Professor Zhi-Li Zhang and a team of U of M researchers are leading an effort to study autonomous vehicles that has recently received a $1.75 million grant from the National Science Foundation (NSF) as part of the NSF’s Smart & Connected Communities grant program. The interdisciplinary University of Minnesota project is one of only 13 chosen by NSF nationwide.

The research envisions an ambitious “smart cloud commuting system” based on giant pools of shared autonomous vehicles.

“These smart cloud community systems have the potential to bring about far-reaching societal changes,” said Professor Zhang, who specializes in computer communication and networks, internet technology, multimedia and emerging applications.

The proposed smart cloud commuting system would also provide equity and boost economic productivity.
Join us in welcoming new assistant professors Favonia, Feng Qian, Evan Suma Rosenberg, and Steven Wu to the 2018-19 academic year. Their research specialties span a wide range of topics—everything from software engineering and programming languages, to robotics and AI, to distributed systems and security, to graphics, visualizations, and networks.

Favonia
Assistant Professor
Favonia (Kuen-Bang Hou) received their Ph.D. in Computer Science from Carnegie Mellon University and served as a postdoctoral member at Princeton’s Institute for Advanced Study, whose primary interest lies in making things more precise and reliable. In recent years, Favonia and their collaborators have been verifying important results in homotopy theory by computers, developing cubical computational type theory, and building the proof assistant RedPRL based on the newly developed type theory. They have also been working on property-based testing and compiler correctness in hopes of improving software quality.

Feng Qian
Assistant Professor
Feng Qian’s research covers the broad areas of mobile systems, VR/AR, computer networking, and system security. He obtained his Ph.D. from the University of Michigan. He is a recipient of several awards including a Key Contributor Award at AT&T Shannon Labs, an NSF CRIR Award, a Google Faculty Award, an AT&T VURI Award, the best paper award at ACM CoNEXT 2016, and several best paper nominations.

Evan Suma Rosenberg
Assistant Professor
Evan Suma Rosenberg received a Ph.D. in 2010 from the Department of Computer Science at the University of North Carolina at Charlotte. His research interests are situated at the intersection of virtual reality and HCI, encompassing immersive technologies, 3D user interfaces, and spatial interaction techniques. Rosenberg has co-authored over 80 academic publications, nine of which have been recognized with conference awards, and his online research videos have been viewed over 2.4 million times. He has directed the development of multiple widely used free software projects and contributed to the MxR Lab's open-source initiative, which has had a major disruptive impact on the virtual reality industry.

Steven Wu
Assistant Professor
Steven Wu received his Ph.D. in Computer Science from the University of Pennsylvania in 2017. His doctoral dissertation “Data Privacy Beyond Differential Privacy” received the 2017 Morris and Dorothy Rubinoff Dissertation Award. After receiving his Ph.D., Wu spent a year as a post-doctoral researcher at Microsoft Research-New York City. His research focuses on algorithm design under different social constraints. In particular, his primary research interest is on data privacy, specifically differential privacy, where he builds tools for data analysis under the constraint of privacy preservation. His recent research also studies algorithmic fairness, especially in the context of machine learning, where he investigates how we can prevent bias and unfairness in algorithmic decision making. He examines problems in these areas using methods and models from machine learning theory, economics, optimization, and beyond.
First-ever study of triple gene combinations could help predict risk of disease

We inherit many traits from our parents including the color of our eyes and hair. Unfortunately, we also inherit risk factors for certain diseases such as cancer, heart disease, and diabetes. Understanding those genetic connections can help prevention efforts and develop new life-saving treatments to combat these diseases.

In the largest study of its kind, researchers from the Department of Computer Science and Engineering (CS&E) and the University of Toronto have revealed a complex network of genes that work together. The research builds on the teams’ previous work that showed how genes combine in pairs to underpin a cell’s health. Leading the CS&E team is associate professor Chad Myers who has helped take the research a step further. The new study examines for the first time how higher-order gene combinations—comprising three genes—help maintain normal cell physiology.

To understand how a cell works, scientists like to take it apart. By removing genes from cells in diverse combinations using cutting-edge gene editing techniques, researchers have now uncovered how different genes work together to keep cells alive. The research will help scientists understand how faults in multiple genes combine to drive common diseases.

Researchers say it’s much like a giant game of Jenga with thousands of gene blocks. While most single blocks can be taken out without compromising the structure, when critical combinations of blocks are removed, the system collapses. Similarly, genes with different roles can combine to keep the cell alive. By unpacking such gene alliances, we hope to reveal clues about the foundations of personal health.

It’s now clear from genome sequencing studies that each person carries thousands of genetic variants—differences in genes’ DNA sequence—that could combine to impact our health. However, these studies do not have the statistical power to predict a person’s risk of disease from their unique combination of genetic variants. This poses a major obstacle for personalized medicine which seeks to use genome information to predict risk of disease and tailor treatment.

To uncover the rules of combinatorial gene function, the team previously investigated how genes work in pairs in yeast cells. Yeast is one of biologists’ favorite cell models due to its relatively small genome comprising 6,000 genes and an already existing wealth of data. Having previously removed from yeast all possible gene pairs—18 million of them—the team now went a step further to examine what happens when you remove a subset of 36 billion possible trigenic combinations.

“Only about 1,000 of the 6,000 yeast genes are essential when deleted individually. When we studied pairs of mutants, we found about 10,000 pairs of genes that were essential when deleted in combination,” said Professor Myers. “Our study of triple gene combinations suggests there are at least 10- to 100-fold more instances of triple mutants that are lethal, which highlights the astounding complexity of biological systems.”

