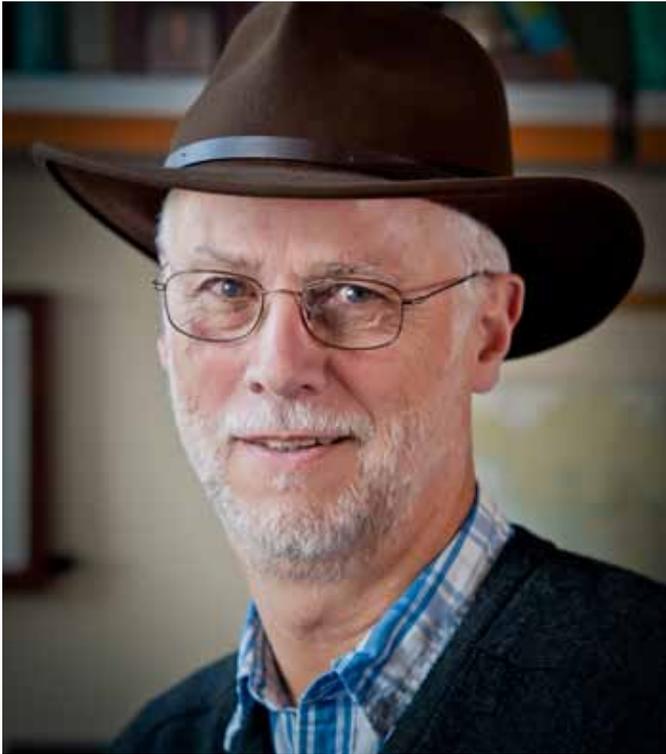


Celebrating Richard Ladner: Noted theoretician, Fibonacci fan, and champion of accessibility



Allen School professor Richard Ladner, who helped to establish the University of Washington as a leader in accessibility research, recently announced his retirement after a 45-year career. It is a career that extends from the most fundamental underpinnings of the field, to practical applications that serve the broadest possible population of users. But beyond the theorems he articulated and the technology he created, Ladner's legacy is really one of empowerment — empowerment of students through hands-on research, and empowerment of people of all abilities through computing.

"A golden era" in theory

While one would expect accessibility to be hard-wired into Ladner's DNA — he grew up with two parents who were deaf and who embraced technology to help them communicate — it took him 35 years to come full circle. He began his career in mathematics, earning a bachelor's degree from St. Mary's College of California in 1965, followed by a Ph.D. from the University of California, Berkeley in 1971. That same year, he joined the University of Washington faculty. His mentor on campus, Bob Ritchie, would later serve as chair of the Department of Computer Science & Engineering. Together, they began building a new research group focused on the theory of computation.

Ladner's eyes light up as he describes those early years. It was, he said, an exciting time to work on the fundamental problems that underpin computer science, which was still coming into its own as a distinct field. "The early 1970s were something of a golden era. That was when the concepts of computational complexity, which I found fascinating, really came into existence," Ladner recalled. "Many of those problems are still around. Does P equal NP? That is still an open question, 45 years later."

Ladner investigated P and NP in his eponymous theorem on the existence of NP-intermediate (NPI) problems. Ladner's Theorem asserts that if P does not equal NP, then problems must exist in NP that are neither in P nor NP-complete. Another early contribution was the discovery, with colleague Michael Fischer, of the Parallel Prefix Computation Algorithm. Researchers already understood how to perform prefix computations in rapid time using linear number operations. With their new theorem, Ladner and Fischer showed that prefix computation could be solved in optimal time with a linear number of operations.

While Fischer's and Ladner's paper has garnered nearly 1,400 citations, researchers tend to focus on a suboptimal time version of the algorithm. "It's an optimization theorem that people weren't using optimally!" Ladner explained with a laugh.

Ladner worked extensively with Fischer, who had been lured to UW in 1975 from the faculty of MIT, in the early stages of his career. One of their collaborations yielded a new system, Propositional Dynamic Logic, which had practical implications for software verification. According to Ladner, the pair embarked on the work more as a curiosity than anything else, but wound up publishing a paper that subsequently has been cited more than 1,200 times. "That turned out to be more important than we first thought," mused Ladner. "It's actually one of my favorite papers, because it's very fundamental."

