

# COMPUTE

WINTER 2019

**School Welcomes  
Eight New Faculty**

**ARPANET Turns 50**

**Women in Computing**



**SCHOOL OF COMPUTING**  
UNIVERSITY OF UTAH



# WELCOME

It's been a great year here in the School of Computing. We are launching a new Bachelor's degree in Data Science. The demand for data scientists is enormous and growing. This new degree and the students who complete it are poised to have a great impact on the IT industry and our society as a whole. This effort dovetails with new research endeavors. The School has cosponsored the formation of a new Utah Center for Data Science, which will bring together researchers from all over campus to push forward data science technology and applications.

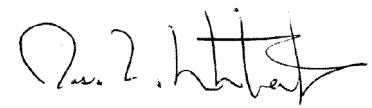
The Masters of Software Development has proven to be a great success. The new cohort of students is double what it was two years ago. Job placements from that program have exceeded our hopes and expectations. Last year I heard testimonials from graduating students whose career trajectories were completely reshaped by this 16-month program — they are now active participants in Utah's (and our nation's) growing software industry.

Speaking of growth, our bachelor's program in Computer Science continues to expand. We had almost 200 students finish with BS-CS degrees, our biggest graduating class ever. As we grow, we remain aware of the disparities in how different groups participate in our national IT economy, and the School of Computing is committed to raising participation rates among underrepresented groups. This year's BS-CS class included 105 women, 14%. This is our best performance ever on graduating women in CS, and we will be working hard to maintain and grow this trend with the help of our Women in Computing organization.

With all of this growth, we have also grown our faculty. Eight new faculty have joined the School, an increase of almost 20%. We have new faculty in security, theory, high-performance computing, information retrieval, and human computer interaction. This is an important step forward for our endeavor, and we are looking forward to more faculty recruiting in the future.

With all of this focus on the future, we are also very cognizant of (and proud of) the important historical role that the School has served in our nation's IT economy. This year, we celebrated the 50th anniversary of the ARPANET, and Utah's important role as the fourth node on that important precursor to the Internet. Our celebration included participation from University President Ruth Watkins, as well as Utah's Lt. Gov., Spencer Cox.

It certainly has been an exciting, productive (and busy) year for the School of Computing: new faculty and programs with an important look back at the proud history of our institution. It's hard to imagine how 2020 could compete with all of these accomplishments — but we are working hard to make sure it does.

  
Ross Whitaker  
Director, School of Computing

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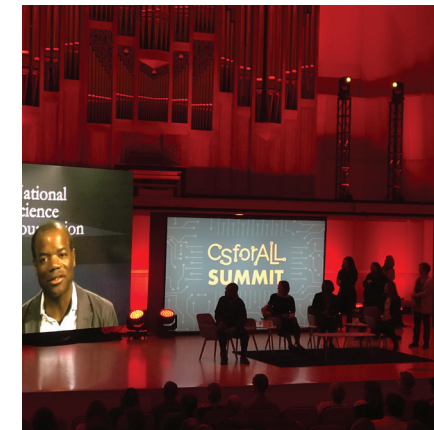
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# School of Computing welcomes eight new faculty

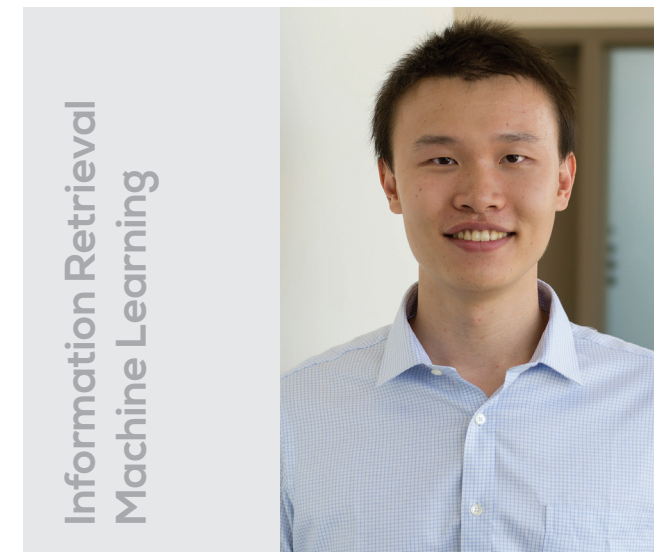
After a vibrant hiring season culminating in the addition of eight faculty members, the University of Utah School of Computing kicked off the 2019–2020 academic year with expanded research initiatives and a heightened ability to help meet state and national needs for tech professionals.