They found that, similar to interactions between two genes, trigenic interactions also mainly occur between genes that are functionally related—they code for parts belonging to the same molecular machine or that exist in the same part of the cell, for example. But with trigenic interactions, the researchers also began to see more surprising partnerships between genes that have unrelated function and are involved in different bioprocesses in the cell.

Using computational modeling, the researchers estimated that all genes in the cell have a role to play when trigenic interactions are taken into account. This could finally explain why yeast maintains 6,000 genes when only about 15 percent of them are essential when removed individually, a rule that holds for other cell types including human cells.

The research was funded primarily by the National Science Foundation and the National Institutes of Health with computing infrastructure support from the University of Minnesota.

To read the full research paper entitled “Systematic analysis of complex genetic interactions” and see a full list of authors, visit the Science website at z.umn.edu/Trigene.
CS&E Professor John Riedl (posthumous) has been selected to receive the IEEE’s InfoVis 20 Year Test of Time Award for one of his most influential papers, “An Operator Interaction Framework for Visualization Systems.”

The paper introduced a framework Riedl and CS&E alum Ed H. Chi developed to enable a new way of organizing systems to generate graphics for data analytics. Information visualization is about creating interactive graphics to allow users to see, explore, and understand large amounts of information at once. Chi and Riedl’s research proposed a number of ways to think about how to transform data step by step into interactive graphics. It also described ways users could understand the data so they can better organize what they are analyzing or creating.

The paper was published at the 1998 IEEE VIS conference. Professor Riedl’s paper was selected in tribute to him and the impact of his work, which has continued to inspire the visualization community and beyond for over twenty years.

Chi, who was advised by Riedl and co-authored the paper, accepted the award and reflected on Riedl’s work and contributions to the visualization community at this year’s IEEE VIS conference in Berlin, Germany.

Faculty members Maria Gini and Shana Watters launched the Emerging Scholars Program, which aims to support the next generation of female scientists and engineers.

With grant funds from the National Center for Women and Information Technology’s (NCWIT) Surging Enrollment Seed Fund, Gini and Watters created the program for women enrolled in our introductory programming course in order to build a greater sense of community among the students and provide resources to encourage them to continue their pursuit of computer science.

“We all have great gifts and abilities and we all think differently,” Watters is quoted as saying in a recent Minnesota Daily article. “In order to create a society that is operating at its best, you don’t want to leave anybody behind because everybody has the ability to contribute.”

The NCWIT created their Surging Enrollment Seed Fund to help universities and colleges find ways to meet heightened demand for their services and expand inclusivity without inadvertently leaving underrepresented populations behind.

University of Minnesota was one of only four institutions to receive the funding. The Seed Fund projects were selected for their potential to apply promising and innovative practices for recruiting and retaining women in higher education.

To find out more, read Minnesota Daily’s article “To support female engineers, U faculty launches new inclusion program” on their website.
YAROSH HELPS CHILDREN BETTER CONNECT WITH VOICE ASSISTANTS

“Ok, Google, tell me a joke!”

If you share your home with a kid and a voice assistant (Google Home, Alexa, Siri, etc.), you may have overheard requests like this. However, Assistant Professor Lana Yarosh and her team noticed that what kids say is not always what the voice assistant hears or understands. Her goal is to find ways parents, children, and voice assistants can live and work together more harmoniously. Her research recently caught the eye of Google, which awarded her a 2017 Google Faculty Research Award.

Through an early investigation, Yarosh’s team found that children struggle specifically with rewording, or reformulating, their requests so the voice assistant system can understand them. For example, a voice assistant may be able to understand “tell me a joke” but unable to understand “I want to hear something funny.”

Though some children had requests met through trial and error without guidance, Yarosh’s team saw some areas in which these interactions could be improved, especially for younger children. One way grew somewhat naturally out of their study, where they saw how well parents collaborated with their children while they used the voice assistant; parents effectively were able to teach their children ways to communicate more clearly with the system.

Another key area they saw that could be improved was that the voice assistant itself could provide visible feedback regarding what it heard or understood.

“A combination of visual and voice interaction could really be the sweet spot for making the most out of voice assistants,” said Yarosh.

With the help of this Google Award, Professor Yarosh developed a prototype voice interface and asked 100 parents and children at the Minnesota State Fair to try it out. Volunteer families interacted with the prototype voice assistant on common everyday tasks, such as cooking together, doing homework, or planning a family activity. Based on the families’ experience, the research team will be able to provide concrete recommendations for how to improve voice assistants to be more usable and more useful for families with children.

“The bottom line is that we hope to reduce the number of times families have to hear ‘I don’t know how to help with that’ from their voice assistant,” Yarosh added.

Professor Yarosh joins a small group of Google Awardees in receiving this award. According to the Research at Google website, only around 15 percent of applicants receive this highly-competitive award.
Assistant Professor Hyun Soo Park received the National Science Foundation's (NSF) Computer and Information Science and Engineering Research Initiation Initiative (CRII) grant. Park received the award for his proposal titled “Towards Learning Skills from First Person Demonstrations.” The project seeks to develop technologies that help people learn from expert demonstrations through first-person videos, while investigating potential problems people may face while learning through these demonstrations.

One of the team’s challenges is that current state-of-the-art computer vision systems assume footage of a subject is happening from the third-person point of view. For example, typically when learning a new skill a student observes the expert in action. Park’s system will instead analyze skills from the point of view of the expert. These videos end up being highly dynamic, generating so much data that Park’s team will need to develop both new hardware and computational models.

