Pencil Puzzles as a Context for Introductory Computing Assignments in Diverse Settings

Zack Butler, Ivona Bezáková, Angelina Brilliantova, Hannah Miller
Computer Science, RIT

Kimberly Fluet
U. Rochester

Pencil puzzles

- Puzzles designed to be solved by humans using paper and pencil
- Naturally induce algorithmic thinking, can be context for different CS topics

e.g: Skyscrapers puzzle

Puzzle

	3	2	4	1	
3					1
2					3
1					3
3					2
	2	2	1	2	

Solution

	3	2	4	1	
3	2	3	1	4	1
2	3	4	2	1	3
1	4	1	3	2	3
3	1	2	4	3	2
	2	2	1	2	

If we imagine the solution as the heights of buildings in each square, the given numbers represent the number of buildings visible (not hidden behind another) looking in from that location.

- Skyscrapers used as context for assignments on 1-D lists, 2-D lists, and custom data structures.
- These and other assignments, using many different puzzles at our website: **https://www.cs.rit.edu/~pencilpuzzle**

This material is based upon work supported by the National Science Foundation under grants DUE-1245349 and DUE-1821459.

Project Goals

Our initial study showed the value of these assignments at RIT. This study aims to evaluate them in different courses at many other universities with different student demographics and pedagogical delivery modes.

Data Collection and Analysis

- 8 instructors at 8 institutions, 11 total sections
- Two assignments each: one using a pencil puzzle and one (on a different topic) not using a puzzle
- Survey of student perceptions after each assignment
- Collected student demographics and background; grades on the assignments, final exam and course

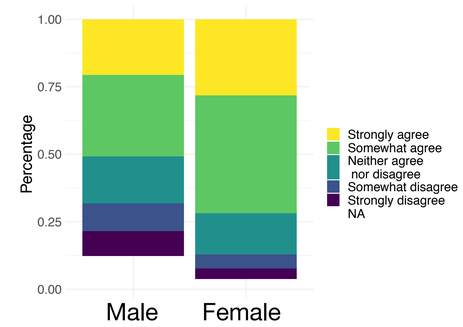
Two survey questions studied here:

- "I **appreciated** this assignment as a learning experience." (agree/disagree)
- "I felt that this assignment helped me to **learn** this week's material."

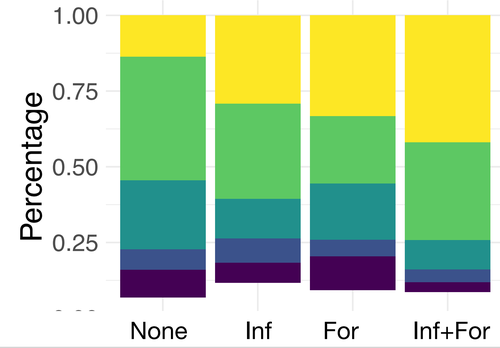
Mixed-effects modeling used to handle the variation between assignments

Preliminary Findings

Survey responses for puzzle assignment independent of most demographics. Some exceptions:



Female students more likely to feel it helped them learn



Students with both formal and informal prior experience appreciated the learning experience more

Future Directions

- Ongoing analysis of all survey responses and grades, including PCA analysis to determine most meaningful questions
- Expansion into mid- and upper-level CS courses in different areas