Learning Programming at Scale

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Summary of Major Research Directions
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Where have I been, and where am I now?

- Bachelors+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 & MIT (2013-2014)

- Assistant Professor of Computer Science, University of Rochester (2014-2016)

- **Assistant Professor of Cognitive Science, UC San Diego** (2016-present)

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Publications
Google Scholar
Curriculum Vitae

Twitter | YouTube | iTunes
RSS: podcast | everything

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My high-level research interests

Studying how people do computer programming, and ***building*** better ways for people to do programming

My early faculty research trajectory (2014-present):
Learning Programming at Scale

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

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

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

1. *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

- What challenges do non-native English speakers face when learning programming? [Guo. CHI 2018]

- What challenges do women programmers face when using the popular Stack Overflow coding Q&A website?
  [Ford, Smith, Guo, Parnin. FSE 2016]

- Why do students attend hackathons, and what do they learn there?
  [Warner and Guo. ICER 2017]

- Who's learning to code but doesn't actually need to write code?
  [Chilana, Alcock, Dembla, Ho, Hurst, Armstrong, Guo. VL/HCC 2015], [Chilana, Singh, Guo. CHI 2016], [Wang, Mitts, Guo, Chilana. CHI 2018] Honorable mention paper award

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

- 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 program visualizations?
  [Guo, White, Zanelatto. 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]

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2. *Building* new kinds of scalable programming environments to support learners (continued)

- How can we automatically detect learner frustration in a scalable way? [Drosos, Guo, Parnin. 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

- How can we let web designers quickly prototype interface ideas by borrowing features from existing websites?
  [Zhang and Guo. UIST 2018]

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

- How do learners interact with digital textbooks on programming?
  [Warner and Guo. EDM 2015]

- What are the shortcomings of MOOC forums for discussing programming questions? [Zhu, Warner, Gordon, White, Zanelatto, Guo. VL/HCC 2015]

- Can learners work together to create step-by-step annotated code examples for education? [Gordon and Guo. VL/HCC 2015]

- How can we efficiently create and give feedback on tutorials for complex multi-application software tasks?
  [Mysore and Guo. UIST 2017] [Mysore and Guo. UIST 2018]

- How can we improve the viewing experience of programming tutorial screencast videos? [Khandwala and Guo. Learning at Scale 2018]

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Broader work in online learning at scale

- How do video styles affect learner engagement in MOOCs?
  [Guo, Kim, Rubin. Learning at Scale 2014]

- How do learners from different demographic and geographical backgrounds use MOOCs?
  [Guo and Reinecke. Learning at Scale 2014]

- How do researchers from different fields approach the challenges of online learning at scale?
  [Kross and Guo. Learning at Scale 2018]

- How do online learners from different cultures follow programming tutorials and debug their code?
  [Thayer, Guo, Reinecke. VL/HCC 2018]

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Where am I now, and what's next?
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- Starting my 5th year as an assistant professor

- Currently advising 3 Ph.D. and 2 masters students

- Ongoing projects: scaling real-time peer tutoring for programming, making it easier to create and improve software tutorials, lowering barriers to prototyping web applications and data science explorations

- What's farther ahead? Studying more diverse groups of programming learners, generalizing code visualizations across languages and domains, expanding to data science and machine learning education

Learning Programming at Scale

Summary of Philip Guo's recent research projects

Last updated: Aug 2018. All papers available at http://pgbovine.net/publications.htm

Understanding Diverse Learners

Conversational programmers
[VL/HCC 2015][CHI 2016][CHI 2018]

Hackathon participants
[ICER 2017]

Gender dynamics in forums
[FSE 2016]

Older adults aged 60+
[CHI 2017]

Non-native English speakers
[CHI 2018]

Culture, values, & debugging
[VL/HCC 2018]

Building Programming Environments

Visualizing code execution
[SIGCSE 2013] [UIST 2017]

One-on-one live help
[VL/HCC 2015]

One-to-many code tutoring
[UIST 2015]

Scaffolding pair programming
[CHI 2017]

Data science using the web
[UIST 2017]

Web UI prototyping
[UIST 2018]

Redesigning Programming Tutorials

Browsing digital textbooks
[EDM 2015]

Discussing code in forums
[VL/HCC 2015]

Learners annotating code
[VL/HCC 2015] [VL/HCC 2017]

Programming tutorial videos
[Learning@Scale 2018]

Creating multi-app tutorials
[UIST 2017]

Profiling multi-app tutorials
[UIST 2018]