Park also led his research team to receiving a Futures Award from Office for the Vice President of Research (OVPR). Working with co-P.I. Professor Ben Hayden from the Department of Neuroscience, Park and his team plan to use the added grant funding to find a new, more accurate method of measuring neural activity in Rhesus macaques. Rhesus macaques have often been studied to better understand brain activity, but up until now research has been limited by the use of large recording devices that require the oft-mobile Rhesus subjects to sit still as researchers record data.

This is where Park and Hayden’s work is trying to make a breakthrough. By developing a system that uses wireless brain sensors and cameras, the team hopes that their data-capturing process will be far less invasive, allowing the monkeys to be observed more naturally which ultimately will result in better, more accurate results.

**Professor Gini Receives NCWIT’s Research and Graduate Mentoring Award**

Professor Maria Gini has been named the recipient of the 2018 Harrold and Notkin Research and Graduate Mentoring Award. The award, sponsored by the National Center for Women and Information Technology (NCWIT), recognizes faculty members from non-profit institutions who distinguish themselves with outstanding research and excellent graduate mentoring, as well as those who recruit, encourage, and promote women and minorities in computing fields.

In NCWIT’s announcement, Marie desJardins, Associate Dean for Academic Affairs of the College of Engineering and Information Technology at the University of Maryland, describes Gini as “a respected and prolific researcher in the areas of intelligent agents, multi-agent systems, and robotics” who “uses her visibility and prominence to make the field a better place for everyone, particularly graduate students and women at all levels.”

Since joining the University of Minnesota, Professor Gini has established an international reputation for her research in robotics and artificial intelligence, and as a role model in mentoring students.

**Professor Guy Receives the Bowers Faculty Teaching Award**

Associate Professor Stephen Guy has been selected as a recipient of the Charles E. Bowers Faculty Teaching Award. This honor recognizes outstanding professors who have demonstrated exceptional interest and commitment to the teaching of students in the College of Science and Engineering.

Guy has been integral in improving the inclusivity of our department and broadening participation in computer science. He has supported and mentored several undergraduates through the Presidential Distinguished Faculty Mentoring Program (PDFMP), the University’s Undergraduate Research Opportunities Program (UROP), and through his lab’s funding. The majority of these students have come from underrepresented groups.

Guy’s work in mentoring and teaching-based outreach extends well beyond our own students and into our local community. Last summer, he led a weeklong “introduction to coding camp” targeted at minority high-school students, guest lectured at local middle schools, and has been on the advisory board of Glitch, a non-profit that provides resources and training aimed at broadening participation in the local game development community. In addition, Guy has been a mentor for national diversity-oriented Computer Science mentoring programing such as the Institute for African-American Mentoring in Computing Sciences (IAAMCS) and the Distributed Research Experience for Undergraduates (DREU) program. Through these programs he has hosted and mentored several undergraduate students from intuitions across the country as summer researchers.

**Professor Tian He Receives the Best Paper Award at ICDCS 2018**

Professor Tian He received the Best Paper Award at the 38th IEEE International Conference on Distributed Computing Systems (ICDCS 2018). Professor He was joined by George Mason University Assistant Professor Song Min Kim and visiting PhD student Shuai Wang. They were honored for their paper, “Symbol-Level Cross-technology Communication via Payload Encoding.”
Congratulations go out to Department of Computer Science and Engineering student Andrey Rainchik for winning a trip to Boston and placing third in The IBM Vault game, a worldwide interactive hacking contest hosted by the computer giant.

In order to qualify for the trip, Rainchik had to be among the top 75 participants to solve six different puzzles, called “locks”. Rainchik competed with over 3,000 participants in the qualifying stage of the game and placed 14th overall.

Solving each lock took a combination of logic, analytical, and computer science skills. He explains his entire process for solving each problem on GitHub, but it’s safe to say these were not your typical Sudoku puzzles.

For one of the problems, Rainchik was given an extensive series of numbers and letters. Here’s a sample:

5833372e32313130343936582d3132312e38303730383431583302e343

On his GitHub site, Rainchik says he did not see a random string of numbers and letters like your average person, but “noticed that the string included hex digits within the printable ASCII range, so I ran it through a hex-to-ASCII converter.”

What this means is that he recognized that the series of numbers and letters was a form of computer encoding called hexadecimal that could be translated to a more human readable encoding called ASCII. This led him to track down an online translator which delivered him a much longer list of the following results:

X.37,2110.496X.-121.8070841

Rainchik was able to make sense of this mess of computer glyphs as well, saying, “These stood out to me as being possible coordinates, so I separated them into pairs.”

Even after separating them into pairs, the results do not look like the typical latitude-longitude coordinates you would see on your average globe. Here’s an example of what he came up with:

X.37,2110.496
X.-121.8070841

Rainchik input these pairs into an online map and discovered that they were in fact coordinates for a number of IBM research centers around the world.

“On a whim, I input these cities as the key, and it worked!”

That combination of logical and creative thinking is what got Rainchik to the final competition at IBM Cambridge. There, he and the other finalists had to hack into different IBM computers, and then prevent others from also hacking in. This was an area that Rainchik happened to also excel in.

“I got third since I’ve been doing that same sort of thing on my own time,” he said.
This past summer, it wasn’t unusual to walk through campus and hear chirping. But it wasn’t the sounds of birds outside. It was the mechanical beeping of robots in the basement of Lind Hall.

The Lind Hall computer lab was full of chirping robots, 32 tiny black domes skittering around on gray tables, and 32 female junior high and high school students listening intently to computer science instructor Shana Watters as she explained how to make the robots do the “tornado.”

