Expanding the Computer Science Pipeline

Sarah Angell, Kyle Dencker, Matthew Gerber, Arup Guha

Department of Computer Science, University of Central Florida

Portions, Graphics and Tables from Mark Heinrich, Department of Computer Science, UCF

Video from Ruth John, Google

The Problem: Undergraduate Retention

- In the past, most entering Computer Science students had some level of prior programming experience, whether through formal instruction or as a hobby
- Now, many students seeking to enter the CS program have no programming experience at all
- Why is this a problem? Well…
- First let’s talk about how programming works

Folding Towels: A Programming Exercise

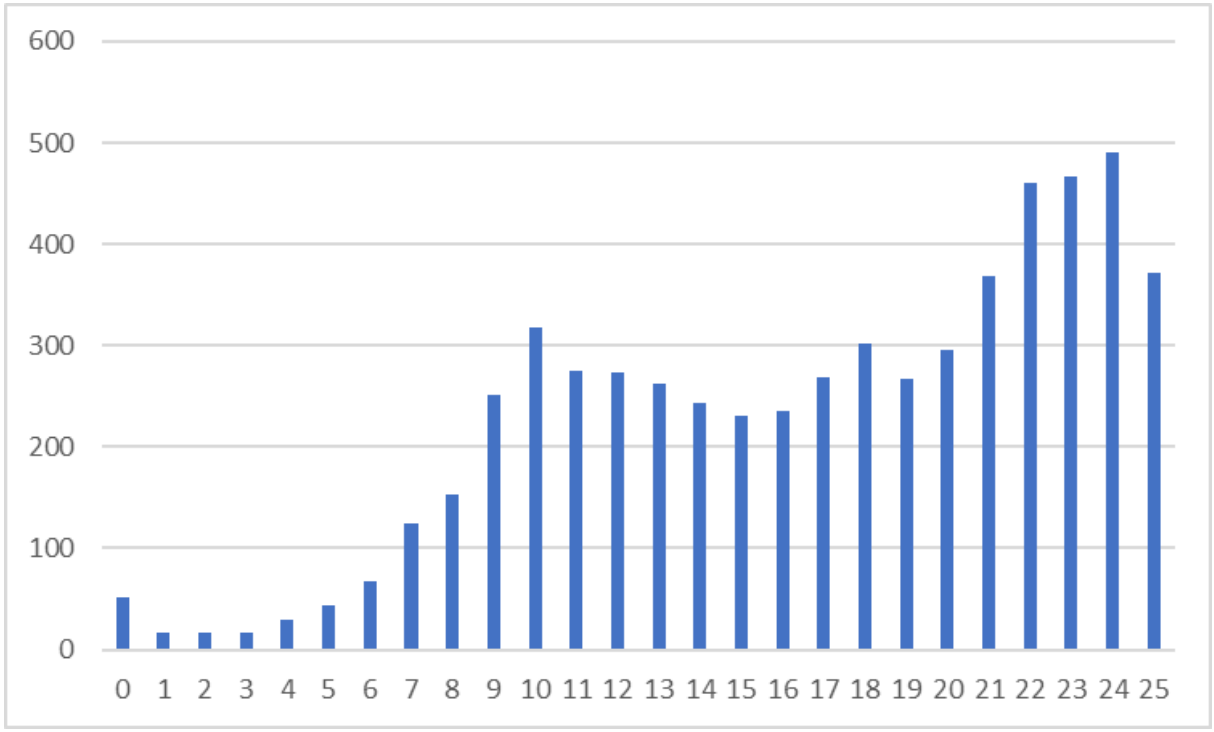
(No, Really)

COP2500: A Truly Introductory Programming Course

- Beginning in Summer 2021, we've offered a new **Concepts in Computer Science** course to first-time programming students
- Funded via an ECSPAND grant to attempt to retain more women and minority students in CS; benefits all students entering with little to no programming experience
- COP2500 uses the *Python* programming language
    - Python is in actual use for scientific computing…
    - …and is one of the best "first languages" to learn
- You've just done an actual exercise we have students in this course do
- We assume that students entering COP2500 have **no** experience in programming

Who Takes COP2500?

