



From Programmer to Computer Scientist

By Kurt Krebsbach '85, Associate Professor of Computer Science

When **Sam Estrem '12** and **Colin Potts '13** graduate from Lawrence, they will become the first two math-computer science majors to have published research papers as undergraduates. But for all of their talent and hard work, they would be the first to admit that in retrospect, they really had no idea what the “science” of computer science was when they arrived as freshmen.

“I have always liked working with computers,” said Estrem. “I starting programming during my junior year in high school, and was a proficient programmer in several, including some unusual, languages by the time I arrived at Lawrence. I had skills and could figure things out on my own, but I soon discovered that programming was only a tiny part of computer science.” Potts concurred: “When I visited LU as a prospective student I discovered that computer science was not fundamentally about programming or computers, but had a strong mathematical basis, in the sense that math is all about abstract models. This way of thinking leads computer scientists to focus on the development of both procedures for efficiently performing tasks and new ways to represent information.”

Associate Professor of Computer Science **Kurt Krebsbach '85**, who returned to his alma mater as a faculty member in 2002,

has mentored both Potts and Estrem for their *Senior Experiences* since the middle of their sophomore years. He described their transformation into scientists as tapping into strengths they didn't know they had: “Sam and Colin were, as many Lawrence students are, enormously talented and hard-working when they arrived, and while that is critical for research, I can't really teach those things. But I can show them how to use the scientific method—forming hypotheses, designing experiments, analyzing data and improving their theories—to design original, general-purpose procedures (algorithms) with provable properties that solve entire classes of problems. Instead of writing individual computer programs, these college students are making significant, publishable contributions to the field of computer science. Once they sense that power, that potential, their creative instincts take over and they're hooked. Everywhere they look they see the potential for new or improved algorithms.”

Estrem, Potts and Krebsbach have done precisely that over the past few years. Estrem began working on his research—“AIRS: Anytime Iterative Refinement of a Solution”—in early 2010. His approach is to have the computer generate a “bad” but valid solution very quickly and use remaining computational time to incrementally improve the solution until time runs out. Potts has developed a variation of the famous IDA* search algorithm he is calling “Iterative Expansion A*,” which exploits available memory to reduce search time. Both of these projects have resulted in peer-reviewed articles, which will be presented by the students at a major international research conference in Florida and published by AAAI Press. An unpublished version of Potts' work also received the “Best Undergraduate Paper Award” at a regional computer science conference in April.

Together, their research collaboration in artificial intelligence with Krebsbach explores ways to improve heuristic search techniques applicable to a wide variety of problems, including areas as diverse as generating driving directions, scheduling package deliveries, planning Hubble Space Telescope observations and even generating candidate answers for IBM's Jeopardy-playing Watson.

“Once these guys began thinking like researchers,” said Krebsbach, “the problem became keeping them from working on too many ideas at once. We've focused on seeing our best ideas through, including writing professional articles—a difficult skill to acquire even for the best students. But the countless editing sessions have been worth it. These accomplishments are rare for undergraduates, and will open up exciting opportunities for them to grow, both personally and professionally.”

But Krebsbach stresses the role that the *Senior Experience* program at Lawrence has played to make these impressive undergraduate achievements possible. He points out that undergraduates have not typically competed at this level, but that the recently implemented *Senior Experience* fund has leveled the playing field. “Without *Senior Experience* funding, we could not have purchased a high-performance multi-core computer to run hundreds of thousands of experiments, and the students would not have been able to afford to present their results at an international conference. The students deserve to be supported and recognized, and the *Senior Experience* program has made that possible.”

The experience, Potts said, has helped him focus on different career paths after Lawrence. “A lot of the stuff we're doing really gives you a better idea about what your life would be like if you chose to pursue a research career. It's really an invaluable experience to just jump into it this early and get a feel for how these things work.” Estrem agreed that his time working on this project has opened his eyes to new possibilities. “My time working with Colin and Professor Krebsbach has fundamentally changed the way I look at a problem. After college, I am no longer restricted to fields where I am told what to program, because I can suddenly see all the places and ways computer science, and even my own research ideas, can be applied.”



ABOVE: Visiting author Debra Monroe visits with students at Björklunden

Writing in the Woods

By David McGlynn, Assistant Professor of English

Lawrence's *Senior Experience* program aims to help students channel their academic majors toward the career paths they'll follow after graduation. For students interested in creative writing, however, that “path” is difficult to discern, let alone follow. The cliché of the starving writer endures precisely because it's true: the number of writers who began their professional careers the summer after graduation from college is small enough to count on one hand with a few fingers left over. For the rest of us, the journey from student to scrivener is a long and winding road.

The best way to mitigate the uncertainty is to seek advice from those who have been down the road before. Since 2009, the Mellon *Senior Experience* Grant has helped Lawrence students advance their writing careers by working closely with renowned fiction and nonfiction writers. Writers such as Jill McCorkle, Thomas Lynch, Debra Monroe and Robin Hemley—all of whom teach in nationally ranked graduate writing programs—have come to campus to read from their work. But the writers who visit Lawrence do far more than just stand behind a podium. They join students for lunch, hold extended Q&A sessions, and in many cases spend the weekend at Björklunden with small groups of advanced students. The Door County retreats provide the space and time

for the visiting writer to conduct master classes, lead workshops, and even meet with students one-on-one to discuss an original story or an essay. Nearly every Lawrence student who participates in a writing retreat returns to campus encouraged and energized about his or her own work. **Magdalena Waz '11** said, “The weekends with visiting writers at Björklunden provided a completely new kind of classroom experience. Visiting writers drew us into a more professional world where we didn't have to think of our writing as just homework. The relaxed setting made it possible for me to ask accomplished writers questions about the process of becoming a writer that wouldn't have been possible during a brief visit. I got hands-on experience and knowledge that I couldn't get out of a book or a homework assignment.”

Indeed, it's hard to overstate the distinctiveness of the Björklunden weekends. Very few undergraduates, whether they attend small liberal arts colleges or large research universities, get to spend such extended periods of time with professional writers. Meanwhile the master classes simulate graduate-level writing workshops and give students first-hand glimpses of graduate-school life. **Alison Thompson '13** said, “The visiting writers and Björklunden trips helped remind me that writing is a living, generative art produced