Each girl had a white sheet of paper, with straight lines drawn in blue, green, and red. To anyone else, the colors meant nothing, but to these girls, different combinations of colors correspond to a program within the robot that commands it to move slowly, quickly or spin around in a circle (the aforementioned “tornado”).

Welcome to ‘fun school’
Robot programming was just one example of activities at Computer Science and Engineering Professor Maria Gini’s summer computer programming academy for young female students. The programming camp, or as the girls like to call it, “fun school,” consisted of two camps, the first lasting two weeks and aimed at girls with prior computer programming experience, and the second lasting one week for girls with no prior experience.

This is the fourth consecutive year of the camp, which Gini started in 2015 with the goal to bring more women into the computer science field. The first two years of the camp were funded by an anonymous donor who wished to kickstart a program that would keep young women interested in computer science down the line.

And if the students’ excitement is any indication, “fun school” is certainly broadening their interest in science and technology.

Opening up endless possibilities
Many of the girls enjoy the endless possibilities and creative opportunities that computer programming provides.

“I think it’s fun to be able to portray whatever you want,” said 16-year-old Amy Wang from Edina. “It’s pretty amazing how much you can do with the program.”

Others added that the camp gives a feeling of accomplishment.

“It feels amazing. Like hey, I made this,” said Arya Lucht, age 16 from Arden Hills.

Over a span of two weeks, these students learned the basics of Python code, animated a virtual Pac Man and designed and assembled foldable wooden boxes using the laser cutter in Anderson Labs. And that’s not even the tip of the iceberg. Other activities included learning image processing, 3D printing designs, programming online quizzes and making drawings move using Sketchpad.

An overwhelming favorite was a trip to the Virtual Reality Lab, in which the students, led by Computer Science and Engineering Professor Victoria Interrante, were able to experiment with VR goggles.

Planning for the future
While the students range from grades 6-12, many of them are already thinking about the future benefits of their experience at the camp. Stuti Arora, a 16-year-old student from Maple Grove, is involved programming on her high school FIRST robotics team, but she wants to learn more.

“I try to grab any opportunity that will teach me how to program more and use more applications of it rather than just programming a robot for competition,” Arora said.

“I guess computer science is a pretty relevant skill to have now, since you can have a lot of jobs with it,” Wang added. “So, I think it’s important to know for the future also.”

Professor Gini herself expressed how impressed she is with the campers and how serious they are about learning, explaining that many students arrived early in the morning and read their programming
Nick Heller Selected as ARCS Scholar

Ph.D. student Nick Heller has been selected to receive the Minnesota ARCS Scholar Award for the academic years of 2018-2020 within the Department of Computer Science and Engineering. The award is made to graduate-level scholars who have high scholastic records and proven abilities in their chosen area of study. Heller’s nomination focuses on his research into the development of machine learning algorithms for medical image analysis. The applications he works on include productivity tools for clinicians, biomarker discovery, and modelling disease progression. He hopes his work will enable clinicians to not only improve patient care, but also more effectively make discoveries about the underlying physiological phenomena of diseases. Heller received the award at the ARCS Annual Scholar Award Event. The award will provide Heller with a total of $10,000 to boost the breakthrough research and work that enabled him to receive this honor.

Bhargava Receives Best Poster at the M.S. Data Science Poster Fair

Data Science student Akhil Bhargava received the best poster award at this year’s Data Science M.S. Poster Fair. He was honored for his poster, “Fully Convolutional Network in Performing Dense Pixelwise Classification for Satellite Data.” His research focuses on using a neural network to determine whether a picture contains water or land pixels. The idea is that if an algorithm can be created to perfectly classify each pixel, analysts will be able to use this algorithm to create accurate water/land maps for the entire globe at any time that has photographic evidence.

Bhargava hopes his capstone project will allow climate scientists to further understand climate change and the water dynamics of Earth. Once his machine learning algorithm is perfected, it may also be possible to aid in predicting the location and time of a natural disaster such as a hurricane. For this project, Bhargava focused on applying machine learning models to satellite data, but a lot of his work is focused in the health care field. He has used the power of data science to help hospitals assess the risk of a patient and physicians decide what drug regimen cancer patients should take.

Ph.D. Students Receive Best Paper at NetAI 2018

Ph.D. students Arvind Narayanan, Saurabh Verma, Eman Ramadan, and Pariya Babaie, along with their advisor Distinguished McKnight Professor Zhi-Li Zhang, were awarded the Best Paper Award at ACM SIGCOMM 2018 Workshop on Network Meets AI & ML (NetAI 2018). They were honored for their paper, “DeepCache: A Deep Learning Based Framework For Content Caching.” Their paper introduced DeepCache, a framework that uses neural network models and state-of-the-art machine learning tools to boost the performance of content caching, a process of temporarily storing files to reduce page load times and stress on servers when computing over networks.

GroupLens Research Team Receives CHI 2018 Paper Award

GroupLens Ph.D. students Estelle Smith, Xinyi Wang, and Raghav Karumur and faculty advisor Haiyi Zhu received an Honorable Mention Award at the ACM CHI Conference on Human Factors in Computing Systems (CHI 2018), the premiere international conference on Human-Computer Interaction. The paper, entitled “(Un)breaking News: Design Opportunities for Enhancing Collaboration in Scientific Media Production” was among the top 5% of over 2500 paper submissions.

Learn more about their work at the GroupLens blog.

