A global genetic interaction map is revolutionizing how genes are being studied. No longer looked at as loners, genes are being understood as the social network of the body, interacting in groups—which may ultimately change our understanding of the genetic roots of diseases.

Prior studies of yeast cells have shown only a fraction, 1 out of 5, of genes was essential for a cell’s survival. This discovery was made by an international consortium of scientists over a decade ago where they targeted each of the yeast cell’s 6,000 genes for deletion. Recent advances in gene editing technology has allowed scientists to tackle the same question in human cells, resulting in the same answer—only a fraction of genes are essential to cell life.

Building on this research, Chad Myers and his lab from the Department of Computer Science and Engineering, along with Professors Brenda Andrews and Charles Boone from the University of Toronto’s Donnelly Centre, have created the first complete genetic interaction network of a yeast cell, one that begins to explain how thousands of genes coordinate with one another to orchestrate cellular life.

The map will help scientists predict how genes function in order to understand, and thwart, the culprits behind diseases, with a potential for developing finely-tuned therapies. The findings are published in the journal Science.
Happy New Year from the Department of Computer Science and Engineering! I would like to take this opportunity to share some reflections on our department with you—where we are, where we have been, and where we are headed.

2016 has been another busy and exciting year for us, and we are pleased to share some of the high points from the last few months in the following pages. A few highlights include:

- Professor Vipin Kumar was named recipient of the 2016 IEEE Computer Society Sidney Fernbach Award, one of the IEEE Computer Society’s highest awards.
- Professor Chad Myers and Ph.D. student Wen Wang were part of a U of M research team awarded the grand prize from the National Cancer Institute’s “Up for a Challenge (U4C) Breast Cancer Challenge Award.”
- Professor Stephen Guy and his team joined with researchers from the Chemistry Department to create a new interactive game called Master of Filtering that allows users to build and test Metal-Organic Frameworks.

2017 marks a major milestone for us—the 50th Anniversary of Computer Science at the University Minnesota.

Fifty years ago, in 1967, under the leadership of the late, great Professor and CS&E Founder Dr. Marvin Stein, the University of Minnesota established its first graduate program in Computer and Information Sciences. By 1969 we had awarded our first graduate degrees, and in 1970 the University formally established the Department of Computer Science.

Over the next three years, we will celebrate this landmark anniversary together, kicking off at the 2017 CS&E Open House in October and concluding with our Commencement Ceremony in 2020. We look forward to celebrating with alumni and friends like you at events here on campus and in regions on both coasts. (Stay tuned for more details on these events and how you can participate…)

As we commemorate our past, we must also plan for the next 50 years to help shape the future of computing at the University of Minnesota and beyond. While the state of our department is stronger than ever, a number of challenges lie ahead.

Today, computing permeates all aspects of our lives. Although it is clear that the next 50 years and beyond will require the expertise and leadership of computer scientists, there is currently a serious shortage of skilled computer scientists, data scientists, and software engineers in the workforce.

To meet this growing need, CS&E at Minnesota has boomed from just a handful of graduate students and faculty in 1967 to an undergraduate and graduate student body today of approximately 2,000. These students are served by 43 faculty members, who consistently rank among the top scholars in our field and provide leadership and expertise in nearly all major areas of computer science and engineering.

But we have not gotten here on our own—our excellence is the result of many individuals and organizations who have invested generously in our future, providing critical resources, time, and expertise to secure our leadership standing. We thank all of you—our alumni community, donors, and friends, who have contributed to our success. Without you, our important work would not be possible.

Today and over the next few years, as we celebrate our 50th anniversary, I invite all of you to join us in investing in the future of computing at Minnesota. On page 15 of this issue of Soundbyte, we celebrate those who have contributed generously over the past year to our department. Here, I encourage you to make a gift as well in support of our exceptional students, faculty, and programs.

Specifically, we seek to maintain our excellence and expand the scope and impact of our work by securing funding for the following priorities:

- Increased support for students in the form of undergraduate scholarships and graduate student fellowships, which will help us to attract and retain the best and brightest students, regardless of their financial needs;
- Increased support for our faculty and their cutting-edge research in the form of endowed professorships and chairs, which will allow us to recruit and retain the top scholars in the world, while helping us to expand and diversify our faculty;
- Lab space and faculty and student learning spaces that bring students and faculty together outside of the classroom to maximize hands-on, applied learning opportunities and encourage collaborative, interdisciplinary problem solving.

Thank you so much for your support. I welcome your questions and ideas about the future direction of our department and look forward to seeing many of you soon at our anniversary celebrations!

— Mats Heimdahl, Professor and CS&E Department Head
Your mission: save the world from carbon dioxide gas (CO₂). Your task: build nanomaterials that will successfully trap those nasty carbon dioxide molecules while allowing life-giving molecules through to save your world. Lose: your world dies. Succeed: you become a Master of Filtering.