- Incoming Computer Science students now (since Summer/Fall 2021 incoming students) take a placement test
- 25 questions testing basic programming knowledge
- Below a certain grade, students **must** take COP2500
- Above that grade, students **may** take COP2500, and are encouraged to if they feel their programming skills need to be refreshed



COP2500 and the Curriculum

- Previously, our first programming course was COP3223, using the C programming language
- C *is* a language all CS students need to learn
- C is *not* a very good first language to learn
    - Many students had difficulty in COP3223 itself…
    - Even more had difficulty in the following COP3502 **Computer Science I** course

COP2500 and Engagement

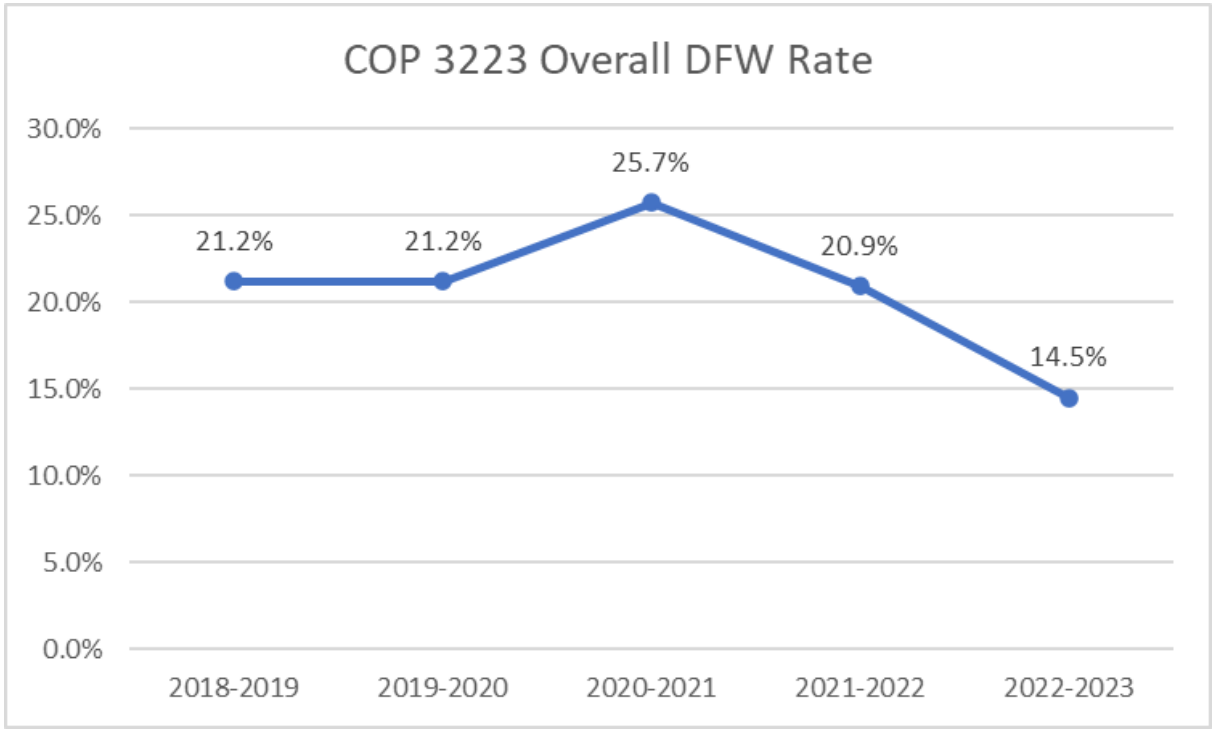
- The towel-folding exercise is an engagement exercise we actually use in COP2500, to teach students the importance of precise instructions
- Other exercises include:
  - Rubber Duck Debugging
  - Think-Pair-Share, Programming Edition / One Line At A Time
  - AI Code Review

COP2500 and Retention

- The most obvious question to ask about COP2500: **are more students passing COP3223?**