Smith et al’s paper provides groundwork for understanding how scientific media is produced along an information pipeline, starting at research labs and moving through communications departments and news outlets until it reaches the general public. There are two main thrusts to the work. The first is to help scientists more easily disseminate their results to the public, and the second is to help journalists, who may lack the expertise within a given area, more easily cover dense scientific topics. Ultimately, they hope that reducing errors in science reporting will improve scientific literacy rates and help educate the public.

The leading author, Estelle Smith, specializes in Human-Computer Interaction to study how socio-technical infrastructures support scientific media creation and user behavior in online health communities. Co-advised by GroupLens Professors Lana Yarosh and Haiyi Zhu, Smith’s future work will explore how these domains intersect.
Kalantzis and Ubaru Receive IBM Fellowship
Ph.D. candidates Vassilis Kalantzis and Shashanka Ubaru have received IBM's 2018 Herman Goldstine Memorial Postdoctoral Fellowship. The year-long fellowship provides scientists of outstanding ability the opportunity to advance their scholarship while being resident members of the Mathematical Sciences department of the IBM Thomas J. Watson Research Center in Westchester County, New York. The named fellowship is given annually to the top two candidates among applicants from around the world, which makes this the first time in the fellowship's history that both recipients came from the same university. Add in that Kalantzis and Ubaru are from the same department, working in the same lab under the same adviser, Professor Yousef Saad, and their achievement is even more remarkable.

Jensen Receives Bowers TA Award
Ph.D. student Kate Jensen has been awarded the John Bowers Excellence in Teaching Assistance Award. The award honors an outstanding teaching assistant who has demonstrated exceptional interest and commitment to the teaching of College of Science and Engineering (CSE) students. Jensen showed such commitment through her outstanding work as a teaching assistant (TA) as well as a Teaching TA independently teaching exceptionally well-liked courses in our department.

Jensen works under the supervision Professor Zhi-Li Zhang, studying graphical networks and computational complexity. She is primarily interested in examining similarity transformation of laplacian matrices. Her research involves taking novel algebraic and geometric approaches to tackle theoretical computer science problems, particularly those in the area of time complexity. As advisor Zhi-Li Zhang noted, Jensen is a “rare talent” in the field of theoretical computer science, taking on difficult problems and obtaining surprising results.

Jensen continues to provide the department with her teaching expertise and mentorship. She joined the 2018-19 academic year as one of our instructors.

Ryan Chan Receives the Riedl TA Award
M.S. in Data Science student Ryan Chan has been awarded the John T. Riedl Memorial Graduate Teaching Assistant Award for 2018. The award recognizes graduate teaching assistants whose efforts have helped other students succeed in the classroom. Chan 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. One student noted that he consistently had a positive attitude and was a motivational presence during labs and office hours.

“I didn't think I was quite prepared for such a position,” she noted, “but he reminded me of how much I had grown and learned in the last semester and encouraged me to pursue new opportunities that would broaden my knowledge and perspective in computer science.”

Congratulations to the 2018 CS&E Scholarship Recipients
The Department of Computer Science and Engineering has selected 16 undergraduate students to receive scholarships for the 2018-2019 academic year.

CS&E sends congratulations to all of this year’s recipients.

The Hopper-Dean Foundation
Zoe Wentzel
Nicholas Freiter
Heather Kuang
Stephen Mylabathula

The Department of Computer Science & Engineering
Yuliya Ryabova
Cole Wallin
Peter Van Dyke
Patrick Murphy

Donors of the Lando Scholarship
George Fisk
Songyu Yan
Matthew Tlachac
Joshua Schwartz
Joe Numainville
Sruti Paladugu
Kennedy Mindermann
Ellie Burns

Courtesy of Phui and Quong Tran
Devon Tuma
Six Ph.D. students working with CS&E professors have been named doctoral dissertation fellows for the 2018-2019 school year. The Doctoral Dissertation Fellowship is a highly competitive fellowship that gives the University’s most accomplished Ph.D. candidates an opportunity to devote full-time effort to an outstanding research project by providing time to finalize and write a dissertation during the fellowship year.

The award includes a stipend of $25,000, tuition for up to 14 thesis credits each semester, and subsidized health insurance through the Graduate Assistant Health Plan.

CS&E congratulates the following students on this outstanding accomplishment:

**Christopher Jonathan**  
*A Context-Aware Crowdsourcing Framework*  
Crowdsourcing has been gaining a lot of popularity and has become a part of our everyday lives. This popularity can be seen by the existence of several crowdsourcing platforms, e.g., Amazon Mechanical Turk and Uber. While many crowdsourcing tasks are currently solved by asking the general crowd, users will be able to achieve better quality results by asking workers with better knowledge about the tasks. This research works toward developing a full-fledged crowdsourcing framework that enables crowdsourcing tasks to be solved by the experts, thus, resulting in more accurate results.

**Wenchao Jiang**  
*Bridging Heterogeneous Wireless Technologies in IoT with Cross-Technology Communication*  
Wireless networks today are being crowded with diverse forms of wireless technologies, such as WiFi, ZigBee, and Bluetooth. Direct communication among these different wireless technologies was believed impossible due to their different modulation/demodulation techniques. Jiang’s dissertation explores how to build direct cross-technology communication among heterogenous wireless technologies, which will pave the way for universal network connections and a new kind of network coordination.

**Sara Morsy**  
*Data-driven Methods for Course Selection and Sequencing*  
The average six-year graduation rate across four-year higher-education institutions has been around 60% for the past 15 years, while less than half of college graduates finish within four years. In this research, Morsy develops data-driven machine learning methods that learn from past undergraduate students’ degree plans and course grades. These methods help predict what grade a student will potentially get in a future course, as well as assists students in strategizing which courses and degree pursuits he or she may be the most success.