The challenge: create a game that will teach young people about nano-technology, engage them in working on a real-world problem and possibly, just possibly, spark their creativity to build structures that will help solve a troublesome real-world environmental issue.

For more than a year, researchers in the Nanoporous Materials Genome Center (NMGC), based in the College of Science and Engineering’s (CSE) Department of Chemistry, and in the CSE’s Department of Computer Science and Engineering have worked to created a game, Master of Filtering™, that lets players design and test brand new Metal Organic Frameworks (MOFs) within an interactive game center.

Chemists working on creating the game were Professors Christopher Cramer and Laura Gagliardi, post-doctorate Hakan Demir, and Xiangyun Lei (B.S. 2016). Computer scientists were Professor Stephen Guy and graduate student Tiannan Chen. Daniel Olson, a Computer Science and Engineering undergraduate, also contributed to the project.

"Working on this project has been very fun," said Guy. "Trying to understand and capture the underlying chemistry forces you to invent new styles of game play that are different from anything else out there right now. The work has a lot of potential to attract gamers who will be excited about playing a game that can contribute directly to science."

In the building phase of the game, each player is tasked with designing MOFs that block or adsorb as much harmful gas—carbon dioxide (CO₂)—as possible, while allowing harmless or even helpful gases—nitrogen (N₂)—to pass through as freely as possible. Each player is given a canvas of 3 by 3 unit cells, and can use the game’s building block library and available budget to buy different building blocks to create structures that will form an important defense matrix for the action phase of the game. During the action phase of the game, a wave of asteroids (CO₂ molecules) and supplies (N₂ molecules) drops from the sky and hits the defense matrix.

One of the NMGC’s important concentrations of research is discovering and exploring MOFs that can be used to capture and separate harmful CO₂ molecules from less environmentally harmful gas molecules such as N₂. From a real-world perspective, it is possible, said Gagliardi, that players may create new materials with enhanced filtering properties that could be useful in separating CO₂ from N₂.

The game’s creators are continuing to refine the game to make it more user friendly and simpler for non experts, to make it available on different platforms, and to extend the building blocks with which the users can build MOFs.

You can download the Master of Filtering game in Windows 64 format (other operating system builds will be coming) at z.umn.edu/mofgame.
A new study led by the University of Minnesota shows that monkeys in captivity lose much of their native gut bacteria diversity and their gut bacteria ends up resembling those of humans. The results suggest that switching to a low-fiber, Western diet may have the power to deplete most normal primate gut microbes in favor of a less diverse set of bacteria.

The study was published in the most recent issue of the Proceedings of the National Academy of Sciences (PNAS), a leading scientific journal.

The microbiome (or gut bacteria) has been tied to a wide variety of medical conditions from autism to obesity. The lack of fiber in modern Western diets is often thought to cause harmful perturbations to the human gut microbiome. However, the causes and consequences of how the gut bacteria of humans changes as societies become modernized and westernized is still a mystery because there are too many variables when studying humans.

To better understand how changes in diet, lifestyle, and exposure to modern medicine affect primates' guts, a team of researchers led by University of Minnesota computer science and engineering professor Dan Knights, veterinary medicine professor Tim Johnson, and veterinary medicine Ph.D. student Jonathan Clayton, used DNA sequencing to study the gut microbes of multiple non-human primates species in the wild and in captivity as a model for studying the effects of emigration and lifestyle changes.

The researchers studied two different species: the highly endangered red-shanked douc and the mantled howler monkey. The authors then compared the captive primate microbiomes to the microbiomes of their wild counterparts and to those of modern humans living in developing nations and in the United States.

What they found could be considered alarming. Not only did captive monkeys lose most of their natural wild gut bacteria, but they consistently all acquired the same new and less diverse set of bacteria—the same bacteria living in our own modern human guts. Across several different zoos on three different continents, all captive primate microbiomes showed the same pattern of converging toward the modern human microbiome.

“We don’t know for certain that these new modern human microbes are bad, but on the other hand many studies are now showing that we evolved together with our resident microbes,” said Knights. “If that is the case, then it is likely not beneficial to swap them out for a totally different set.”

In the wild, each primate species had its own signature fingerprint of microbes. Yet in captivity, they all lost their distinctive microbes and ended up being dominated by the same bacteria that dominate our human guts—species of Bacteroides and Prevotella.

This, along with other analyses to rule out confounding factors like genetics, geography and antibiotic usage, suggested a simple explanation for why the captive primate guts looked more like human guts on the inside—they weren’t eating enough plants.