This robust crop of hires will bolster school research and teaching in an array of disciplines, from computer security to robotics and beyond. School of Computing Director and Professor Ross Whitaker lauded the hirings. This kind of strategic growth, he said, ultimately means more courses, degrees, research, funding, and undergraduate and graduate students. “This will result in an expanded talent pool and broader expertise to address the demands of the growing tech sector in Utah,” Whitaker said.

The new professors — one career-line and seven tenure-line faculty members—are eager to make their marks here. They cited outstanding research, collegial peers, proactive students, and cross-discipline collaboration opportunities as motivations for coming to the U. New assistant professor Qingyao Ai, for one, said he’s excited to work with the accomplished faculty members powering the School of Computing: “Together, we will push the boundaries of computer science.”

## New faculty members’ research areas include:

- Information retrieval, machine learning
- Programming languages, computing education
- Compiler optimization, high-performance computing
- Crisis informatics, social computing, network science
- Data-driven graph algorithms, parameterized complexity
- Teaching computers to analyze unconventional programs, like web designs or mathematical formulas
- Computer security, particularly building tools to detect, diagnose and defeat security problems in emerging software systems
- Enabling robots to accomplish tasks in human-centric environments, with specific applications in robot-assisted surgery and, more broadly, healthcare



## Qingyao Ai

Qingyao’s is an assistant professor in the School of Computing, his research focuses on information retrieval and machine learning related topics. Currently he’s working on applying deep learning techniques on IR problems including ad-hoc retrieval, product search/recommendation and learning to rank. He received his MS/Ph.D degree from College of Information and Computer Sciences, University of Massachusetts Amherst, advised by professor W. Bruce Croft in the Center for Intelligent Information Retrieval (CIIR) and his bachelor degree from Dept. Computer Science & Technology, Tsinghua University.



## Swaroop Joshi

Swaroop is an assistant professor (lecturer) in the School of Computing. He has a Ph.D. in Computer Science and Engineering from The Ohio State University, a Master of Technology (M.Tech.) from Indian Institute of Technology (IIT) Bombay, and a Bachelor of Engineering (B.E.) from National Institute of Technology Karnataka, Surathkal in India. His interest is in a range of topics in Education Technology and Software Engineering, including but not limited to Computer Supported Collaborative Learning, Active Learning, Programming Languages, and Mobile App Development. He serves as an associate editor for the *Journal of Engineering Education Transformation*.



Human-Centered  
Data Science



## Marina Kogan

Marina Kogan is an assistant professor in the School of Computing and focuses her research on human-centered computing and crisis informatics in an attempt to understand and model how people coordinate and problem-solve on social media in crisis. With background in both computer science and sociology, Marina crosses disciplinary boundaries in her work in Human-Centered Data Science, where she applies and develops methodological approaches that both harness the power of computational techniques and account for the highly situated nature of the social activity in crisis.

Robotics



## Alan Kuntz

Alan Kuntz joins the School of Computing as an assistant professor from a postdoctoral research position in mechanical engineering at Vanderbilt University. He earned his PhD from the University of North Carolina at Chapel Hill in computer science. His research interests include shared autonomy, motion planning, and design optimization for manipulators and tentacle-like, flexible robots with an emphasis on home assistance and surgical applications. His interest in health care applications stems from his previous experience as a paramedic in the 911 system of Albuquerque, NM.

Programming  
Languages



## Pavel Panchekha

Pavel's research focuses on developing programming language techniques to meet challenges from all areas of computer science. He is an assistant professor in the School of Computing, where he holds the Warnock Chair for Junior Faculty. He completed his Ph.D. at the Paul G. Allen School for Computer Science and Engineering at the University of Washington, where he was advised by Michael D. Ernst and Zachary Tatlock. He has been awarded fellowships by the NSF, the ARCS foundation, Adobe Research, and the Wissner-Slivka foundation, and received his BS in mathematics from MIT.

