Learning Programming at Scale

Philip Guo
Assistant Professor of Cognitive Science
UC San Diego
http://pgbovine.net/

UCSD Cognitive Science Ph.D. student orientation, 2017-09-22
Who am I, and how did I get here?

• Undergrad+masters in Electrical Engineering & Computer Science, MIT (2001-2006)
• Ph.D. in Computer Science, Stanford (2006-2012)
• Software engineer at Google (2012-2013)
• Postdoc at edX and MIT (2013-2014)
• Assistant Professor of Computer Science, University of Rochester (2014-2016)
• Assistant Professor of Cognitive Science, UC San Diego (2016-present)
My research spans human-computer interaction, online learning, and computing education.

Summary of my recent work Learning Programming at Scale

Publications | Google Scholar | Curriculum Vitae
What is research in Human-Computer Interaction?

**Studying** how humans interact with computers, and **building** better ways for humans to interact with computers.

http://pgbovine.net/what-is-hci-research.htm
Programming is one of the most powerful, yet hardest to learn, forms of human-computer interaction.

http://blogs.uw.edu/ajko/2014/03/25/programming-languages-are-the-least-usable-but-most-powerful-human-computer-interfaces-ever-invented/
My high-level research goals:

**Studying** how humans interact with programming, and **building** better ways for humans to interact with programming.
My current research (2014-present): Learning Programming at Scale

1. *Studying* why and how people from diverse backgrounds are learning programming

2. *Building* new kinds of programming environments to support learners

3. *Building* new kinds of programming-related instructional materials

http://pgbovine.net/learning-programming-at-scale-CACM.htm
Studying why and how people from diverse backgrounds are learning programming

• Why are older adults (age 60 and over) learning programming? (Guo, CHI 2017, honorable mention paper award)

• How do female programmers use the popular Stack Overflow coding Q&A website? (Ford et al., FSE 2016)

• How do students learn at college hackathons? (Warner and Guo, ICER 2017)

• Are there people who want to learn programming but don’t actually need to write code for their job? (Chilana et al., VL/HCC 2015), (Chilana et al., CHI 2016)

http://pgbovine.net/publications.htm
Building new kinds of programming environments to support learners (1 of 2)

• How can we visualize the inner-workings of the computer to help learners build mental models? (Guo, SIGCSE 2013) http://pythontutor.com/ (3.5+ million users from 180+ countries)

• Can multiple learners simultaneously interact with and chat about visualizations? (Guo et al., VL/HCC 2015)

• How can a single tutor simultaneously monitor and help dozens of learners as they code? (Guo, UIST 2015)

• Can we visualize everything about what a piece of code does on-screen at once? (Kang and Guo, UIST 2017)

http://pgbovine.net/publications.htm
Building new kinds of programming environments to support learners (2 of 2)

• How can we detect learner frustration in a scalable and cost-effective way? (Drosos et al., VL/HCC 2017)

• How can we help novices get started with learning pair programming, testing, and version control? (Warner and Guo, CHI 2017)

• How can we use open data on the web to help novices get started with learning data science? (Zhang and Guo, UIST 2017, honorable mention paper award)

http://pgbovine.net/publications.htm
Building new kinds of programming-related instructional materials

• How do learners interact with digital textbooks? (Warner and Guo, EDM 2015)

• What are the shortcomings of MOOC forums for discussing programming questions? (Zhu et al., VL/HCC 2015)

• Can learners work together to create step-by-step annotated code examples? (Gordon and Guo, VL/HCC 2015)

• Can we easily generate step-by-step tutorials for multi-application command-line and GUI tasks? (Mysore and Guo, UIST 2017)

http://pgbovine.net/publications.htm
Where are we at now, and what’s next?

• Starting 4th year of assistant professoring

• My lab: 6 graduate students (2 cognitive science, 4 computer science)

• What’s next? Looking into broader groups of non-traditional learners, removing unnecessary barriers to getting started, expanding more to data science education

http://pgbovine.net/learning-programming-at-scale-CACM.htm