To test whether a partial loss of plant-derived dietary fiber would result in a partial loss of native gut microbes, the authors also collected fecal samples from a semi-captive population of red-shanked doucs who lived in a sanctuary and received about half of the normal variety of plants eaten by wild doucs. Interestingly, these semi-captive animals' microbiomes fell right in between those of the wild and captive doucs, further supporting they hypothesis that lower plant consumption causes loss of microbial diversity.

By comparing DNA sequenced from primate stool samples to plant genomes the authors were able to actually measure the amount and diversity of plants being consumed by the captive and wild primates, and the difference was stark. Wild primate stool contained up to 40 percent plant DNA, while the captive primate stool contained almost none.

“We think this study underscores the link between fiber-rich diets and gut microbiome diversity,” Knights said.

This research was funded primarily by a variety of grants from the Morris Animal Foundation, University of Minnesota, Margot Marsh Biodiversity Foundation, Mohamed bin Zayed Species Conservation Fund, and a PharmacocoNeuroImmunology Fellowship through the National Institutes of Health.

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Prof. Kumar’s Research Featured by the NSF
In 2010, the National Science Foundation (NSF) awarded a $10 million Expeditions in Computing grant to a University of Minnesota-led research team that uses data-driven approaches to address key challenges in climate change science. Data-driven approaches have already proven useful in a number of scientific disciplines, from materials science to genomics. The project, called Understanding Climate Change: A Data Driven Approach, developed methods that use climate and ecosystem data from a range of sources to refine predictions and identify changes in the climate. “These innovative approaches are helping to provide a new understanding of the complex nature of the Earth system and the mechanisms contributing to the adverse consequences of climate change,” said Regents Professor and project Leader Vipin Kumar.

Excerpt from the National Science Foundation’s feature story “Using data to better understand climate change”: z.umn.edu/1bbs.

Mokbel Appointed Editor-In-Chief for Distributed and Parallel Databases
Associate Professor Mohmed Mokbel has been appointed the Editor-in-Chief for the international journal Distributed and Parallel Databases. He began his appointment at the start of the new year. Professor Mokbel will share the role with University of California at Santa Barbara Professor Divy Agrawal. Their responsibilities will include control of the editorial development and editorial content of the journal, as well as being responsible for applying consistently high standards to all published works. The journal’s focus is on the presentation and dissemination of new research results, system development efforts, and user experiences in distributed and parallel databases systems.

To subscribe to the journal, visit z.umn.edu/1c0u.

How Robots Are Changing MN’s Workforce
Robotics and artificial intelligence expert Professor Maria Gini provided insight on the future of robotics in local industry in the MinnPost article, “How robots are changing Minnesota’s workforce.” In the article, she talks about how tractors and robots have replaced manual labor in the agricultural sector. Machines now pick fruit, vegetables and other crops, a development that has increased production but also contributed to the decline of the agricultural workforce. She goes onto to say, “We need to rethink the educational system. Making sure that everybody is not just learning how to read and write. Maybe they have to learn how to use computers. In a few years, no jobs will exist that don’t require the use of computers.”

Visit MinnPost’s site for the full article at z.umn.edu/mnrobots.

Prof. Shekhar Uses Big Data on Global Food Supply
McKnight Distinguished University Professor Shashi Shekhar was recently co-awarded a grant under the University’s Driving Tomorrow Research Initiatives that aims to address critical challenges facing Minnesota and the world. For example, in coming decades, the world population is projected to grow significantly, substantially increasing the demand for food and other resources. Furthermore, the challenge is amplified due to climate change, urbanization and the need to sustain ecosystem services and conserving biodiversity. The team’s project, titled “Big-data transparency in global food supply”, aims to provide more accurate assessment of geographic variability of risk and performance across sourcing regions of the global food chain. It investigates spatial big data, novel spatial data mining concepts, and environmental life-cycle assessment methods to characterize and predict sustainability benefits and burdens across supply chains spanning highly heterogeneous local landscapes and management practices. The project’s success has the potential to reduce the environmental impact of food production and improve prediction and management of disruptions of food supply chains in vulnerable countries and regions.

For more information on all the Grand Challenges research initiatives that aim to address critical challenges facing Minnesota and the world, visit the Driving Tomorrow website at z.umn.edu/drivingtomorrow.
Department of Computer Science and Engineering Professor Nikolaos Papanikolopoulos has been awarded a prestigious McKnight Presidential Professorship by University President Eric Kaler. The professorship is among the highest honors for faculty at the University. Professor Papanikolopoulos, who serves as the Director of the Center for Distributed Robotics, is the first professor from CS&E and only the fourth from the College of Science and Engineering to receive this honor.

The award recognizes the critical importance of the University’s most distinguished faculty, with an aim to help the University recruit and retain the very best professors and world-class scholars who bring special distinction to the University of Minnesota.

