Summary of Research Directions

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My very high-level research interests …

Studying how people currently write code and analyze data, and ***building*** better ways for people to write code and analyze data.

My early faculty research trajectory (2014-present):

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

- Why are older adults (age 60 and over) learning programming, and what unique challenges do they face?
  [Guo. CHI 2017, **Honorable Mention Paper**]

- 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]

- Who is well-positioned to help adults from underrepresented groups learn data science to improve their employment prospects? [Kross and Guo. VL/HCC 2019]

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

- How do online learners from different cultures follow programming tutorials and debug their code differently? [Thayer, Guo, Reinecke. VL/HCC 2018]
- Why do students attend college hackathons, and what do they learn there? [Warner and Guo. ICER 2017]
- Why are software developers trying to learn machine learning, and what barriers do they face? [Cai and Guo. VL/HCC 2019]
- Why are many kinds of people now learning to code who don't actually need to write code for a living? [Chilana, Alcock, Dembla, Ho, Hurst, Armstrong, Guo. VL/HCC 2015], [Chilana, Singh, Guo. CHI 2016], [Wang, Mitts, Guo, Chilana. CHI 2018, **Honorable Mention Paper**]

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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/ **(over 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

- 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 and machine learning? [Zhang and Guo. UIST 2017, **Honorable Mention Paper**] [Zhang and Guo. UIST 2019]

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

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

- How do learners interact with online computer science textbooks? [Warner and Guo. EDM 2015]

- What instructional tools do people use to teach data science? [Kross and Guo. CHI 2019, **Honorable Mention Paper**]

- What are limitations of traditional online forums for discussing coding-related questions? [Zhu, Warner, Gordon, White, Zanelatto, Guo. VL/HCC 2015]

- Can learners work together to make step-by-step code walkthroughs? [Gordon and Guo. VL/HCC 2015]

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

- How can we create and give feedback on multi-application software tutorials? [Mysore and Guo. UIST 2017] [Mysore and Guo. UIST 2018, **Best Paper Award**]

- How can we create annotated GUI workflows from command-line applications? [Vaithilingam and Guo. UIST 2019]

- How can we make coding screencast videos easier to comprehend? [Khandwala and Guo. Learning at Scale 2018]

- How can we combine the benefits of live coding demos and slide presentations for teaching? [Chen and Guo. Learning at Scale 2019]

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Broader research in online learning at scale

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

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