



PINC: Promoting INclusivity in Computing

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PINC: Promoting INclusivity in Computing

- ▶ **A pilot program at San Francisco State University (SFState)**
 - ▶ Computer Science Department & Biology Department
 - ▶ Launched in Fall 2016
 - ▶ <https://pincsfu.com>
 - ▶ Funded through the Technology Pathways Initiative: <https://www.cawit.org/universities/>
- ▶ **Key objectives**
 - ▶ Improve diversity in computing
 - ▶ Increase computing literacy in data-intensive, non-computer science fields

Why at SFState?

- ▶ **One of the most diverse universities in USA**
- ▶ **In 2016, SFState**
 - ▶ Female students: 58%
 - ▶ Under represented minority group (URM): 50%
(Black/African American, American Indians, Alaskan Natives, Native Hawaiian, Pacific Islander, and Latino)
- ▶ **College of Science & Engineering (COSE @ SFState)**
 - ▶ Female students: 49%
 - ▶ URM: 48%
- ▶ **Computer Science department (CS @ COSE)**
 - ▶ Female: 15%
 - ▶ URM: 28%

Why now?

- ▶ **As per US Bureau of Labor Statistics, by 2024:**

- ▶ demand for computing literate workforce: 1.1 million
- ▶ supply: 450,000 CS graduates

- ▶ **Multidisciplinary positions**

- ▶ Domain knowledge + Computing skills
- ▶ E.g. Bio/Medicine/Health + CS, Agriculture + CS, Public policy + CS
- ▶ Driven by unprecedented explosion of digital data in all fields

How?

▶ PINC Curriculum

- ▶ 5 3-unit Computer Science courses
 - ▶ CSc 306 includes the basic building blocks of programming
 - ▶ CSc 220 introduces data structures, algorithms and algorithmic thinking, and basic performance analysis
 - ▶ CSc 307 basic web programming (HTML, PHP, Python, SQL, and MySQL)
 - ▶ CSc 698a & CSc 698b allows students to brainstorm, design, develop and manage a software prototype, with their near-peer mentors' guidance (capstone project)

PINC Curriculum: Student Learning Outcomes

	SLO 1	SLO 2	SLO 3	SLO 4	SLO 5
CSC 306: An Interdisciplinary Approach to Computer Programming	I				
CSC 220: Data Structures & Algorithms	D	I			
CSC 307: An Interdisciplinary Approach to Web Programming	D	D	I	I	
CSC 698a: Topics in Computing I	D	D	D	D	I
CSC 698b: Topics in Computing II	M	M	M	M	D

1. demonstrate basic skills in computer programming using a widely used language, such as, Java or Python
2. develop simple software programs that employ core concepts, including lists, stacks, queues, trees, tables, graphs, recursion, iteration, sorting, search, and hash table.
3. program database applications by applying core concepts of database theory and management.
4. develop simple internet applications using web development technology.
5. design, develop, and manage software prototype creation process with the goal of solving a problem from their field, or providing an improved solution to the problem.

How?

- ▶ **Three key pedagogical pillars:**
 - ▶ cohort-based program structure
 - ▶ near-peer mentoring & affinity research groups
 - ▶ project-based learning

Cohort-based Program Structure

- ▶ **Small groups of only non-CS students that progress through the program together**
 - ▶ helps combat *imposter syndrome*
 - ▶ provides collaboration opportunities with people who have similar goals and backgrounds
 - ▶ diverse cohorts reduce stereotype threat
 - ▶ foster community building, helps retention

Near-peer Mentoring & Affinity Research Groups

▶ **Near-peer mentors:**

- ▶ CS Seniors & graduate students
 - ▶ strong academic performance & strong interpersonal skills
- ▶ Mandatory weekly office hours with mentees
 - ▶ course topics, homework assignments, encouragement, moral support
- ▶ Attend class meetings to assist during hands-on assignments

▶ **Affinity research group**

- ▶ Research mentor for capstone project (group of 3 to 4 students)
- ▶ Weekly mentor meetings: define, plan, develop, and manage project