Recipients of the award are recommended by their college dean and chosen at the discretion of the president, in part, on their academic and research accomplishments and their contributions to advancing the University among their peers. Along with the professorship, Professor Papanikolopoulos will receive annual funding to support his research and strategic programmatic initiatives. The award is made possible by a $15 million gift to the University from the McKnight Foundation.

Nikolaos Papanikolopoulos’s research interests include robotics, sensors for transportation applications, computer vision, and control systems. As the director of the Center for Distributed Robotics and a faculty member of the Artificial Intelligence and Robotic Vision Laboratory, his transportation research has included projects involving vision-based sensing and classification of vehicles, and the recognition of human activity patterns in public areas and while driving.

Papanikolopoulos received a diploma in electrical and computer engineering from the National Technical University of Athens, Greece, an M.S.E.E. in electrical engineering from Carnegie Mellon University (CMU) and a Ph.D. in electrical and computer engineering from Carnegie Mellon University in 1992. He is the recipient of numerous academic awards including the University of Minnesota’s Faculty Creativity Award and the Distinguished McKnight Professorship. He has authored or coauthored more than 160 journal and conference papers; one of these (co-authored with Osama Masoud) which was awarded the IEEE VTS 2001 Best Land Transportation Paper Award.

Professor Papanikolopoulos joins 21 other prominent U of M scholars whose names have been engraved on a monument that lines the Scholars Walk. Please join CS&E in sending our sincerest congratulations to Professor Nikolaos Papanikolopoulos.

Visit the CS&E site for a full list of faculty awards at z.umn.edu/157i.
Prof. Kumar Receives IEEE Fernbach Award

Regents Professor Vipin Kumar has been named recipient of the 2016 IEEE Computer Society Sidney Fernbach Award, one of the IEEE Computer Society’s highest awards. He was honored at the International Conference for High Performance Computing, Networking, Storage and Analysis (SC16). Established in 1992 in memory of high-performance computing pioneer Sidney Fernbach, the award recognizes outstanding contributions in the application of high-performance computers using innovative approaches.

The award acknowledges Professor Kumar for his “foundational work on understanding scalability, and highly scalable algorithms for graph partitioning, sparse linear systems and data mining.”

Prof. Zhu Receives NSF and Allen Newell Awards

Assistant Professor Haiyi Zhu and collaborators recently received the Allen Newell Award for Research Excellence from the School of Computer Science at Carnegie Mellon University. The award recognizes an outstanding body of work that epitomizes Allen Newell’s research style, which, according to his words, is “good science that responds to real problems, is in the details, and makes a difference.”

In addition to the Newell Award, Professor Zhu was recently awarded the National Science Foundation’s Computer and Information Science and Engineering (CISE) Research Initiation Initiative (CRII) grant. Also referred to as the “Mini CAREER Award”, the NSF CRII supports untenured junior faculty to build enough preliminary results to successfully apply for an NSF CAREER award. Professor Zhu’s project will focus on building a trustworthy sharing economy system by facilitating people to share spare resources and post requests over their direct (friends) and extended (friends of friends) social networks.

Prof. Tripathi’s Work Receives Best Paper Award at IEEE CLOUD 2016

Professor Anand Tripathi and his graduate student Gowtham Rajappan received the best paper award at the 9th IEEE International Conference on Cloud Computing (CLOUD 2016) for their paper “Scalable Transaction Management for Partially Replicated Data in Cloud Computing Environments.” This paper presents a scalable protocol for transaction management in key-value based data storage systems with partially replicated data. The project is supported by the National Science Foundation while the computing resources for the research were provided by the Minnesota Supercomputing Institute. The conference is a premier and highly selective conference in the area of cloud computing.

Prof. Mokbel and Alumnus Win Award for Cutting-Edge Database Research

Associate Professor Mohamed Mokbel and alumnus and Assistant Professor at City University of Hong Kong Chi-Yin Chow received the “10-Year Award” at the Very Large Data Bases Conference (VLDB) in New Delhi for their groundbreaking research on databases. The award is given to author(s) whose paper appeared at VLDB 10 years ago and has proven to have a profound impact on database research since then. Mokbel and Chow’s work focused on location privacy, which has become increasingly important over the years since many mobile platforms report location information to use their services. Their research led to location-based services that not only maintain high-quality results, but also provide anonymity for data and queries while protecting user privacy.

CS&E Researchers and U of M Team Win Breast Cancer Challenge Award

Researchers from the Department of Computer Science and Engineering are part of an interdisciplinary team that has won the National Cancer Institute’s Up for A Challenge (U4C) Breast Cancer Challenge Award, which is offered in partnership with Sage Bionetworks. The recognition will help further the University’s innovative work in exploring genetic connections in breast cancer research.

Researchers from CS&E and the Masonic Cancer Center are using a unique computational methodology to examine how combinations of genetic variants are tied to a person’s chances of getting breast cancer. They used data from published genome-wide association studies (GWAS) to help identify novel molecular pathways involved in breast cancer susceptibility.