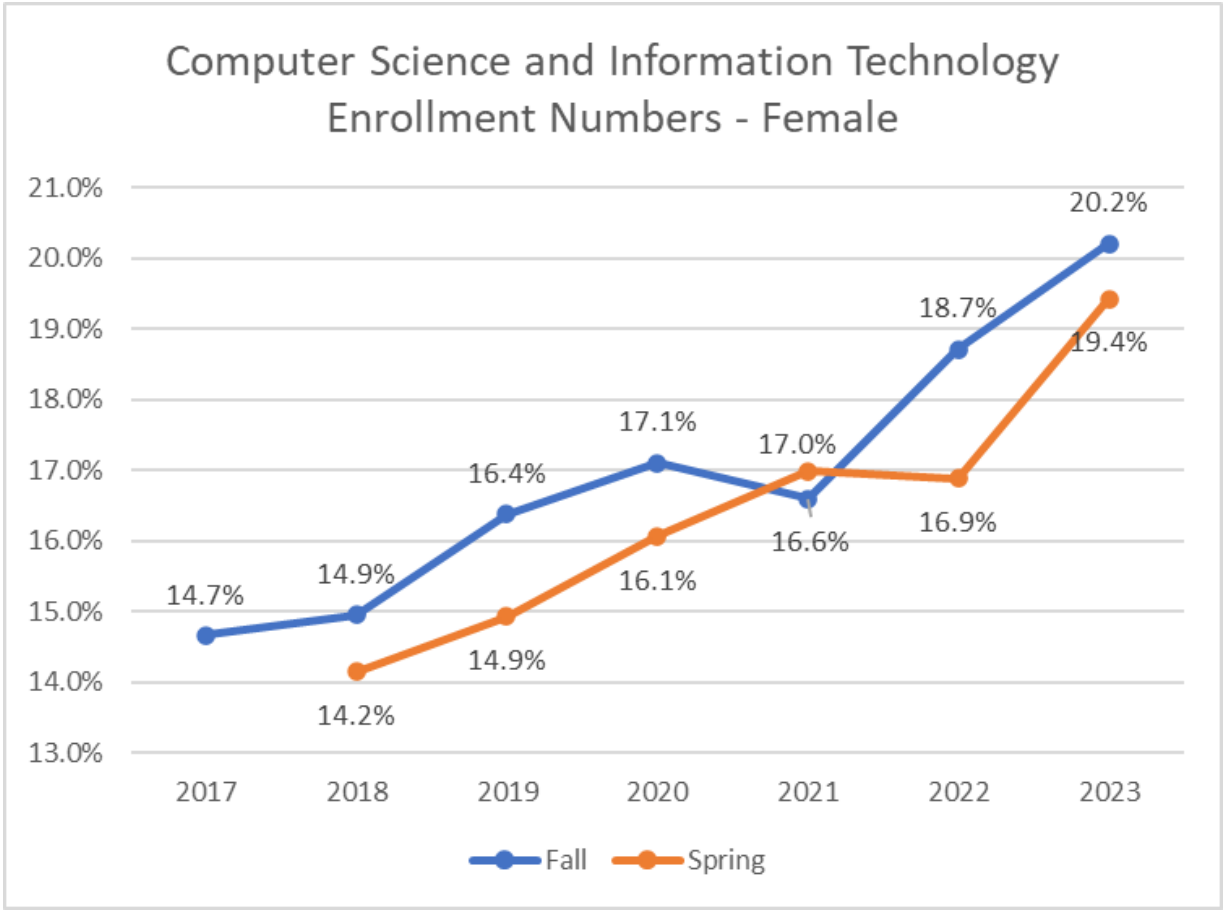
COP2500 and Retention

- The most obvious question to ask about COP2500: **are more students passing COP3223?**
- Yes.