In the early 1980s, Fischer left UW for Yale, while Ladner expanded his horizons. He became fascinated with algorithms: geometric algorithms, network algorithms — "I still like those!" — and parallel algorithms. He began teaching computer networks and doing research in distributed computing, which he enjoyed for the challenge it presented.

"The theory of that was really hard — harder than computational complexity," Ladner commented. "For

the latter, there are many models and they are all equivalent. In distributed computing, there was no accepted model."

A sign of things to come

Around that same time, Ladner became involved in projects that offered an opportunity to put theory into practice and foreshadowed the future direction of his research. "I decided I needed to get back to my roots, so I enrolled in sign language classes at Seattle Central Community College," he explained. "I felt like it would help keep me grounded in the real world."

He began volunteering in the community, working with people who were deaf and blind, and writing the occasional article on accessibility issues. Ladner credits his first-hand experience with making him a more effective researcher later — a lesson he has been keen to pass on to his students.

"I appreciated Richard's holistic approach to accessibility research," said former student Kyle Rector (Ph.D., '16), who is now a faculty member at the University of Iowa. "At the beginning of graduate school, I was reading several research papers. However, it was just as important for me to read about history and culture, e.g., Deaf culture, meet people with disabilities at local events, and learn about the current technology they use."

Although Ladner was not yet ready to commit to accessibility research full-time, he made one of his first forays into it with the DBNet project in the mid-1980s — and produced one of the first conference papers on the subject. DBNet was a kind of precursor to the internet that sought to make news, email, and other communications services available to people who are deaf-blind. The emergence of the mainstream internet and screen readers led him to abandon the project and revert to his theorems and algorithms. But it was a sign of things to come.

In the early 1990s, Ladner spent a sabbatical at AT&T, working alongside Amotz Bar-Noy on algorithms for delivering media on demand. He enjoyed the interlude, which allowed him to focus solely on research. "It was kind of like being a grad student all over again," he recalled. After he returned to UW, Ladner embarked on a multi-year collaboration with Eve Riskin of Electrical Engineering on optimizing data compression for images and videos. It was, he reflected, a project more concerned with technology than theory. Ladner and Riskin would continue working together for over 20 years on research that would come in handy in his work on accessibility. Long before that became his primary focus, Riskin noted, Ladner was concerned with diversity and made it a priority in his research.

"He worked with many students from underrepresented groups, both graduate and undergraduate, during his career," Riskin said. "Richard was committed to diversity in tech long before it became a national issue. A highlight for me was leading his successful nomination for the Presidential Award for Excellence — and seeing that picture of him with George W. Bush," she concluded with a laugh.

Ladner's shift toward accessibility gathered momentum with the arrival of graduate student Sangyun Hahn in 2002. Hahn, who is blind, revealed to Ladner in one of their regular meetings that he was having trouble accessing portions of his textbooks. Although he arranged to have the books scanned and converted to an accessible format, mathematical formulas and figures required special handling and took a long time to produce — if they were produced at all. Because standard optical character recognition could not understand formulas, someone needed to either read them aloud to Hahn or convert them to a format like Braille that he could read himself. Graphs and diagrams had to be manually traced in a drawing program, supplemented with text in a Braille font, and then printed on an embosser.

This painstaking process meant Hahn received only a portion of the figures he needed, and often later than he needed them. His experience spurred Ladner to initiate the Tactile Graphics project, which automated the process of converting figures in textbooks to make them fully accessible in a much shorter time frame. In so doing, his transition from theory to full-time accessibility researcher was complete.



*To Richard Ladner
With best wishes,*

President George W. Bush and Richard Ladner, taken when Ladner visited the White House to receive his 2004 Presidential Award for Excellence in Science, Mathematics and Engineering Mentoring

Celebrating Richard Ladner (continued)

Accessibility goes mainstream

Accessibility was still largely a nascent area of computer science when Ladner made the switch. "It took quite a while to secure the funding for Tactile Graphics," Ladner mused. "The area was still very much in its infancy back then." Now, Ladner says, "UW has become the leader in accessibility by almost every metric."

Ladner played a central role in making it so. In addition to Tactile Graphics, one of his projects that helped to establish UW's leadership early on was MobileASL. Ladner's friend and collaborator Riskin suggested it as an outgrowth of their earlier work in video compression. With MobileASL, they sought to make mobile phones a viable option for deaf people to communicate using American Sign Language — no mean feat with the limited bandwidth of the time.