“We’ve applied this innovative methodology to other diseases, like Parkinson’s and heart disease, but this award will jump start our efforts within the breast cancer research community,” said Chad Myers, an associate professor of computer science and engineering.

Please visit cs.umn.edu/news for a full listing of CS&E’s latest news.
CS&E welcomes two new faculty members to the 2016-17 academic year. Hyun Soo Park’s research focus is on computational vision, while Catherine Qi Zhao also focuses on computational vision, as well as machine learning and cognitive neuroscience.

**Hyun Soo Park**
Assistant Professor

Hyun Soo Park’s primary research focuses on computational vision. He is interested in developing a computational visual representation to understand human behaviors from first-person cameras, which includes: (i) understanding social interactions via visible social signals such as gaze direction, facial expression, and body movements, (ii) learning visual sensorimotor behaviors, and (iii) modeling a geometric relationship for dynamic human body motion, e.g., 3D body reconstruction. Park received his Ph.D. from Carnegie Mellon University in 2014 and joins the University of Minnesota after working as a postdoctoral fellow at University of Pennsylvania’s General Robotics, Automation, Sensing and Perception (GRASP) Lab.

**Catherine Qi Zhao**
Assistant Professor

Catherine Qi Zhao’s research focuses on providing theoretical foundations and computational innovations in the study of computational and human vision. Zhao takes an integrated experimental and computational approach with theories and tools from computer vision, machine learning, visual cognition, computational neuroscience, and physics to develop quantitative models, to inspire interesting experimental design, to gain insights into visual and cognitive disorders, and to build intelligent visual systems. Zhao received her Ph.D. in computer engineering from the University of California, Santa Cruz in 2009. Previously, she was a postdoctoral researcher at the California Institute, an assistant professor at the National University of Singapore, and the principal investigator at the Visual Information Processing Lab.
The Department of Computer Science and Engineering’s successful Research Experiences for Undergraduates (REU) program embarked on its second year. The program is supported by the National Science Foundation and offers 10 students from around the U.S. the opportunity to dive into big data at the University of Minnesota.

These 10 students were joined by undergraduate students of the CS&E Department, as well as participants of CRA-W’s Distributed Research Experience for Undergraduates (DREU) and the U of M Multicultural Summer Research Opportunity Program (MSROP), which has created a talented and diverse cohort.

The competitive program allows undergraduate students the opportunity to get meaningful hands-on experiences working on open research questions driven by massive complex datasets, under the guidance of Department of Computer Science and Engineering professors.

The program provides participants with technical training, professional development, and opportunities to participate in on-line and in-lab instruction, attend Big Data Colloquia, participate in workshops, engage with faculty mentors, and present research findings. Additionally, students were encouraged to publish their work in national publications.

All participants actively engaged in research, ranging from large-scale machine learning problems to working with augmented reality-based applications. The research options were as diverse as the fields of inquiry from CS&E faculty and represented collaborations across U of M’s campus. They also presented a poster of their work at a campus-wide symposium in the McNamara Alumni Center.

CS&E sends congratulations to all the students who participated in our REU programming: Tosin Alliyu, Greg Aronson, Alec Beri, Alejandro Buendia, Alex Dawson, Andrew Jewell, Nikki Kyllonin, Francine Lapid, Malik Majette, Spencer Peloquin, Steven Roach, Corey Tesdahl, Tong Thao, Eliza Tlalka Scott, and Hannah Weissman.

REU Site programs are offered at a variety of universities across the country. Students interested in an REU program for 2017 can visit http://www.nsf.gov/crssprgm/reu/ for information on how to apply.
Ph.D. Candidate Awarded Prestigious Scholarship
Ph.D. candidate Konstantina Christakopoulou has received the Gerondelis Scholarship. The $5,000 scholarship is meant to help Christakopoulou defray graduate student expenses as she pursues her research in machine learning and its application to large-scale, real-world problems. The broader area of her research is machine learning, with a particular focus on recommendation systems. The main focus of her thesis is scalable dynamic personalized content delivery for web services. Examples of target domains include Yahoo’s front page and Google News. She is currently researching how to best capture the “human-in-the-loop” present in interactive systems, using ranking models, collaborative filtering, and exploration-exploitation strategies.

Ghassabani Receives Best Contribution Award
Ph.D. student and research assistant Elaheh Ghassabani received the best contribution award at Formal Methods in Computer-Aided Design (FMCAD 16) for her contribution “Inductive Validity Cores for Formal Verification.” Ghassabani shares the award with Master of Science in Software Engineering Director Michael Whalen and Industrial Logician at Rockwell Collins Andrew Gacek. Their work presents a way for extracting information from proofs. For safety-critical systems, it is often not enough to have a proof of correctness of software; it is important to know that properties (software requirements) are correctly formalized and that there is a sufficiently large number of properties to adequately exercise the software. Elaheh presented a new algorithm that computes an Inductive Validity Core (IVC). This information can be used to provide traceability and check completeness of requirements.

