

# GrACE: An AI-Based Game for Broadening Participation in Computer Science and Teaching Computational Thinking

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## Project Goals

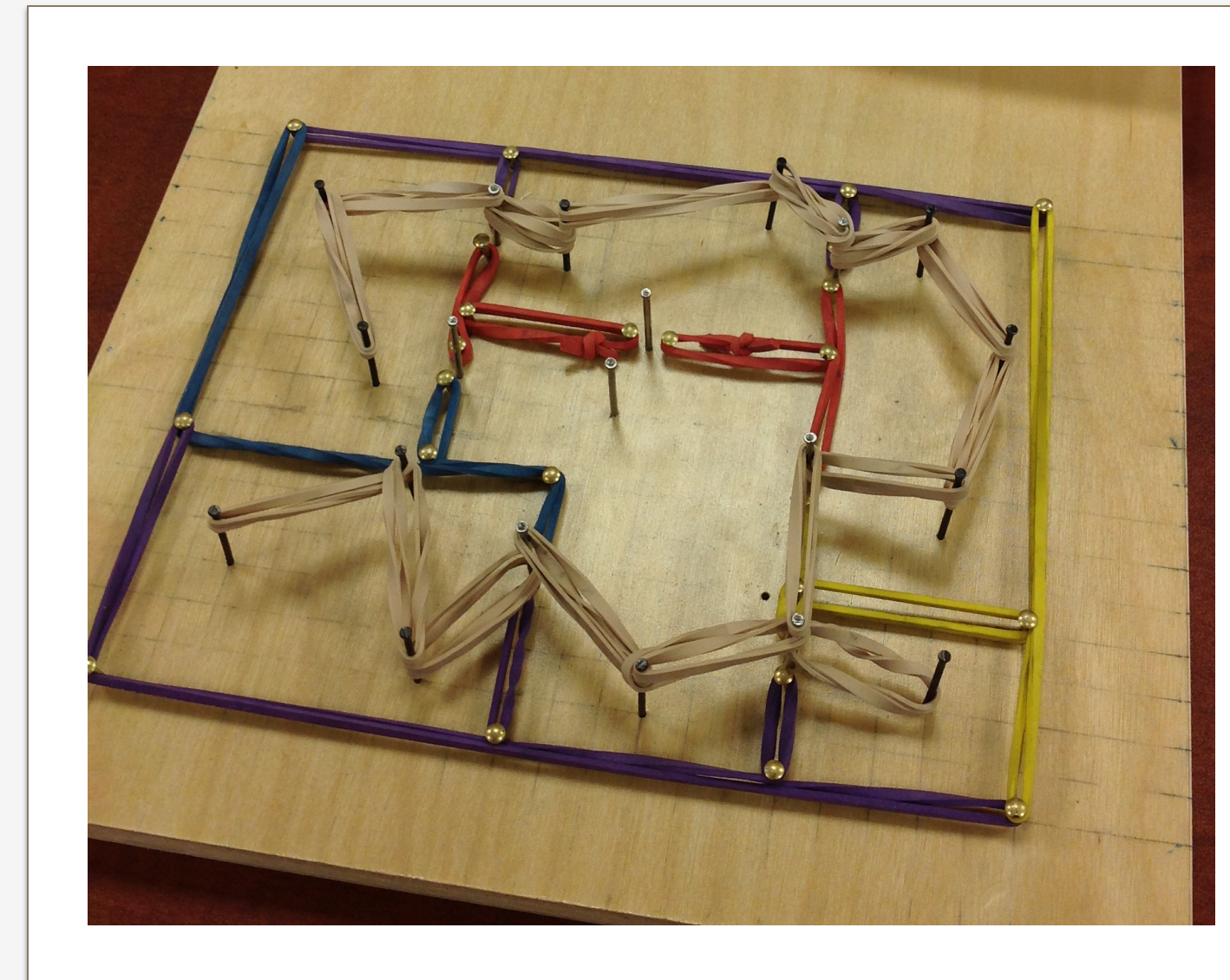
- Design and evaluate an educational game that teaches **computational thinking** and altering **attitudes towards computer science** among young girls
- Use principles of **gender-inclusive game design** to create a game that is engaging for players of all genders
- Foster **procedural literacy** among the broader population
- Use **procedural content generation (PCG)** to have the computer create a wide variety of controllably-random educational puzzles
- Investigate impact of PCG upon **collaborative learning**: how do students who see different—yet similar—puzzles from each other work together to find strategies?
- Investigate impact of PCG upon **mindful learning**: how does the ability to see many different puzzles enable players to experiment with different contexts and guide them towards understanding the underlying problem?