Algorithms  
Theory



## Blair Sullivan

Blair D. Sullivan is an associate professor in the School of Computing. Prior to joining the faculty at Utah, Blair was an associate professor of Computer Science at North Carolina State University and a research scientist at Oak Ridge National Laboratory. She received her Ph.D. in Mathematics from Princeton University in 2008 as a DHS Graduate Fellow, and BS degrees in Applied Mathematics and Computer Science from Georgia Tech in 2003. Blair's research cross-cuts the fields of theoretical computer science, network science, data-driven science, and discrete mathematics. In 2014, she was named one of 14 Moore Investigators in Data-Driven Discovery.

High Performance  
Computing



## P. (Saday) Sadayappan

Saday is a professor in the School of Computing, with a joint appointment with Pacific Northwest National Laboratory. He was previously a professor and University Distinguished Scholar at the Ohio State University. His current research interests include optimizing compilers, domain/pattern-centric performance optimization, and algorithm-architecture co-design. He collaborates closely with computational/data scientists in creating frameworks to enable high productivity in developing high-performance applications. Sadayappan is a Fellow of the IEEE.

Computer Security



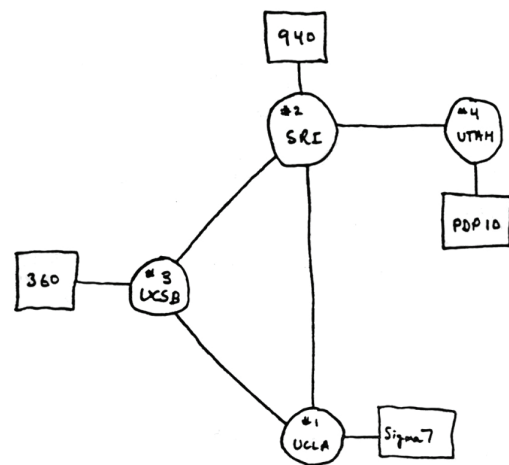
## Mu Zhang

Mu is an assistant professor at the School of Computing. Previously, he was a postdoc at Cornell and a research staff member at NEC Labs. His research interests lie in several aspects of computer security and he particularly focuses on software security, mobile security, and cyber-physical systems security. His work has been extensively published in top-tier security and programming language conferences including IEEE S&P, CCS, NDSS and OOPSLA, and he is a recipient of Distinguished Paper Award at OOPSLA 2019.



# ARPANET turns 50

In 1969, the University of Utah's fledgling computer science department secured an enviable spot in history when it became the fourth node on the U.S. Department of Defense's Advanced Research Projects Agency Network, or ARPANET—the precursor to the internet. Fifty years later, School of Computing faculty and alumni have continued this legacy of leadership, and one of the school's latest high-profile research projects even bears a resemblance to ARPANET's origins and scale.



THE ARPA NETWORK

DEC 1969

4 NODES

During an October 7 event celebrating ARPANET's anniversary, speakers praised the School of Computing for that fortuitous early accomplishment and for its ongoing achievements. University President Ruth Watkins lauded the school's history and alumni, as well as current faculty and students "for making innovation and discovery happen, for driving excellence, for the creativity that it takes to develop initiatives like ARPANET."

"It is a remarkable thing that this is part of the University of Utah legacy, and one that we're so proud of," Watkins said.

The computer science department started in 1965 under the chairmanship of David Evans, a Salt Lake City native, U alumnus, and graphics pioneer who worked as a professor at University of California, Berkeley, before returning to his hometown. Evans already had ARPA funding at Berkeley and helped to secure federal money for the U upon his move. In 1969, he recruited fellow graphics expert Ivan Sutherland to join him in the CS department, solidifying the U's status as a leader in that field. The computer science world was, of course, relatively small at that time: in joining the U, Sutherland left his position as head of the Department of Defense's Information Processing Techniques Office, which oversaw ARPANET. Accordingly, the U's early reputation for innovative, well-connected CS faculty and sharp students — coupled with a level of ARPANET enthusiasm that other federally-funded CS departments reportedly



Ivan Sutherland and David Evans

lacked—drove federal officials to tap Utah for the fourth node.

