I want to pursue a PhD and create systems to augment collaborative technical work and online education. I am interested in **human computer interaction**, **programming languages**, and **software engineering** research. I am currently working with Professor Philip Guo, building programmer productivity tools. Previously, I built and tested wireless sensors networks with Professor Wendi Heinzelman. I have published my research in major conferences and journals four times, once as first author [1, 2, 3, 4].

While working with Professor Heinzelman in the Wireless Communications and Networking Group, I learned about energy harvesting sensor nodes - those powered by transmission signals. Passive sensor networks are increasingly popular, but their short transmission range limits possible applications. We designed a new node that extended the maximum multi-hop transmission range. I helped configure these nodes (which involved surface mount soldering) and developed a system to automate network performance testing. This system used an Arduino with an AC motor driver and Bluetooth module to wirelessly move a node-mounted platform through a random walk pattern, simulating different physical network configurations.

Our node design increased the maximum range of passive multi-hop wireless sensor networks, and led to the dissertation of the PhD student directing the project. We presented this work at the IEEE International Conference on Communications [1], and published it in the ACM Transactions on Sensor Networks [2]. From this project I learned about systems integration and testing, but I wanted to pivot into more human-centric computer science research. I began working with Professor Philip Guo on HCI and online learning projects.

With Professor Guo in the Human Computer Interaction Group, I first examined usage patterns of a massive-scale online textbook (`http://interactivepython.org`) to develop insight into how to produce more engaging online resources. I analyzed 6.8 million log events in the first and largest-scale interactive digital textbook study, focusing on how high school, college, and online students used the textbook differently. I published this as a first-author paper at the International Conference on Educational Data Mining [3].

In this study, I examined metrics such as the frequency of non-linear navigation (skipping or backing over chapters), and transition patterns between actions (running code, page navigation, etc). I proposed to dynamically use this navigation information to improve the textbook - e.g., a link to relevant material other students found helpful could appear when a student triggered a certain coding error. These findings can improve the user interface of the popular Interactive Python learning platform, which is used by 12,000 users per day on average, and similar online learning resources.

I also collaborated on another student's project to identify problems that hold back traditional web forums from being efficient channels of discourse for online computer science courses. This work was published in IEEE VL/HCC [4]. Both of these projects inform the design of the next generation of online education tools. From these projects, I learned how to glean design insight from running empirical studies of big data. With this, I shifted my research focus towards the systems-building aspects of HCI.

In my master's thesis, I introduce the novel idea of *Code Piloting*: programmers concurrently doing development, testing, and documentation tasks on a shared codebase. To explore this idea and gain experience in building interactive systems, I developed CodePilot - a web application that merges real-time document collaboration with GitHub for version control. Programmers can import or fork a repository, then commit and push their code changes back to GitHub. I developed a novel integrated chat and event feed that keeps the programmers in sync contextually without disrupting their normal workflow. CodePilot includes a HTML/CSS/JS renderer and debugger for parallel web development - programming, testing, and version control woven together seamlessly.

CodePilot's integrated collaboration environment supports remote pair programming, where the physical distance between programmers prevents informal communication that helps programmers stay synced. CodePilot also lends itself to novice-expert pair programming. The structure of the collaboration environment allows the expert to easily guide and monitor the novice's progress, helping the novice code confidently. I plan to submit this work to CSCW 2016, and a prototype is available online at `http://codepilot.xyz`.

Taking a programming languages class piqued my interest in extending languages to the browser. CodePilot's web-based code execution engine can be extended with projects such as *asm.js* and *emscripten* to compile and run arbitrary code in any language, directly in the browser. Enabling students to run code without a complex development environment encourages them try out new languages, making new forms of computation accessible. As an educational tool, CodePilot offers new opportunities for tutoring multiple students simultaneously. Students can have the unprecedented ability to branch off and explore concepts on their own, while maintaining the context of the tutor. I envision using CodePilot to find and create more powerful ways to share technical knowledge and facilitate collaboration.

I am interested a variety of research in systems-building and empirical studies projects within HCI, software engineering and programming languages. My career aspiration is to lead a research laboratory in industry after completing my PhD, where I will strive to make usable, effective technology with a positive societal impact. Technology continues to become more powerful and interconnected, but not necessarily more intuitive or promotive of self-efficacy. I seek to narrow this gap by designing and creating intuitive systems that eliminate unnecessary technical hurdles.

I want to continue my studies at UC Berkeley because of the strong human computer interaction group within the Computer Science department. I especially find the work of **Professors Hartmann**, **Hearst**, **Fox** and **Dragan** exciting and relevant to my research interests. I also like to engage with people from different backgrounds, so the diversity of the research groups in EECS is appealing. For these reasons, I would like to join the Computer Science Doctoral Program at the University of California, Berkeley.

## References

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