**Xun Tang**  
*Mining Spatial Patterns from Big Data*  
Computational techniques to discover spatial patterns from large scale data provide critical insight in applications such as public health and public safety. Specifically, Tang’s research studies the problem of Spatial Hotspot Discovery which is one of the novel and valuable patterns in spatial data mining. His thesis proposes several new approaches to overcome the computational challenges and find interesting patterns that have been overlooked by more traditional approaches.

**Jie Xue**  
*Efficient Geometric Computing on Stochastic Datasets*  
Compared to conventional datasets, stochastic datasets are usually more expressive and can model real data more precisely. Xue’s research focuses on designing efficient algorithms for solving geometric problems on stochastic datasets and proving hardness results for such problems.

**Yang Zhang**  
*Securing and Accelerating Networks via Virtual Network Functions*  
In an era of ubiquitous connectivity, various new applications, new protocols, and online services (e.g., cloud services, distributed machine learning, cryptocurrency) are constantly being created. Demands for securing and accelerating networks—whether backbone networks of Internet service providers, campus/enterprise networks, data center networks, or even satellite networks—have been growing rapidly. Zhang’s thesis is centered on designing and developing new and effective virtualized network functions and systems for intelligent network processing, with the goal of enhancing security and performance of networks.
Dick Seebach (B.S. '69, M.S. '72) has returned home. After spending a successful career in New Jersey working for Bell Laboratories, marrying the love of his life, Dot, and raising a family, Dick has moved back to his ancestral home in the Midwest to be closer to family in Minnesota and Wisconsin.

Dick's Minnesota roots go back to his great grandfather who immigrated from Germany in the 1850s and settled in southeastern Minnesota. However, it was Dick's father, Leslie Seebach, who began the Seebach legacy at the University of Minnesota. Shortly after Leslie stepped onto campus, his brother, Richard, and sister, Lydia, followed him to the U. Leslie and Lydia graduated from the U's medical school. Richard majored in education.

"And then there was me," Dick said. "I came to the U because it was a state school and it was where my father had gone."

Dick's passion for the sciences started in the seventh grade, while he was living in Indiana where his father was stationed as a Navy doctor. Officer's kids were bussed to Indiana University for school and that's when Dick asked himself the question, "What's the most basic science?"

Physics, was the answer he landed on, so from that time on he began to seriously pursue the science through his undergraduate pursuits here at the U.

Finding community in band and science
As a son of Red Wing, Dick's first impression was that the U was very big. The size of the campus and breadth of opportunity led Dick to find ways to make it feel a little smaller, so he joined the marching band. "I played clarinet the first couple years, then I played alto sax. The band was only about 180 members, all men."

The band gave Dick a community and an opportunity to live with his band mates in the Centennial dorm. "I was a dorm person. Dorm life was good and I met a lot of kids. There were dances and parties. I also paid my way through school and one way of doing it was working the dorm cafeteria."
Where one starts is not always where one ends up, and this was true of Dick’s academic career. After majoring in physics and starting a graduate degree in physics, he realized it was not for him, so he talked to the CS department head at the time, Professor J. Ben Rosen, and made a slight pivot.

“Computer science was very interesting,” Dick said. “First off, programming was fun. It was very good for me. Also, the theory courses were intellectually challenging.”

Back when Dick started with the CS department, however, the discipline was quite different than it is today. The computers were the size of a lab space, the premiere programming language was FORTRAN, and inputting information into the Control Data machines was via punch cards.

“Back in the 60s, you didn’t have PCs, so we would either solve partial differential equations by hand or punch up cards and submit decks to the computer lab. We had no computer graphics. It was the engineering dark ages,” Dick reflected.

The department was also much smaller. Where Dick attended classes with 20 students or fewer, nowadays an average freshman intro course in computer science for majors has 430 students in three different lecture sections.

Dick received his master’s degree in computer science in 1972. Shortly after, with the help of the placement office, he interviewed and landed at Bell Laboratories in New Jersey, which formerly employed another University of Minnesota alumnus and Nobel Prizewinner, Dr. Walter Brattain. Brattain was a co-inventor of the transistor while at the Labs.

Working in data before ‘Big Data’

When Dick started with Bell Laboratories, the computing world itself was evolving. As businesses relied upon computers more and more, database systems were introduced to organize and analyze the growing amounts of data.

It’s a similar issue today. Businesses have vast troves of data, but they don’t know how to access it, store it, or in many ways use it. Dick was at the forefront of today’s current Big Data revolution.

“Even back then, Bell operating companies realized that there was so much data they needed to manipulate, they could no longer keep going with manual record keeping systems, so they brought Bell Labs in to help computerize their operations,” Dick said.

Where Big Data projects now are able to sift through many terabytes of data at unprecedented speeds, Dick’s first project with Bell Labs was much more modest. “My first job was a project to automate the production of telephone directories,” Dick said. “Before computers, telephone directories were created using lead type—the same way books and newspapers were.”

Up until Dick and his team undertook this massive project, phone directories were created by accessing warehouses full of lead-typed plates and stamping ink onto sheets of paper. Workers had to change the lead type for each page by hand—updating personal information, addresses, and phone numbers. Dick was bringing a form of printing invented at the dawn of the millennium to the modern age of computational storage.

“We’d take customer data, put it in our databases, and then generate a magnetic tape that could be fed into a photocomposer,” Dick said. “So instead of all the information being in a warehouse, it was sitting on an IBM 360 machine.”