Near-peer Mentoring & Affinity Research Groups (cont'd)

- ▶ **Affinity research group (cont'd)**
 - ▶ Supports cooperative learning
 - ▶ Positive interdependence
 - ▶ Face-to-face interaction
 - ▶ Individual accountability
 - ▶ Group processing
- ▶ Mitigate *CS difficulty* stereotype

Near-peer Mentoring & Affinity Research Groups (cont'd)

- ▶ **Monthly mentor training workshops**
 - ▶ strategies to identify & resolve mentees' learning challenges
 - ▶ co-discover effective tutoring techniques
 - ▶ importance of sharing their personal struggles with CS, and perseverance strategies (role model)
- ▶ **Course credit**
- ▶ **Female or URM mentors: 81%**

Project-based Learning

- ▶ **2 semester long group projects (3 to 4 students)**
- ▶ **Project topics**
 - ▶ defined by students
 - ▶ interdisciplinary (motivated by problems from their major)
- ▶ **Collaborative learning experience**
- ▶ **Better appreciation of the breadth of the field**
- ▶ **Deeper understanding & longer retention of the learned CS concepts & skills**

Project-based Learning (cont'd)

- ▶ **Distant Supervision by PINC PIs**
 - ▶ creative independence
 - ▶ high level project management
 - ▶ identify & bring in domain & technical experts as needed
 - ▶ periodic evaluation of student learning & project progress

Project Descriptions

- ▶ **CatGen** - a web based application for introductory genetic courses to use cat genetics in a punnett square
- ▶ **Fluotify** – a cell tracking program for 3D images of tissue samples
- ▶ **GatorHealth** - a mobile app for on campus student health services to facilitate student access & use of health center appointments, pharmacy, services, and other resources.
- ▶ **HealthMsgU** - a web application that data mines social media (primarily Twitter) about stigmatized diseases (AIDS/HIV) and their treatments/preventions (PrEP)
- ▶ **HIV Subtyping Tool** – a web based application that identifies HIV subtypes present in a given genome
- ▶ **Woozie** - an android app that estimates intoxication levels, compares to the CA DMV blood alcohol content chart to promote responsible drinking and deter or prevent drunk driving.