ARPANET was a scalable general architecture for networking computers across long distances, according to School of Computing Director Ross Whitaker. And Utah was the first node outside of California. The first three nodes were at University of California, Los Angeles; Stanford Research Institute; and University of California, Santa Barbara, respectively. The key piece of this technology, Whitaker explained, was packet switching: "This idea of being able to use nodes

and break data into pieces and move it around in a way that was scalable, so that you didn't have to just have two computers on a shared phone line." Hence the project's federal support in the Cold War era: it elevated the country's communications technology at a time when the government was concerned about enemy attacks, particularly on the phone system.

During the ARPANET anniversary celebration, College of Engineering Dean Richard Brown credited Evans and Sutherland for leading the U's involvement in the revolutionary technology.



“I’ve often thought that these people would’ve been proud to know what’s happened at the University of Utah since they were here,” Brown said. Sadly, Evans passed away in 1998. But in Sutherland’s case, Brown presumed correctly: Sutherland visited the U in 2016 and was “simply astounded” at the school’s decades of success, Brown recounted.

And dozens of individuals have been part of that computing success, Brown said. Former faculty member Tom Stockham created the first digital recordings of sound. Ed Catmull earned his Ph.D. in computer science here, then went on to co-found Pixar Animation Studios. Alan Kay, a Ph.D. graduate and A.M. Turing award winner, developed the first personal computer, the first graphical user interface and the first object-oriented language. Another Ph.D. graduate, John Warnock, founded Adobe Systems and revolutionized digital publishing. The list goes on.

University of Utah Senior Vice President for Academic Affairs Dan Reed echoed Brown’s sentiment. “There are an equally amazing set of things going on at the U right now in terms of wireless communication, in terms of graphics in gaming, scientific visualization, computational modeling,” and more, he told guests at the anniversary celebration. “All of that grew out of that early, prescient notion that betting on people, betting on culture, betting on the future is really where we have to go.”

Now, the School of Computing’s dozens of faculty members continue to advance the field in various areas. One in particular, Kobus Van der Merwe, is collaborating with computer scientists across the country to build on ARPANET’s foundations and push networking forward. The associate professor is the principal investigator of the Platform for Open Wireless Data-driven Experimental Research, also known as Powder. The project involves building a citywide wireless testbed, starting on the university campus and expanding out into Salt Lake City over three years. Powder’s key innovation is a networking

infrastructure that’s software defined from end to end: researchers can run different pieces of software on general-purpose hardware and make a 4G network, a 5G network or something completely new and experimental, Van der Merwe explained.

Like ARPANET, Powder is federally funded—

**“There are an equally amazing set of things going on at the U right now in terms of wireless communication, in terms of graphics in gaming, scientific visualization, computational modeling.”**

in this case, by the National Science Foundation (NSF)—and driven by government interest in hands-on research to spark the evolution of mobile and wireless networks. In addition to enjoying Powder’s recent designation as a Federal Communications Commission Innovation Zone, Van der Merwe’s team is involved in a new NSF project called FABRIC, which aims to connect Powder and similar projects to a fully programmable infrastructure across the nation. According to FABRIC’s researchers, the platform will be used “to experiment with new ideas that will become building blocks of the next-generation internet and address requirements for emerging science applications that depend on large-scale networking.”

During the anniversary celebration, Van der Merwe compared a 1972 ARPANET national map to a 2019 FABRIC map. “The similarity should be obvious,” he said, pointing out that the University of Utah is one of the few entities on both maps. Though ARPANET was retired in 1990, its principles prevail in today’s internet—hence a shared desire among experts such as Van der Merwe to take the next step. “We’re building experimental networks to make that real, and Utah is again in the midst of that.”



Linda DuHadway (Ph.D. '16), with her father, Wendall, and son Christopher (SoC Senior) talk with Utah Representative Jeffrey D. Stenquist



Spencer J. Cox, Utah Lt. Governor



ARPANET 50<sup>TH</sup> CELEBRATION  
OCTOBER 7, 2019

WELCOME REMARKS

Ruth V. Watkins  
President  
The University of Utah

Daniel A. Reed  
Senior Vice President of Academic Affairs  
The University of Utah

Richard B. Brown  
Dean, College of Engineering  
The University of Utah

INVITED SPEAKERS

Spencer J. Cox  
Lieutenant Governor

Damien Patton  
Banjo, CEO

Kobus Van der Merwe  
NSF POWDER, Principal Investigator

SCHOOL OF COMPUTING  
THE UNIVERSITY OF UTAH



# News and Notes

## New Bachelor's degree in Data Science

The School of Computing has developed a new bachelor's of science degree in data science that addresses all aspects of compiling, organizing and analyzing data. It is one of only a handful of universities in America with an undergraduate degree in the discipline.