## Research Questions

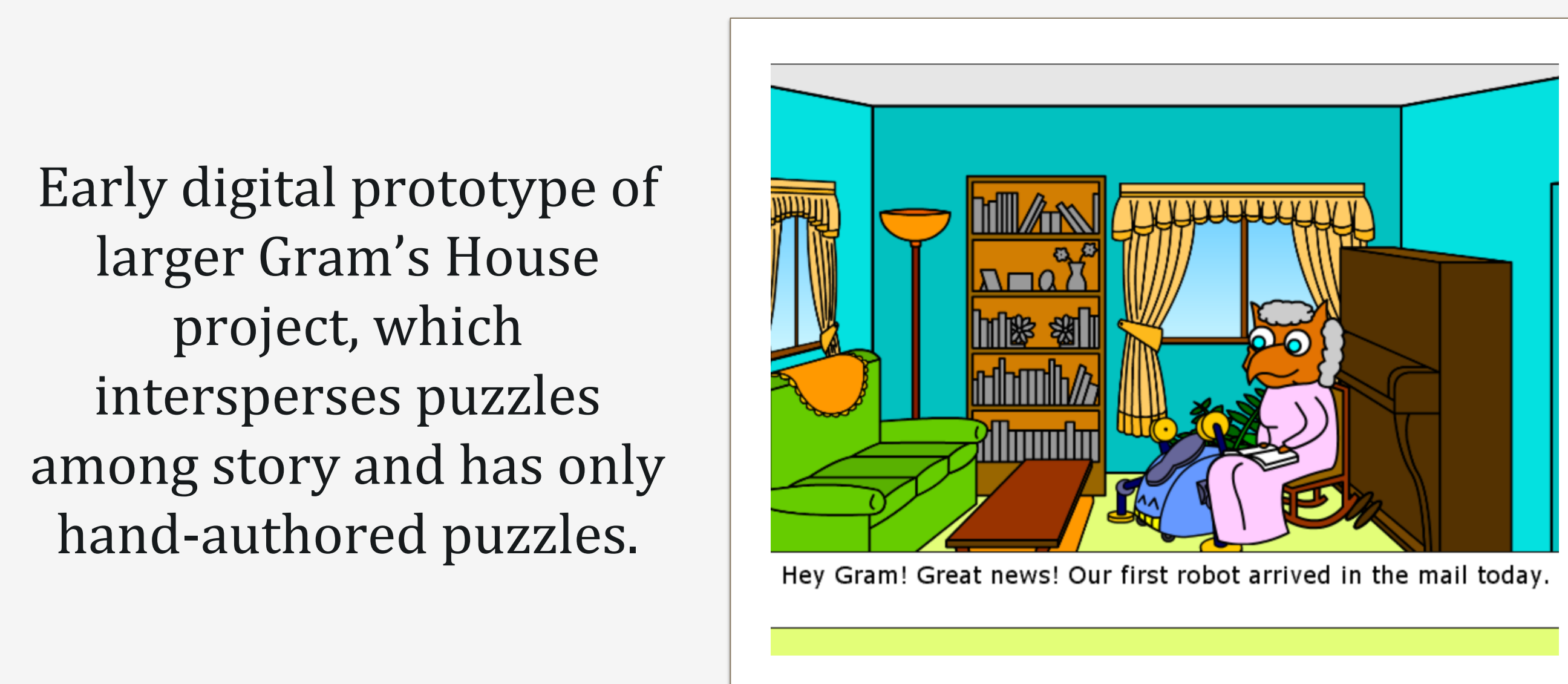
- **Design research**: What is an appropriate puzzle design for a digital game that aims to foster algorithmic thinking and a positive computer science attitude change in middle school girls, and how can PCG play a role in this design?
- **Empirical research**: To what extent is a PCG-driven educational puzzle game aimed at middle school girls more effective in teaching algorithmic thinking and affecting a positive computer science attitude change than an educational puzzle game without PCG?

## Prototypes

Paper prototype for the abstract minimum spanning tree concept, building the lowest cost route for the robot to take through the house.



Paper prototype for an octopus concept with the same underlying puzzle. This metaphor had appealed to our target audience.



Early digital prototype of larger Gram's House project, which intersperses puzzles among story and has only hand-authored puzzles.

## Audience

- Gram's House is intended for middle school students, approx. ages 10-13
- Following a gender-inclusive design process to ensure broad appeal without alienating groups.
- Intended for use in informal settings. Testing in after-school programs, with long-term goal of online casual gaming.

## Partners

### Students

Donald Bass – PhD, computer science

Max Lever – undergraduate, computer science/interactive media

### Collaborators

Dr. Elizabeth Gee, Arizona State University

Gail Carmichael, Carleton University

Carolee Stewart-Gardiner, Kean University

### External Evaluation

Jim Hammerman, TERC – Cambridge, MA

### Recruitment Partners

Northeastern Center for STEM Education

South End Technology Center, Boston, MA

## Further Reading

Hartevelde, C., Smith, G., Carmichael, G., Gee, E., & Stewart, C. **A Design-Focused Analysis of Games Teaching Computer Science.** In *Proceedings of Games, Learning and Society Conference 10*, June 2014.

Stewart-Gardiner, C., Carmichael, G., Latham, J., Lozano, N., Greene, J. **Influencing Middle School Girls to Study Computer Science Through Educational Computer Games.** In *Journal of Computing Sciences in Colleges*, 2013.



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