Girls Who Code Club Program Receives Support
Field Nation, the online marketplace for on-site and on-demand field service solutions, announced its support of Girls Who Code at the University of Minnesota. The new chapter of Girls Who Code, a national non-profit organization working to close the gender gap in technology, will teach coding and real-world software skills to middle school and high school girls from the Twin Cities area. The weekly after-school program will be taught by University of Minnesota professors Drs. Chad Myers, Lauren Mills, Dan Knights and Melissa Gardner.

ACM-W Hosts Women in Computer Science Dinner
ACM-W worked with the National Center for Women and Informational Technology (NCWIT) and Professor Maria Gini to put together their second Women in Computer Science Dinner in the McNamara Alumni Center. Over 80 attendees joined the dinner, which included a captivating presentation from CS&E Professor Vicki Interrante and focus group discussions afterwards for participants to gain valuable insight into what it takes to get into and succeed in graduate school. The dinner was organized in order to celebrate, support, and advocate for the full engagement of women in all aspects of the computing field. Professor Gini plans to make the dinner an annual event every fall.
Collegiate Programmers Converged on the U of M

Nineteen teams from schools around Minnesota converged on Keller Hall to compete in the ACM North Central North America Regional Programming Contest (NCNA). Not only did teams spend all day competing for “bragging rights” as top collegiate programmers, but they attempted to advance to the contest’s World Finals. U of M’s top team “Hack to the Future” placed 6th out of nearly 230 teams that competed in 14 sites across Minnesota, Wisconsin, Western Ontario, Manitoba, Iowa, North Dakota, South Dakota, Nebraska, Kansas, and the UP of Michigan.

Kwangsung Oh Receives the Riedl TA Award

CS&E Ph.D. student Kwangsung Oh was awarded the John T. Riedl Memorial Graduate Teaching Assistant Award for 2016. The award recognizes graduate teaching assistants whose efforts have helped other students learn. Oh was selected for playing an instrumental role in the experience of CS&E undergraduates, often going above and beyond what was required as a TA, spending many hours designing and building projects to help students through some of the difficulties they faced in their coursework. His dedication and careful explanation of challenging concepts helped students excel.

Ph.D. Candidate Christakopoulou and Professor Karypis Receive Best Paper Award at RecSys 2016

Ph.D. candidate Evangelia Christakopoulou and Professor George Karypis received the best paper award at the 10th ACM Conference on Recommender Systems for their paper “Local Item-Item Models for Top-N Recommendation.” This paper generalizes and improves upon the widely popular item-item method for computing top-N recommendations by explicitly modeling the fact that not all users behave the same way; rather, there exist subsets of like-minded users. The paper presented an approach that simultaneously identifies these like-minded user subsets along with their associated item-item recommendation models in order to maximize the overall recommendation performance.

Ph.D. Students Kartal and Sohre and Professor Guy Receive Best Paper Award at AIIDE

Ph.D. students Bilal Kartal and Nick Sohre, along with Professor Stephen Guy, received the best paper award at the AAAI Conference on Artificial Intelligence and Interactive Digital Entertainment (AIIDE 2016) for their paper “Data-Driven Sokoban Puzzle Generation with Monte Carlo Tree Search.” Their research focuses on Sokoban puzzles, which are a popular form of video game involving organizing boxes by pushing them with a player-controlled agent on a grid board. In order to address the needs of users playing Sokoban games, they had to look at several key challenges inherent in the field of puzzle generation, including speed of the system, support of on-demand puzzle generation, and production of a variety of puzzles. The results of their pioneering work could lead to limiting the need for human input in generating puzzles, while still producing puzzle levels that are of varying degrees of difficulty and are guaranteed to be solvable.

Please visit cs.umn.edu/news for more student highlights.
Donald Sawyer works in the “wilderness” of big data. Working with Target’s Business Intelligence (BI) Engineering group and often leveraging complex distributed architectures, he helps process, store, and analyze the petabytes of data Target generates daily.

When Sawyer was at the University of Minnesota, he was enrolled in the Masters of Science in Software Engineering program (MSSE) focusing on growing the skills required for leading these engineering efforts.

“I felt that before going to Target, the fields of BI and data science needed some help in building systems and tools that employed quality engineering practices,” Sawyer said.

Leveraging his strong passion for data science, his undergraduate background in artificial intelligence, and his recent experiences from MSSE, he seeks to build well-engineered data pipelines for one of the largest retailers in the United States. This work gives him the opportunity to analyze architectures and data models, implement robust testing, communicate technically complex systems through design, and, ultimately, lead agile projects.