"There's a clear demand for it in industry," says University of Utah School of Computing associate professor Jeff Phillips, who developed the new degree. "Data scientist, data engineer, data analyst — these jobs are some of the best jobs in the U.S., and they're extremely well paid. Companies are looking for more data scientists than there are available."

Some of the classes taught in the curriculum include Data Wrangling (how to compile messy data sets efficiently), Algorithms, Foundations of Data Analysis, Natural Language Processing, even Ethics in Data Science. Another aspect to the curriculum highlights how data science is used in the research of other disciplines from science and engineering to health and medicine and the social sciences.

While the bachelor's degree in data science is new, the School of Computing already has graduate programs that emphasize the discipline. There is a master's degree in computing with an emphasis in data management and analysis. The college also has a Graduate Certificate in Big Data that is for mostly non-traditional students such as full-time employees looking to boost their education.

## CSforALL Summit Conference



In October, the University of Utah hosted the annual convening of the national computer science education community in Salt Lake City, Utah. CSforALL aims to make high-quality computer science an essential part of the educational experience of all K-12 students and teachers in the United States. Ensuring that computer science becomes an integral and sustained part of the K-12 experience will help students develop a pathway to college and career success. School of Computing staff and faculty were key contributors to conference planning and the technical program.

## Professor Sneha Kasera and team presented award

Professor Sneha Kumar Kasera and his doctoral students, Christopher Becker and Aniqua Baset, along with Kurt Derr and Sam Ramirez from the Idaho National Laboratory received the prestigious 2019 "R&D 100 Award" from R&D World magazine.

The team was presented the award for the development of a system for Wireless radio Frequency signal Identification and protocol Reverse Engineering, or WiFIRE.

WiFIRE involves the use of software-defined radios as well as new software that can continuously monitor wireless spectrum. In real-time, it can identify multiple types of signals, trace them and report if any are from authorized or unauthorized wireless users.



## Milinda Fernando named recipient of the prestigious ACM/IEEE-CS George Michael Memorial HPC Fellowship

Weerahannadige Milinda Shayamal Fernando, a Ph.D. student working with professor Hari Sundar was named recipient of the prestigious ACM/IEEE-CS George Michael Memorial HPC Fellowship.



The ACM/IEEE-CS George Michael Memorial HPC Fellowship is endowed in memory of George Michael, one of the founding fathers of the SC Conference series. The fellowship honors exceptional PhD students throughout the world whose research focus is on high-performance computing applications, networking, storage or large-scale data analytics using the most powerful computers that are currently available.

Fernando's research is focused primarily on developing computational algorithms for the numerical solution of large-scale partial differential equations. New discoveries in science and engineering are primarily driven by computer simulations instead of physical experiments.

## Mary Hall named IEEE Fellow

Professor Mary Hall was named an 2020 IEEE Fellow and recognized for her contributions to compiler optimization and performance tuning.

This prestigious recognition was conferred upon Hall by the IEEE Board of Directors due to her outstanding record of accomplishments in an IEEE field of interest.



## Michael Clemens received a 2019 National Science Foundation (NSF) Graduate Research Fellowship (GRF)

Michael Clemens, a first-year Ph.D. is studying how to use musical play to teach computer science to fifth through eighth graders who are vision or hearing impaired. He believes that music in certain forms can be implemented to teach basic concepts in computer science, such low frequencies or music used for yes-or-no feedback. Clemens, whose advisor is School of Computing assistant professor Rogelio Cardona-Rivera, graduated with a bachelor's in electrical engineering from Valparaiso University in Indiana.

The NSF Graduate Research Fellowship Program recognizes and supports outstanding graduate students in NSF-supported science, technology, engineering, and mathematics disciplines who are pursuing research-based master's and doctoral degrees at accredited United States institutions.





# WOMEN & COMPUTING



Over the past decade, the percentage of female computer science or computer engineering majors in the University of Utah School of Computing has tripled from 5% to 15%, thanks in part to faculty members who've been personally invested in moving the needle. Now, school leaders are setting the ambitious goal of doubling that percentage in another five years.