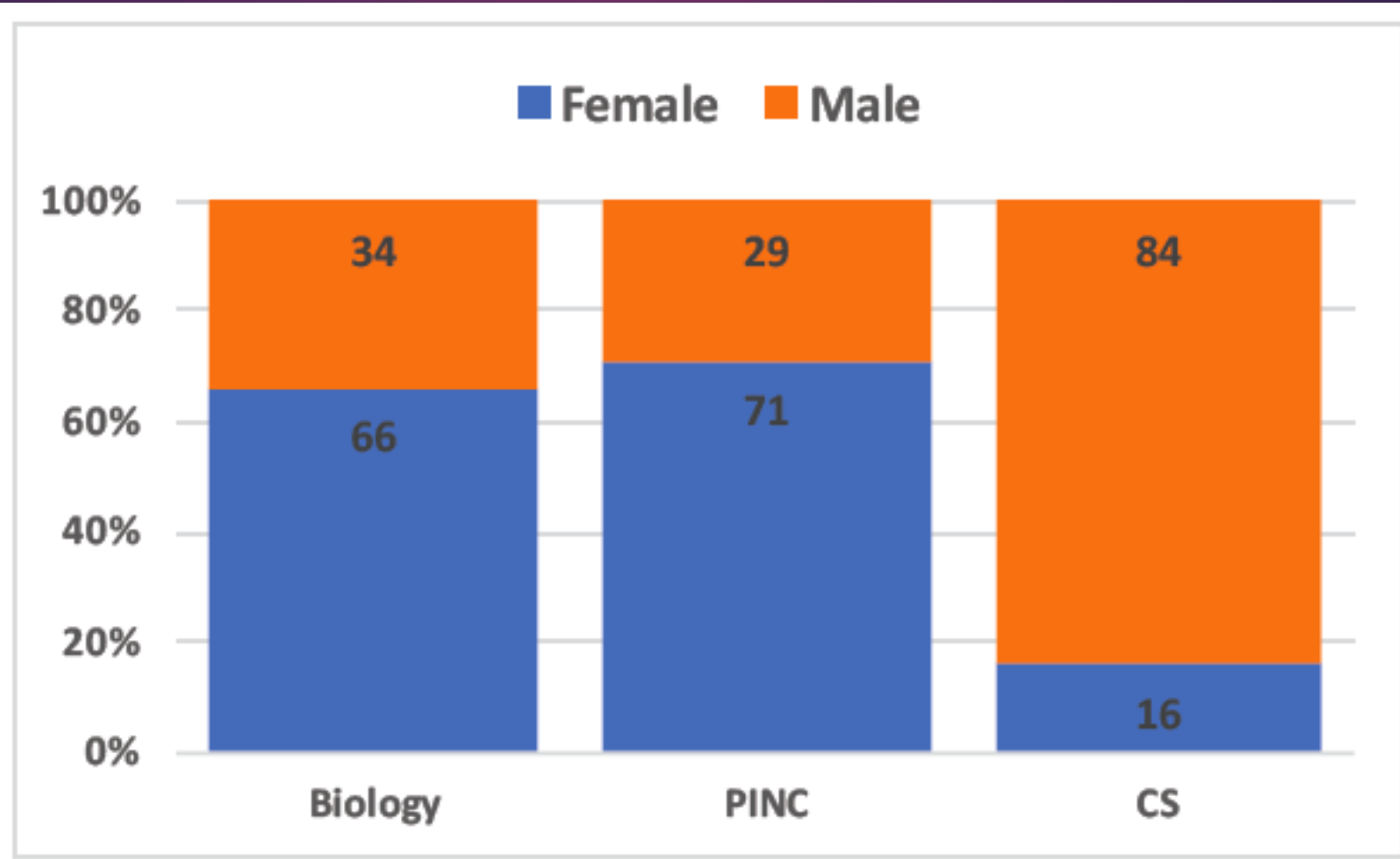
Utilized Project-based Learning Tools

- ▶ **Students obtained working knowledge of:**
 - ▶ Web & mobile development frameworks (Flask, PhoneGap)
 - ▶ Web development libraries (Bootstrap)
 - ▶ IDEs (Android Studio, PyCharm)
 - ▶ 3rd Party APIs (Twitter, Google Maps)
 - ▶ Classification algorithms from Machine learning (scikit)
 - ▶ Image processing software (OpenCV)

