntelliJ and local testing
06/23/2018	Understanding of existing functionality and Parson's Puzzle MVP
07/14/2018	Parson's Puzzle creation implementation
07/21/2018	Parson's Puzzle editing functionality implemented
08/01/2018	Palettes hidden in Parson's Puzzle play mode
08/11/2018	Mission assignment functionality implemented

6. Future Work

Future work can focus on enhancing the functionality introduced by this project to support Parson's Puzzles in SAGE Scratch. This can include functionality such as intelligent hinting to help students make progress if they are stuck while solving puzzles. Additionally, integration with a scoring system can be used to motivate students while making progress on these puzzles. Student scores should also be saved and stored in the database so teachers can evaluate students that have worked on solving the Parson's Puzzles. These features can be worked on once the functionality described in this project is implemented and integrated into SAGE.

7. References

Bender, J. (2015). Developing a Collaborative Game-Based Learning System to Infuse Computational Thinking within Grade 6-8 Curricula.

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