Giving back

As computers advanced, so did Dick’s career, going into fields as varied as networking and security. While at Bell Labs, Dick saw the evolution of the UNIX operating system from an experimental program to one that controls the operation of many computer platforms.

Though the technological landscape has seen dramatic changes since Dick started his journey, one thing has remained the same: his desire to get back in touch with his Minnesotan roots.

“After moving back to the area (River Falls, WI), an important thing was building a stronger relationship with the College of Science and Engineering as well as the marching band and the Alumni Association,” said Dick. “We’ve been to many UMAA events and have attended programs such as the Tate Hall dedication and the marching band’s annual picnic. Being physically close allows us to have a better relationship with the University.”

Part of reconnecting with Minnesota for the Seebachs has been finding a way to give back to the University, so in addition to giving annually to the College of Science and Engineering and the marching band, the Seebachs established the Seebach Family Graduate Fellowship fund for the Department of Computer Science and Engineering to help a student offset the rising cost of tuition, something Dick remembered he was able to cover on his own by working on campus and working over the summer. This new $50,000 endowed fellowship, which honors Dick’s father, uncle and aunt as Minnesota graduates, will provide an annual fellowship to a deserving graduate student.

“It’s important for us to come back to the U and walk around campus and know our contributions are staying in the area and helping students who need help,” Dick said. “It’s part of our family legacy.”
NCWIT Honors Alumna for Technical Accomplishments

CS&E Ph.D. alumna Aarti Sathyanarayana was recently honored by the National Center for Women & Information Technology (NCWIT) for demonstrating a high level of innovation and potential societal impact for her research.

Sathyanarayana received the NCWIT Collegiate Award’s honorable mention distinction for her research project on a machine learning approach to computational sleep science. Her work leverages wearable technologies, such as Apple Watch and Fitbit, that compile massive amounts of data to discover underlying factors that disrupt an individual’s sleeping patterns.

“One in six consumers own a wearable device—it’s a four-billion-dollar industry,” Sathyanarayana points out in her research overview video on her website. “It opens the door to an unprecedented amount of personal data that can be particularly revolutionary for sleep science.”

She goes on to say that even though using wearables to study sleep patterns is not new, traditional analysis has been unable to keep pace with the explosion of wearable use for health monitoring. This is where Sathyanarayana’s research is changing the science of sleep. By combining deep learning techniques with a human activity recognition algorithm that looks at an individual’s activity in a given day, her method is able to predict sleep quality from wearable device data. Additionally, her study has been shown to streamline computational analysis of current sleep science processes by shortening the time it takes for medical practitioners and scientists to screen, diagnose, and eventually recommend treatments for individuals suffering from sleep disorders.

For example, if an individual had a physically or mentally arduous day, their wearable would collect this health monitoring data and Sathyanarayana’s computational approach would allow this individual to see how their daily activity could affect their upcoming night of sleep. Based on this information, the individual could make behavioral changes to ensure the night will be restful and healthy.

Since sleep deprivation can lead to many health risks, Sathyanarayana’s work has the potential for a tremendous impact on current health epidemics, from obesity and diabetes to Alzheimer’s and cancer.

“By building new computational methods and connecting the dots between physical activity and sleep we can help improve the health, sleep, and quality of life of society as a whole,” said Sathyanarayana.

Sathyanarayana received her Ph.D. from the University of Minnesota in 2017 and was a member of Professor Jaideep Srivastava’s Data Mining Research Group. Currently, she works as a research fellow in the Computational Health Informatics Program at Harvard Medical School.

Alum Receives Best Dissertation Distinction from SPEC

Recent alum Benjamin Heintz (Ph.D. 2016) received a rare honor from the Standard Performance Evaluation Corporation (SPEC) Research Group.

Due to the high quality of dissertations nominated for SPEC’s 2017 Kaivalya Dixit Distinguished Dissertation Award, Heintz’s dissertation titled “Optimizing Timeliness, Accuracy, and Cost in Geo-Distributed Data-Intensive Computing Systems” was selected to be honored as a runner-up to this year’s best dissertation. The award recognizes outstanding doctoral dissertations within the scope of the SPEC Research Group in terms of scientific originality, scientific significance, practical relevance, impact, and quality of the presentation.

The SPEC awards committee noted in its public announcement “the innovativeness and the practical applicability of the methods and metrics proposed by Dr. Heintz to address the tradeoff between staleness of data and the quantity to be processed.”

Particularly, the awards committee appreciated Heintz’s “thorough, meticulous, insightful, and methodologically rigorous analyses presented in the dissertation.”

Heintz was advised by Professor Abhishek Chandra and received his Ph.D. in December of 2016. He currently is a software engineer at Facebook.
“Autonomous bus” (continued from page 1)

“Using autonomous vehicles in this way will provide inexpensive mobility services to all people especially people with socio-economic disadvantages,” said Saif Benjaafar, a University of Minnesota professor of industrial and systems engineering in the College of Science and Engineering and a Center of Transportation senior scholar who is a co-director on the project. “A system like this would help build stronger family and community ties, and boost economic productivity and equity by mitigating or removing mobility constraints.”

The researchers say the work will also draw collaborators from across the state to help build stronger, smarter communities.

“The research will draw on innovative mobility field experiments underway in the Twin Cities region and will collaborate with several public, private and civil society partners,” said Tom Fisher, a University of Minnesota professor of urban design in the College of Design and a Center for Transportation Studies scholar who is also involved in the new project. “These partners will include the cities of Minneapolis and St. Paul, the Destination Medical Center in Rochester, and the Minnesota Department of Transportation, the Metropolitan Council, and Metro Transit to design, plan, and analyze a shared autonomous vehicle system for greater community health, equity, livability, and prosperity.”

