Undergraduate Research and Booming Enrollments: Who Wins?

Panel Co-chairs:
- Kelly Shaw (Williams College)
- Christine Alvarado (University of California, San Diego)
Trends in CS Degree Production

Growth in BS Production

Since 2010, ~60% PhD students are Nonresident Aliens
Impact of Participation in a REU

- Increases interest in graduate school [Russell et al., Science 2007] [Nyame-Mensah et al., CERP 2015]
- Increases applications to graduate school and enrollment in PhD programs [Wright, CERP 2018]
  - 31% with formal research applied vs. 15% without
  - 50% with formal research who enrolled chose PhD program vs. 26% without
- Stronger positive relationship on interest in research careers [Nyame-Mensah et al., CERP 2015] and professoriate [Tamer and Stout, SIGCSE 2016] for students from underrepresented groups than students from majority groups
Demand for REUs Exceeds Supply

Acceptance rates: ~30% in recent years
How Do We Create More Research Experiences for Undergraduates?
Speakers

- Christine Alvarado - Univ. of California, San Diego
  - Early Research Scholars Program
- Edward Coyle - Georgia Tech Univ.
  - Vertically Integrated Projects
- Brandon Fain - Duke Univ.
  - CS+ / Code+ / Data+
- Sarah Heckman - North Carolina State Univ.
  - Undergraduate Research Projects
Early Research Scholars Program

Dr. Christine Alvarado

Teaching Professor, Assoc. Dean of Undergraduate Education
U. of California, San Diego

Applicants selected

1 major elective

Research methods course + Research group observation

Proposal

Independent research + Research group observation

Poster

1st-year
spring

2nd-year
fall

2nd-year
winter

2nd-year
spring
Research Experience Structure

- Project-specific mentoring
  - Research adviser
  - four 2nd year ugrads

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- Team-based
  - General mentoring + research class

- Dual-mentored
  - Research adviser
  - four 2nd year ugrads
Program Outcomes

- Benefits / incentives?
  - **Students**: academic credit toward graduation, opportunity not otherwise available, confidence, feeling of belonging, retention, teamwork, experiencing research
  - **Faculty**: new research perspectives, possible publication, broadening participation in engineering, good will

- ERSP has been running for 8 years
  - ERSP started at UCSD in 2014
  - ERSP has grown to include 8 schools of varying sizes and demographics

- Roughly 150 students participate yearly across 6 (soon to be 8) universities
  - 40-72% women+non-binary
  - 16-28% Black, Latinx, Native American
Vertically Integrated Projects

Ed Coyle, Director of VIP@GT and J.B. Peatman Distinguished Professor
ECE, Georgia Institute of Technology

- VIP is AY, For-Credit, Graded A-F Each Semester
- Vertically Integrated Teams: 1st Year thru PostDocs on Each Team
- Long-Term, Large-Scale, Multidisciplinary Teams led by Faculty/Researchers
- Avg. 17 Students/Team; Teams last many years, even decades
Research Experience Structure

- Each Student can Participate for 2+ Years; Academic Credit Each Semester
- 10-20+ students/team; Returning Students Mentor New Students
- Add New Students as Others Graduate; Ensures Continuity and Productivity
- Peer-to-Peer Learning, Mentoring, Leadership
- Team Goals Set + Progress Monitored by Faculty and their Grad Students
Program Outcomes

- Spring 22: 1504 Students on 81 VIP Teams
- ~30% of 2022 Graduating Students had VIP
- VIP Spans Campus: Every Team Multidisciplinary
- Equitable Participation and Persistence
- 1995 – First VIP Teams
- VIP now at 44 Institutions
CS+ (and other Duke Plus Programs)

- Brandon Fain, PhD, Asst. Prof. of the Practice.
- Duke Plus Programs (CS+, Data+, Code+)
  - 10 week “full-time” summer program
  - Mostly rising 2nd and 3rd year undergraduates
  - Targets gender-balanced cohorts
  - Most students participate for one summer, some continue in fall (without formal program structure)
Research Experience Structure

**CS+**
- Shared space, talks, social events
- Project Team
- Team of 3-4 undergraduates
- Faculty Mentor(s)
- Graduate Student Mentor

Other Project Team

**Data+**

Plus Programs
- Dates/structure
- Tech training
- Shared speakers
- End-of-summer presentations

**Code+**

CRA Computing Research Association
Program Outcomes

CS+, ~30 students/year, running 3 years

Code+, ~50 students/year, running 4 years

Data+, ~80 students/year, running 8 years

CS+ Summer 2021 Student Feedback/Outcomes

- I am more interested in studying computer science than before CS+
- I am more interested in pursuing research than before CS+
- I feel better prepared to pursue a career in computer science than before CS+
- I plan to continue working on my project or with my mentor in the future
- I feel that I established at least one valuable relationship with a mentor in CS+
UG Research: Pathways & Connections

- Dr. Sarah Heckman
  - Teaching Professor & Director of UG Programs
  - North Carolina State University

- Program overview
  - Coursework
    - Methods -> Mentored Research -> Independent Research
  - Stipends
    - College level support for UG research
  - Lightning Talks
    - Connect students with faculty mentors
Research Experience Structure

**Lightning Talks**
- First Friday afternoon every semester
- Faculty give 5-minute overview of project
- Students connect with faculty

**CSC 298 - Research Methods**
- Part of ERSP program, but open to all students
- Student teams are matched with faculty mentors
- Create research design

**CSC 299 - Mentored Research**
- Intended for students earlier in the program
- 9-10 hours per week
- Higher level of faculty/grad student mentoring
- Can be continuation of CSC 298

**CSC 498/499 - Independent Study/Research**
- Intended for students later in the program
- 9-10 hours per week
- More independent work
- Part of CSC honors program
- Required proposal & paper

**COE REU Stipends**
- Stipend paid through financial aid (and returned if project is not completed)
- Faculty mentor submits abstract
- No final deliverables
- Available during the summer

**Other Pathways**
- Direct faculty support
- NSF REUs
- CRA DREU and CREU programs
- Unpaid research (2-3 hours/week)
- Participate in research
Program Outcomes

- **Quadrupled** UG Research / Study Participation
  - Lightning Talks (lightweight)
  - COE REUs
  - ERSP
- Culture of mentoring UG researchers
- Clarified student expectations
- Pathways to research
Panel Discussion
Audience Questions
CRA-E Virtual REU Support Program

- Educate undergrad researchers about
  - Research methods
  - Graduate school
  - Research careers
- Create cross-institution research community