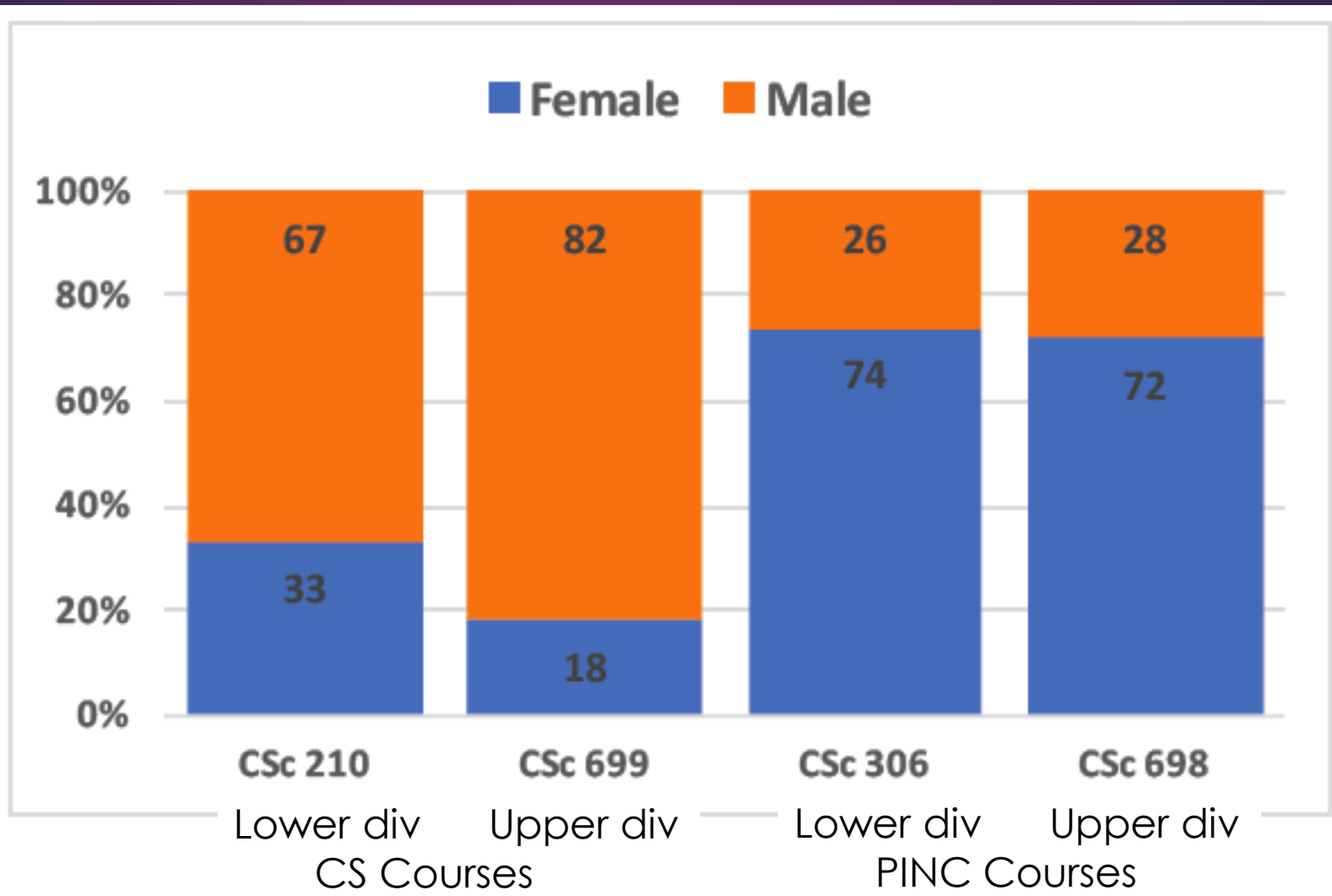
Early Trends

- ▶ **Gender distribution**
- ▶ **Female and URM retention**
- ▶ **Impact on increasing computer literacy**