Tell us about working with large-scale systems.

The systems that are used for ingesting, storing, processing, and analyzing large amounts of data have a fascinating collection of architectural patterns that are different from traditional relational/transactional systems. Each component of a big data architecture has specific strengths and quality attributes it is solving for, thus requiring an understanding of whether it is best suited for storage, delivery, analysis, or some other use case. When choosing components of the system, one must understand what problem(s) each component solves, as well as what it doesn’t solve. Processing data at scale requires you to understand how to store data effectively so systems can leverage these data for analysis, while conserving processing resources.

What drew you to software engineering as opposed to the other fields within computer science?

I was a software engineer and architect for many years and I knew that having a well-rounded software engineering background allowed me to contribute in many ways beyond technical innovation. An architect is involved in just about every facet of software creation, including analysis, design, testing, and project management. First and foremost, I wanted to be able to be a person that could contribute wherever I was needed, rather than just the technical space. In addition, the MSSE program accommodated my schedule to minimize time away from my family and job.

What were your early experiences with computing that inspired you growing up?

Growing up, I wanted to be a mechanical engineer or mathematician. I loved solving problems and figuring out how things worked and how to build new things. I was always interested in technology, but I assumed programming would be too hard. When I took my first computer science class as part of the M.E. major, I loved that I could solve any problem a variety of innovative ways, which tapped into my creative side. I realized that with the passion I had for computer science, success was much easier to attain. Lastly, I was always fascinated by the brain and was always reading about learning and cognition, so being exposed to artificial neural networks only drove my interest in computer science further.

What is one of your fondest memories from your time at the U of M?

I really connected with my classmates and professors. The students in the MSSE program had a diverse set of backgrounds and we learned so many things from each other. My fondest memory of my time there was the excellence that my classmates and I strived for to have the best deliverables, presentations, and grades. It was great to be around other people who valued excellence in what they did. I am very thankful for the relationships I’ve created with everyone in the MSSE program, and for Jenny for making life very easy for us.

What are some unique challenges you face working in a highly specialized technical field?

The largest challenge for a technical person like myself is trying to understand and communicate with business-focused individuals. I like to speak in bits, bytes, and code, and there are times when it can be frustrating to communicate because many of our technologies aren’t trivial to a non-technical individual. It is also very difficult to communicate the cost of a project to your stakeholders who finance your projects when you only know the end goal. On the flip side, it can be easy to understand the business because I love shopping at Target and I understand how a Target guest thinks. I can put myself in a guest’s shoes, literally.

What is it about computer science that keeps you excited and motivated for the future?

I love data and engineering. I love how we’re using huge scales of data to make smarter systems and help people make more informed decisions. It’s really fascinating to see how artificial intelligence, algorithms, and mathematics are being applied to everyday problems. For example, it’s amazing to think that using computer science we’ll find medical treatments that are highly effective for a specific 5% population, rather than just treatments that are effective 95% of the time across the general population.
Alumnus Named Professor Emeritus of Computer Science at UCSB
After 32 years of service at the University of California, Santa Barbara, Alumnus Teofilo Gonzalez (Ph.D. 1975) has been named Professor Emeritus of Computer Science. One of the first students to receive a computer science undergraduate degree in Mexico, Professor Gonzalez’s career spans decades. He has been a member of the faculty at Oklahoma University, Penn State, and UT Dallas, and has spent sabbatical leave at the ITESM Monterrey (Mexico) and U. Utrecht (Netherlands). He joined UCSB in 1984. His work has been published in top CS journals and conferences, and he has been editor of handbooks, journals, and numerous conference proceedings.

Kumar Lab Alumni Win $1M USAID Grand Challenge Award
Department of Computer Science and Engineering and Kumar Lab alumni James Faghmous and Matthew Le are part of a team that has been selected as one of the winners of the U.S. Agency for International Development’s (USAID) “Grand Challenge to Combat Zika and Future Threats.” The award sought up and coming innovators to address outbreak of Zika in hopes that the work will provide solutions to manage Zika outbreaks and other infectious disease. The award includes $1M to help fund the team pilot their ATLAS spatial platform to monitor Zika in Guatemala. The team’s approach uses telecom data, collected from mobile phones, to enhance Zika surveillance, thereby mapping the risk of international disease spread using data visualization and social mobilization.

PhD Graduate Team Member Awarded $11M for Kidney Cancer Research
CS&E Ph.D. graduate and current assistant professor at the University of Texas Southwestern Medical Center (UTSW) Tae Hyun Hwang was awarded a large grant from the Specialized Programs of Research Excellence (SPORE). Professor Hwang and his team were awarded the grant to research kidney cancer, which continues to be a significant problem for adults and children, with over 400,00 people in the U.S. living with kidney cancer and over 60,000 new cases expected in the U.S. in 2016. Professor Hwang will serve as a Data Analysis Core co-director, leading a team of bioinformatics scientists to oversee and develop new computational approaches, as well as managing and analyzing various types of clinical genomic data.