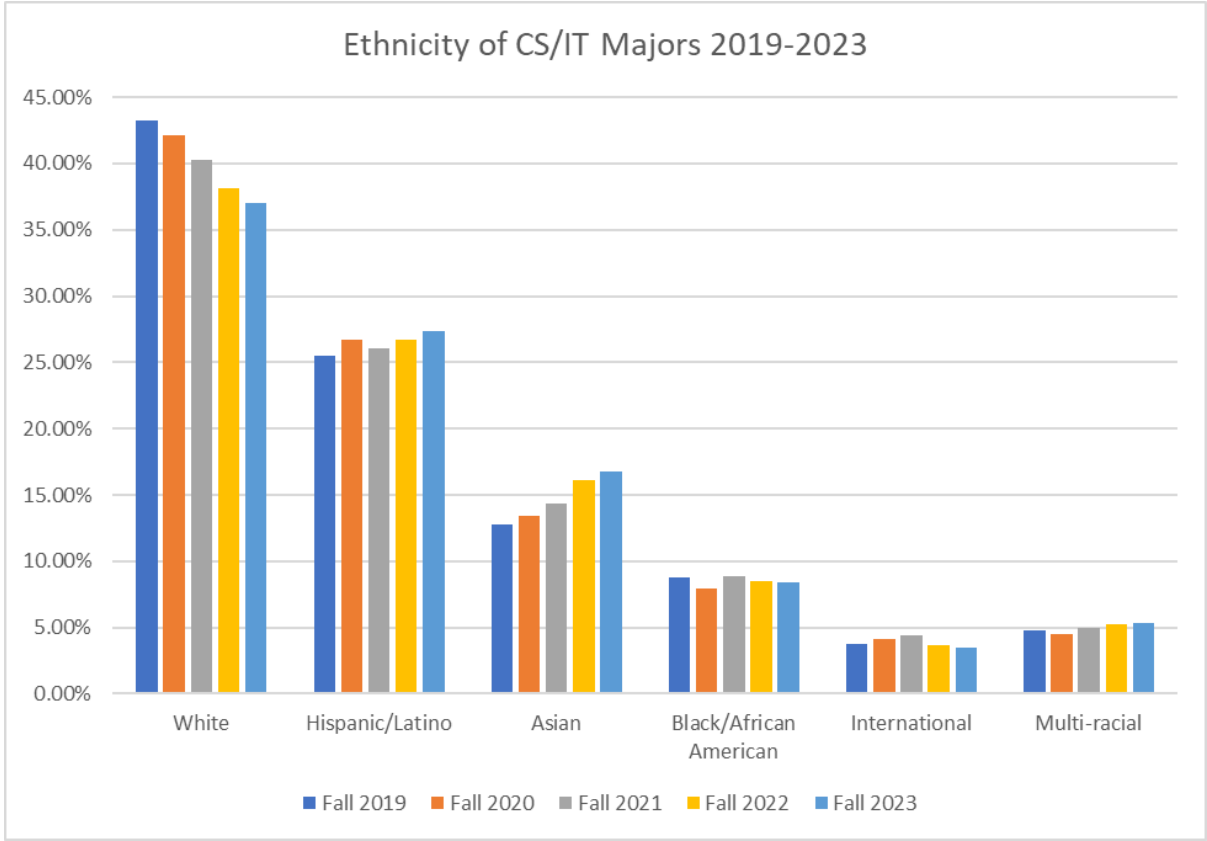
COP2500 and Retention

- The most obvious question to ask about COP2500: **are more students passing COP3223?**
- Yes.
- Also, we're enrolling and retaining more women students.



COP2500 and Retention

- The most obvious question to ask about COP2500: **are more students passing COP3223?**
- Yes.
- Also, we're enrolling and retaining more women students.
- We're enrolling and retaining more minority students as well.



COP2500 Student Performance

- In terms of passing the course, students required to take COP2500 are now performing roughly as well as students who test out of it
- (Only the first two lines are passing – grades of C- and below are useless to CS students)

COP 3223 Grades – All Majors Fall 2021 thru Spring 2023				
Grade	With COP2500		Without COP2500	
A, A-, B+, B, B-	1249	63.2%	2028	68.2%
C+ or C	366	18.5%	380	12.8%
C-, D, F	235	11.9%	364	12.2%
W	125	6.3%	203	6.8%
Total	1975	100.0%	2975	100.0%
Pass Rate	1615	81.8%	2408	80.9%

Discussion: Barriers to Retention

Questions for your groups to consider:

1. Are there specific groups of students you know your department or discipline has trouble retaining?
2. What hurdles are there in the curriculum that turn away those students – or simply turn away students in general?
3. What changes to your curriculum could be made to strengthen retention of those students – ***without*** compromising the curriculum's outcomes, rigor, or breadth of instruction?