At least one student—senior and Women in Computing club president Cindy Liao—is optimistic. “It’s definitely doable,” said Liao, a double major in computer science (CS) and math. She’s noticed more women and other underrepresented groups in CS classes, as well as a general uptick in interest from her peers that she partially attributes to increased news coverage of the field. And after four years in the school, she’s seen how its leadership has collaborated with students on diversity-related issues. “Any time we’ve asked them for help, they’re always really willing to provide it,” she said, citing a bystander-intervention training that all teaching assistants attended last spring, per her club’s request.

Liao thinks that increasing outreach efforts—including those targeting students with nontraditional backgrounds—will be the key to new growth. Computer science can be hugely appealing to anyone, she said, because of the sheer promise of the degree: “You really have an opportunity to change your life with CS, because it’s so easy to get a job in it.” And it’s especially easy to get a job here in Utah, where rapid tech-sector growth has meant that programming jobs are going unfilled.

Professor Mary Hall and associate professor Erin Parker—who founded the school’s Diversity Committee along with Professor Emeritus Bill Thompson—agree with Liao that moving forward, outreach will play a major role in boosting the percentage of female CS majors. Ten years ago when the Diversity Committee started and the school had only 11 female CS majors, Hall and Parker were laser-focused on retention. They’d regularly meet with that group over lunch, and encourage them to stick with the major. “When there were 11 women that’s how we did it,” Parker said, “because we could have so much impact.” With 100 women majors as of last year, school leaders recalibrated: they checked in with that group via catered luncheons led by the school’s director of business affairs, a new role filled by John Melchi. And the club Liao now leads—Women in Computing, or WiC—was born out of those luncheons.

Through WiC, students themselves are now empowered to play an active role in diversity outreach. Though it’s not the first club of its kind, club faculty advisor Parker thinks it’ll be the group that stands the test of time due to staff support from people like Melchi, succession planning involving myriad leadership roles in addition to Liao’s, and sheer numbers with the current pool of 100 women majors. WiC has already sparked a paradigm shift for freshmen and sophomore women in the major: club leaders regularly announce WiC happenings in intro classes, straight from the start of the semester. “That visibility and the normalcy of this for new students—that’s what’s going to really have the impact,” Parker said.

Of course, plenty of behind-the-scenes faculty and staff diversity work predates WiC. The school added an on-ramp for beginners with little or no programming experience, and a two-course programming sequence for non-CS majors. That two-course sequence has doubled in size since its 2017 launch and is often nearly gender balanced, though students haven’t typically gone on to major in CS. The school has also created a female peer-mentoring program, and heavily recruited female teaching assistants for early courses. And last year, the inaugural Goldman Sachs Women

in Computing Scholarship went to Emma Beatty, a CS and art double major covering most of her own college expenses through a combination of scholarships and on-campus jobs.

Now, Diversity Committee members have been ramping up efforts to collaborate with institutions such as the National Center for Women in Computing and the Northeastern University Center for Inclusive Computing—essentially, experts who can analyze the school’s diversity-related data and current practices. “We can work with organizations that have experience



and knowledge, and they can help us figure out how to apply best practices to our unique context,” Hall said. Ultimately, the path forward could involve a few ingredients working together: new scholarships for women, CS-specific summer camps, a new staff member in charge of diversity and outreach, and more.

In the meantime, WiC continues to be an invaluable asset to the school’s diversity efforts, and the club’s success belies its youth. A recent WiC resume workshop led by Lucid—one of Utah’s fastest-growing tech companies—was standing-room only, with over 50 attendees. “It was amazing,” Liao beamed. In addition to internship and job application assistance, club meetings have offered members a mix of industry guest speakers and mental health workshops focused on topics such as stereotypes and microaggressions. The president stressed that although the club is women focused, it’s open to everyone and runs on an inclusive ethos. So far, the student body has been supportive: last academic year, an imposter syndrome workshop had roughly equal attendance from men and women. “We’re here for empowerment of people within our group, but that’s not to say that men won’t benefit from our club,” Liao said. “When we do well, you will also do well.”



# COMPUTE

School of Computing  
University of Utah  
50 S. Central Campus Drive RM3190  
Salt Lake City, UT 84112

[www.cs.utah.edu](http://www.cs.utah.edu)



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