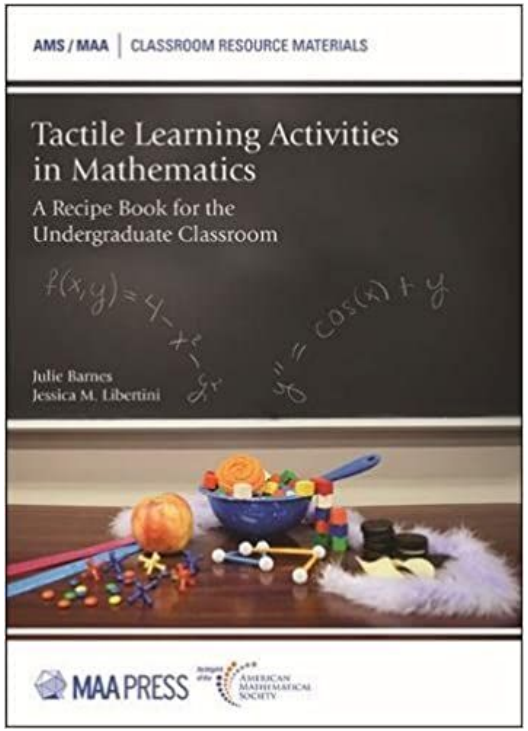
Learning Programming Through Tactivities

Sarah Patterson, PhD
Blain Patterson, PhD
Virginia Military Institute

Overview

- Tactivities
- Classroom Background
- Puzzle Coding
- Classroom Reflections

What are Tactivities?



- Function Composition with Crackers and Cheese (Precalculus)
- Paper Shredder Riemann Sums (Calculus)
- Population Modeling with M&M's (Differential Equations)
- Proof Rearrangements (Discrete Math)

Classroom Background

- Virginia Military Institute (VMI): small public military institute (~1700) in Lexington, VA.
- *Mathematical Software*: Second course in a year long sequence on the use of Matlab in mathematics, engineering and physics.
- 15 student section of *Mathematical Software* at VMI.
- Prior to lesson, students knew how to write scripts and functions involving for loops, while loops, and if statements.

Puzzle Coding

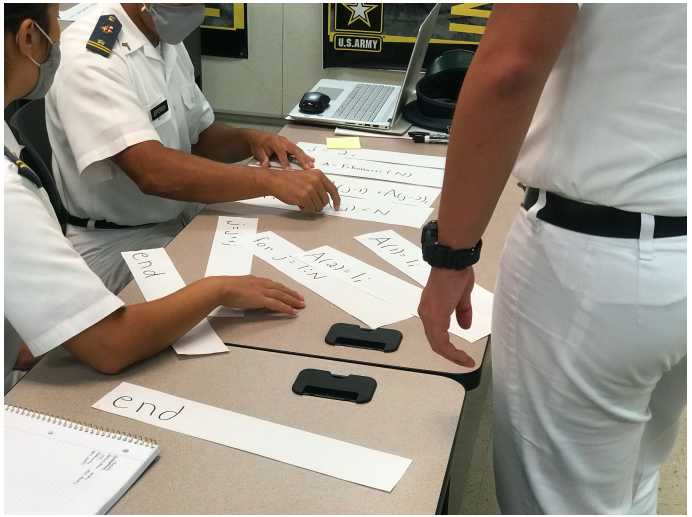
Objectives and Materials

Objectives

- Review of programming logic and logical operators.
- Practice testing and debugging techniques.

Materials

- Whiteboard
- Sticky Notes
- Code Strips



Overview

1. Use the code strips to create a function or script that solves each of the problems.

2. Determine appropriate test cases to check your functions.

3. Desk check your code. Use one of the provided whiteboards as your command window and one to use as their workspace. “Run” your program by:
    - Writing appropriate command(s) into the command window.
    - Reading through your function line by line.
    - Tracking of the current value of all defined variables in the workspace whiteboard.

Coding Scenarios

1. Write a function to find all of the Fibonacci numbers that are less than *N*.

2. Write a function to compute the first *N* Fibonacci numbers.

3. Write a function that takes a numerical test score and determines the grade earned according to the standard ten point grading scale.

https://tinyurl.com/JMMtactivity

Editor - /Users/pattersonse/Documents/MATLAB/Fibonacci.m

Fibonacci.m

1. Use the code snippets to write a function to find all of the Fibonacci numbers that are less than *N*.
2. Write a function to compute the first *N* Fibonacci numbers.

```
function A=Fibonacci(N)
for j=3:N                A(1)=1;

while A(j)<N      A(2)=1;
                                  j=j+1;
A(j)=A(j-1)+A(j-2);
                                  j=2;
          end
end                          end
```

Classroom Reflections

Classroom Reflections

- Students enjoyed the experience!
- By removing the syntax of MATLAB, students could focus on the logic and debugging.
- Students focus on understanding each line of code.
- Explore the relationship between workspace, editor, and command window.
- Could be done early on - as soon as students learn how to define variables.

Classroom Reflections

Challenges

- Students who struggled with the workspace also struggled to get started.
- Some students focused too much on the ideas of proper coding habits (indentation and documentation), which possibly conflated the goal of the task.
- This was done in the second course in the sequence, so it mainly served as a review.

Suggestions

- Model this with a simple example (e.g. for loop that defines *x* to be the even numbers less than 10).
- Consider not asking students to indent and comment on their code and instead focus on the order of the lines and the variables defined in the workspace.
- This activity could be done as soon as students learn how to define variables.

Future Tactivities

1. Indexing the Class Matrix
    - Students sit in a grid with whiteboards.
    - Each student is an element of a matrix.
    - Different operations are projected on the board.
    - As a class, students must determine how the operation changes the matrix.
2. Logical Program Flow
    - Code is printed out and attached to a cork board.
    - Students must determine the path, that the code would follow.
    - This is represented using string and pushpins.

Questions? Feel free to contact us at:

pattersonse@vmi.edu
pattersonba@vmi.edu

References

[1] Barnes, J., & Libertini, J. M. (2018). *Tactile Learning Activities in Mathematics: A Recipe Book for the Undergraduate Classroom* (Vol. 54). American Mathematical Soc..