

Research Statement

My research interests generally involve system software. I believe diversity poses one of the biggest challenges to modern systems, both in terms of hardware capabilities and application demands. The vision of system software as simply abstracting underlying hardware and generically multiplexing resources among application programs is becoming increasingly restrictive. Hardware capabilities now range from handheld programmable data assistants to parallel super computers, and application demands now span a spectrum from scientific computing to entertainment applications. Systems thus need to be structured to more effectively manage radical diversity.

On the one hand, systems need to incorporate a wider range of hardware capabilities within existing and new abstractions. Some of the experience I have had on this front is the incorporation of embedded network processors into a global memory management system that uses available cluster memory instead of disk for backing-store. Intelligent network interfaces and similar devices are bound to become increasingly prominent as they become commodity hardware, and I am interested in better understanding how to better expose their power within existing systems.

On the other hand, system-level application-aware resource management strategies need to be implemented in ways that are more configurable and extensible than traditional approaches. Some of the experience I have had on this front is the aspect-oriented implementation of prefetching modes depending on memory access patterns. Systems must be increasingly sensitive to dynamic context, such as the balance of application demands within the current computing platform capabilities, and I am interested in techniques that explicitly structure these kinds of system elements.

As we attempt to introduce diversity into systems more effectively, we need new measures to evaluate and predict the impact structural variations will have on evolution and maintenance. I have had some preliminary experience on this front, studying the evolution of several operating system concerns in both their original and aspect-oriented implementations through successive releases of a system. New developments in programming techniques need to be carefully considered within the performance sensitive domain of systems software, and I am interested in this overlap of software engineering and systems research.

In the short term, I would be most interested in further establishing the role programming language and software engineering techniques, such as aspect-oriented software development, could play within systems code. In particular, I think it would be most fruitful to focus on configurability and extensibility of existing systems, and explore effective measures of evaluation within existing system structure. From this foundation, I believe the next step would be to design and implement new systems, structured specifically to better respond to diversity in both hardware and application demands.

Teaching Statement

Between degrees, I worked for six years as a full-time instructor at a small college, teaching first and second year computer science. During that time, I came to realize that teaching has many dimensions beyond trying to effectively impart information. I believe that other important and inter-related dimensions of teaching involve inspiration, celebration, and respect.

With regard to inspiration, I see this as the “coaching” aspect of teaching. I believe it is important to establish upfront that a course will be challenging and that students are expected to be hungry to learn and willing to work hard. I also want to recognize that each student has his/her own individual interests and reasons for wanting to learn the course material. As much as possible, I want to try spark or encourage this inner motivation. As a result, I see consistently trying to introduce concepts first in terms of a broad context of issues – related concepts, current innovations in industry, and/or day-to-day experiences – as an important part of this dimension.

I believe that related to inspiration is celebration, and that students sometimes need to be encouraged to make mistakes. That is, I believe it is important to recognize the value of their first infinite loop in an introductory programming course, or a page-fault in kernel mode in an operating systems course. I want to be sure they associate these kinds of mistakes as crucial positive steps towards a deeper understanding, feeding both their inner motivation and confidence. Further, I believe one of the most effective ways to celebrate and encourage this kind of exploration is to have students voluntarily share some of their most spectacularly frustrating experiences with each other.

Finally, I believe ensuring a course is conducted in a way that is respectful to everyone requires a clear protocol. This impacts both evaluation components of the course and in-class interaction. In terms of evaluation, barring extenuating circumstances, everyone is given the same amount of time for assignments and exams. I therefore believe it is important to ensure any late penalties are well advertised and strictly enforced. Similarly, everyone is given the same opportunity and encouragement to participate in class. I therefore attempt to ensure that an expectation of participation is established, and a wide variety of students contribute in class.

Teaching Interests

I would be most interested in teaching any undergraduate courses involving operating systems, distributed systems, or networking. At the graduate level, I would like to focus on advanced topics in systems, including embedded systems and ubiquitous computing, and more specifically the application of new programming language and software engineering techniques to this domain.