Another example was WebAnywhere, a non-visual interface that enables people who are blind to navigate the web which was developed by Ladner's student Jeffrey Bigham (Ph.D., '09). Described as a "screen reader on-the-go," WebAnywhere worked in any browser without having to download and install special software. Like the name suggested, it made the web accessible anywhere, on any connected computer or device.

"Richard cares about impact with research. This is frustrating when you're a Ph.D. student and maybe feel the urge to just publish papers, but long term it's been incredibly smart for ensuring the work I do has impact," said Bigham, who is now a faculty member at Carnegie Mellon University. "Richard was trained as a mathematician, yet he intuited and rigorously practices a core lesson of human-computer interaction: work with people to build truly useful technology."

Ladner's impact on accessibility extends beyond the lab. In addition to making computing technologies accessible to a broader population, he has also championed the inclusion of people with disabilities in computing fields. Along with Sheryl Burgstahler he co-founded the Alliance for Access to Computing Careers (AccessComputing), in conjunction with UW's DO-IT Center. For more than a decade, Ladner hosted one-week summer workshops for disabled high school students to explore careers in science, engineering, and math in partnership with DO-IT. He also organized the Summer Academy for Advancing Deaf and Hard of Hearing in Computing from 2007 to 2013, providing more than 80 students from across the nation with an intensive educational experience aimed at preparing them for majors and careers in computing.

In recognition of his leadership, Ladner has received the Presidential Award for Excellence in Science, Mathematics, and Engineering Mentoring; the SIGCHI Social Impact Award; the Broadening Participation in Computing Community Award; the Richard A. Tapia Achievement Award for Scientific Scholarship, Civic Science, and Diversifying Computing; and the SIGACCESS Award for Outstanding Contributions to Computing and Accessibility.

Throughout his career, Ladner has never wavered in his commitment to mentoring the next generation of computer scientists — including those at other institutions who were passionate about accessibility but could not find the expertise among their home faculty. Ladner has supervised 27 Ph.D. students, with four more in the pipeline, and more than 100 undergraduate student researchers. The latter is evidence of his belief in the importance of hands-on experience.

"In the early days of CSE, an undergraduate research project was required as part of the curriculum," Ladner recalled. "When it ceased to be, I kept on doing it anyway. Some students I recruited to work with me, while others actively sought me out."

Former students who went on to careers in academic research try to emulate his approach. "When I started doing research with Richard, he gave me lots of leeway in choosing problems to work on," said Anne Condon (Ph.D., '87), a professor at the University of British Columbia who worked with Ladner on the DBNet project in her student days. "He sent me to conferences long before I had papers to present, and helped me connect with others attending."

"I especially loved how Richard sincerely communicated respect for all of his students, highlighting different qualities of each that he admired in their approach to research," she continued. "This greatly bolstered my



Richard Ladner conversing with students at the 2007 Summer Academy for Advancing Deaf and Hard of Hearing in Computing

confidence, and helped me appreciate that there are many ways to shine. I try to do the same for my own mentees."

Ladner's commitment to helping students to discover their passion may be one of his most enduring contributions. When word reached Justin Goshi (Ph.D., '04) that Ladner was retiring, he felt compelled to share what his former adviser's commitment meant to him and so many others like him.

"When I think back to my time at UW, I think I must have given you a hard time," Justin wrote. "I remember you were always trying to help me to find my passion, but I was always so passive about stuff. You had me read that *What Color Is Your Parachute?* book to try and help me out. I really appreciated that you always cared about me as a person and you were constantly trying to help me find myself.

"It wasn't just about the research," he continued. "I felt you really cared about me, and that meant a lot."

Ladner's legacy will be more than the technology he helped to create and the students he helped to educate; it will be his role in bringing accessibility into the mainstream —



Richard Ladner and Ann Sauer at the Allen School celebration March 2017

and of changing perceptions of what it means to have a disability and the role of accessibility research.

"Part of my job as an accessibility researcher is to change people's mindset about disability," Ladner said. "It presents challenges, yes, but it's not necessarily a tragedy. It is part of the diversity of life.

"Our role as researchers and technologists is to embrace this diversity and make sure we reflect that in our work."

MOST SIGNIFICANT BITS

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