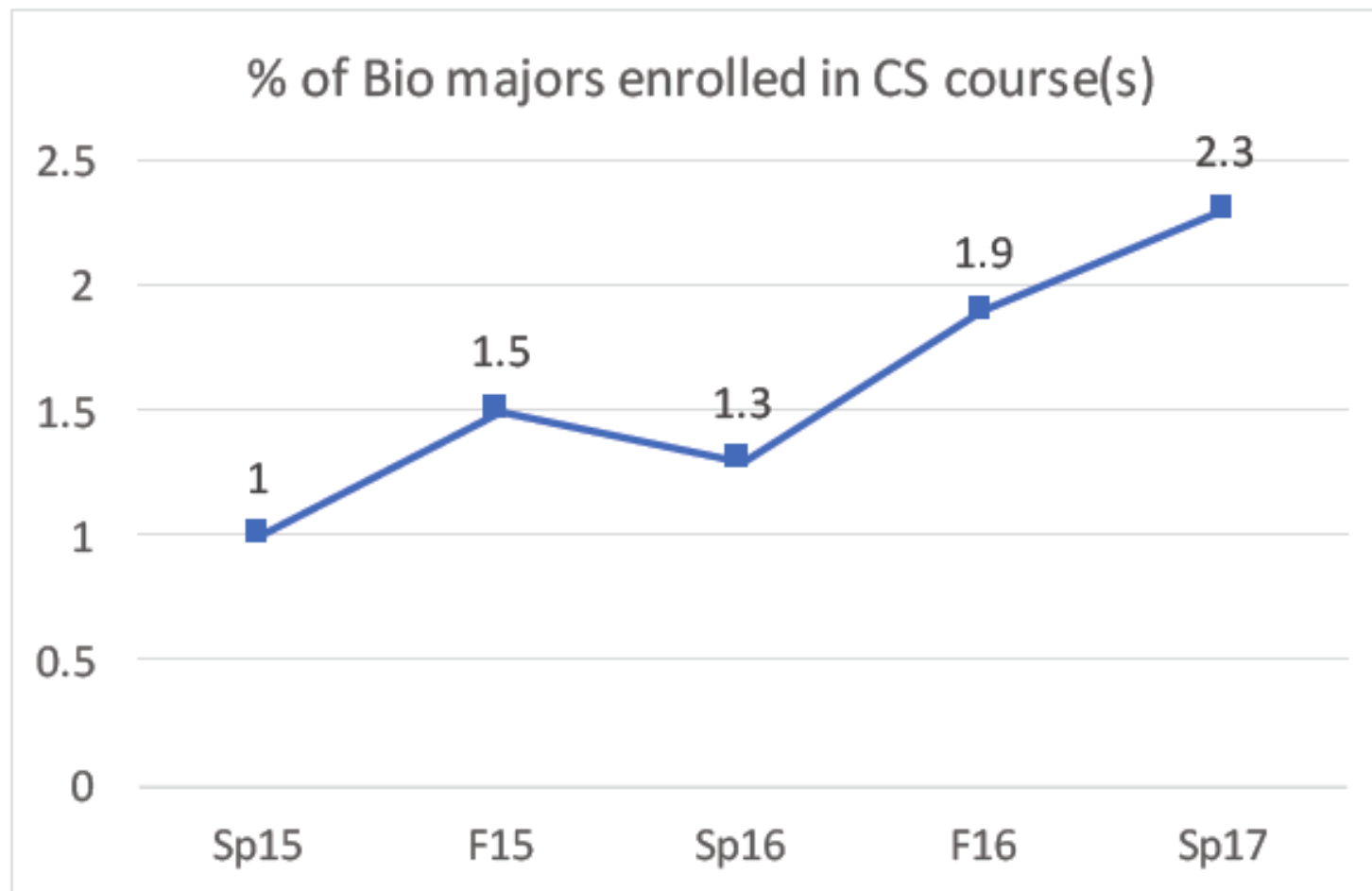
Gender distribution of students in:



Female & URM Student Retention



% of Biology Majors Enrolled in CS Courses



First Cohort Graduation!



Student Feedback about:

▶ Cohort-based program structure

- ▶ *“Working with others that do not have a background in computer science help me feel like I am not the only one struggling”*
- ▶ *“The interaction we have with our mentors and classmates, it feels like a close community”*
- ▶ *“I have enjoyed the camaraderie of working with a cohort. We all get to suffer together!”*

▶ Mentor support

- ▶ *“Having a mentor is a great help. I really appreciate their input”*
- ▶ *“We get to work with experienced mentors who are very knowledgeable”*

Future work

▶ **Primary attrition reasons:**

- ▶ student finished their degree
- ▶ could not balance the dual workload (major & PINC)

▶ **Planned steps to reduce attrition:**

- ▶ Enrollment criteria: At least 4 semesters away from degree completion
- ▶ Have some of the PINC courses counted toward Biology degree (e.g. quantitative GE course)
- ▶ Offer some PINC courses during summer
- ▶ Demonstrate the benefits of the PINC program (Poster sessions by senior PINC students, social events with PINC alumni)

Conclusions

- ▶ **PINC is a new model for CS education with two key objectives: to improve gender and ethnic diversity in computing, and to increase computing literacy among non-CS majors.**
- ▶ **Evidence-based practices that create a welcoming & supportive environment for minority students that can recruit, retain, and nurture non-CS students through a CS minor**
- ▶ **PINC helps student see computer science as an enabler.**