Recent Graduate Awarded Prestigious NSF Fellowship
Alumnus Noah Trebesch (B.S. 2014) was awarded a competitive and prestigious National Science Foundation Graduate Research Fellowship, which he will use in his current research at the University of Illinois at Urbana-Champaign. A Ph.D. student at the Center for Biophysics and Quantitative Biology, the fellowship will support Trebesch’s current research through a three-year annual stipend of $34,000 along with a $12,000 cost of education allowance.

CS&E Alumnus Jeff Dean Elected to Academy of Arts & Sciences
CS&E alumnus Jeff Dean has been elected to the American Academy of Arts & Sciences. His election to the prestigious Academy seats him among some of the world’s most accomplished scholars, scientists, writers, artists, and leaders. Established in 1780, the American Academy is one of the nation’s oldest learned societies and independent policy research centers that convenes leaders from many different sectors to address critical challenges facing our global society. The Academy has a membership of 4,600 Fellows and, this year, Dean is among only six computer scientists elected to the Academy out of 213 new members.

CS&E Alumnus Named Associate Dean for Research at UNT
Dr. Yan Huang has been named Associate Dean for Research and Graduate Studies at the College of Engineering at the University of North Texas (UNT). Her responsibilities include developing strategies to bring growth in externally sponsored research and increase graduate student enrollment within each of the departments in the College. Yan has previously served in key leadership roles at the Association for Computing Machinery’s International Conference on Advances in Geographic Information Systems (ACM SIGSpatial). Yan obtained her Ph.D. degree from CS&E in 2003 with Dr. Shashi Shekhar as her thesis advisor. She joined UNT right after graduation and was promoted to Professor in 2014. She is grateful for the training and mentoring she has received in the five years she spent at CS&E and the University of Minnesota which have prepared her well for challenges in career and life.

Please visit cs.umn.edu/news for more alumni highlights.
“Even though many common diseases are thought to be caused by many different loci in the genome, we don’t really understand the basic principles for how multiple genes combine to have effects,” said Professor Myers. “Our comprehensive study of double mutant combinations in yeast establishes a set of first principles that we expect to apply in many different species, including humans.”

**Biking Without Brakes**

These findings suggest that most genes within our genomes are “buffered” to protect the cell from mutations and environmental stresses. Cells contain backup systems to ensure the essential functions of life keep working properly, even when one part is damaged. To address this buffering property, scientists had to ask if cells can survive upon losing more than one gene at a time, and they had to test millions of gene pairs.

Andrews, Boone, and Myers led the pioneering work in yeast cells by studying cell survival in the context of double mutants. To do so, they automated yeast genetic analysis, and they used robots to construct and examine almost all of the 18 million pairwise double mutant combinations.

The global genetic interaction map catalogues the pairs of genes that provide back up for one another—if the gene function of one is lost, the other gene in the genome fills its role.

Consider a bicycle analogy: a wheel is akin to an essential gene—a part without which it would be impossible to ride. Front brakes? That depends, because you could ride just fine as long as the back brakes are working. But what if you were to lose both sets of brakes? Without back brakes, the front brakes become essential, and vice versa.

Geneticists would call the relationship between front and back brakes as “synthetic lethal”, meaning that losing both, but neither by themselves, spells doom. Synthetic lethal double mutant gene pairs are relatively rare, but when they are found, they reveal important information on gene pairs that work together to control essential functions.

**Guilt by Association**

What’s more, the global map shows that synthetic lethal gene pairs are more likely to control the same biological process in the cell. This way, scientists are able to predict what a gene actually does in the cell simply based on its genetic interaction patterns, a process referred to as “guilt by association”.

If most genes in the human genome have one or more backup genes, then instead of searching for single genes underlying diseases, researchers now must look for gene pairs. This poses a huge challenge because they must somehow examine on the order of 200 million (!) possible gene pairs in the human genome that are associated with a disease.

Fortunately, with the know-how from the yeast map, researchers can now begin to map genetic interactions in human cells, and even expand it to a number of different cell types.

“Technology to manipulate human genomes on a large scale exists now,” said Professor Myers. “Our work in yeast provides a blueprint for how we can learn about the human genome through systematic manipulation in cell lines.”

The concept of synthetic lethality is already changing cancer treatment because of its potential to identify drug targets that exist only in tumour cells. Cancer cells differ from normal cells in that they have scrambled genomes, littered with mutations. If scientists could find the highly vulnerable back-up genes in cancer, they could target specific drugs at them to destroy only the cells that are sick, leaving the healthy ones untouched.

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