The research will occur over a three-year period and will result in policy recommendations, design guidelines, and quantifiable information.

“We’re hoping that our work can inform local and statewide decision making for our cities and communities,” said Yingling Fan, a University of Minnesota professor of urban and regional planning in the Humphrey School of Public Affairs and a Center for Transportation Studies scholar.

“The Smart and Connected Communities program continues to generate innovative and collaborative research applications that are addressing challenges faced by our local communities and cities and are offering solutions to help improve people’s lives,” said Jim Kurose, NSF’s assistant director for computer and information science and engineering.

“Cracking the Code” (continued from page 8)

“textbooks without being told. They all want to be here, and they are all working very hard,” Gini said. “It’s a pleasure to have these kinds of girls.”

Gini said last year, about 20 percent of the computer science majors at the University of Minnesota were women. Although she agreed that this number wasn’t bad, it wasn’t good either, and she wants to increase that percentage.

“Companies need women,” Gini said. “When you design things, you kind of design what you think would be useful to you, so if there are no women, a lot of things would not get designed.”

Gini explained that an important part of expanding the pipeline of women engineers is inspiring confidence in young girls. This is something that, by the end of the computer science academy, Gini’s students clearly demonstrate.

During the last few days of the program, each camper came up with a creative project that incorporated programming, whether it be reverting colors in pictures, creating mosaic designs or 3D printing. Gini said that last year, a couple of her students designed an LED T-shirt meant to be worn by cyclists at night.

“They are more confident because there’s one thing they’ve done on their own, and they’re proud to show it,” Gini said.

Gini added that some of her former campers have gone on to win technology awards at their high schools or even decided to pursue computer engineering at the University of Minnesota.

Not to be outdone, this year’s group of students have some pretty big dreams as well. A few future applications the girls cited included architectural design, prosthetic limbs and—a long shot, but a dream nonetheless—teleportation devices.
Software Engineering is a creative discipline, combining art and science, requiring leadership and pragmatism. Our focus is not to train, but to educate. We help students build a strong foundation of theory and best-practice knowledge that they can apply in a variety of technical and business environments today and in the future.

**AN ADVANCED DEGREE IN TWO YEARS** while still working full-time and immediately applying what you’re learning in the classroom to your job.

**STUDY WITH THE BEST** by learning from top faculty and industry professionals at the region’s premier research institution in Computer Science and Engineering.

**CONTINUED SUPPORT** with a strong alumni network, opportunities to present at events, the option to take future elective offerings or become involved in research projects, MSSE boasts a lifelong link to professional and educational opportunities.

**COST** of the program includes tuition, mandatory collegiate and university fees, textbooks, guaranteed parking, and catered breakfast. The Fall 2018 cost of attendance is $10,600. Tuition and fees have not been finalized for Fall of 2019 students. Financial Aid may be available: [onestop.umn.edu/finances](onestop.umn.edu/finances)

**APPLICATION PROCEDURE**

[msse.umn.edu/application-procedure](msse.umn.edu/application-procedure)

Early application deadline - February 28, 2019
Final application deadline - June 30, 2019

---

**CODE FREEZE 2019: MACHINE LEARNING**

**WEDNESDAY, JANUARY 16, 8:30AM–5:00PM**

Machine learning is becoming ubiquitous in software-controlled systems. A variety of techniques enable such systems to learn complex patterns, mimic sophisticated behaviors, and exhibit superior skills to address challenging tasks in a variety of application domains. The increasing use of ML also brings into focus questions related to reliability, robustness, trust, safety, and ethics. In this event we will examine how these algorithms work, when they might fail and how we might deal with the consequences, and what new domains and opportunities these techniques open up for software applications. We will hear from leading researchers and engineers who are using ML “in the trenches.”

Keynote speakers: **Scott Ernst**, Director of Data Science and Engineering at When I Work, **Bonnie Holub**, Principal Data Scientist and Director of Data Sciences at Teradata, **Tim Menzies**, Professor of Computer Science at North Carolina State University.

**SEE THE CONFERENCE WEBSITE FOR SCHEDULE, SESSION TOPICS, AND MORE INFORMATION:** [Z.umn.edu/codelocke2019](Z.umn.edu/codelocke2019)
COMPUTER SCIENCE & ENGINEERING
INTEGRATED PROGRAM

The Department of Computer Science & Engineering offers an integrated Bachelor’s and Master’s Degree program. The program allows acceleration toward graduate study. The program allows students with strong academic performance records to take additional credits (above and beyond what is needed for their undergraduate degree) at undergraduate tuition rates in their last few semesters which can be used towards the Computer Science MS program. This is exclusively available to students officially admitted to the CSE Computer Science BS, the CSE Bachelor’s of Computer Engineering, the CLA Computer Science BA, or the CLA Second Major in Computer Science.

WHY CONSIDER GRADUATE SCHOOL AND THE CS&E INTEGRATED PROGRAM?

- Leave school with better credentials
- A graduate degree can lead to greater career advancements and autonomy in some companies
- Become an expert in a field of computing
- Make teaching and research your job if you love academia
- Potential to get paid to go to graduate school through teaching assistantships, research assistantships, and fellowships
- Through this program, the cost of attending a graduate program is reduced (up to 16 of the 31 credits for the Computer Science MS program can be completed paying an undergraduate tuition rate)

If you’re interested in applying to this program please contact your undergraduate department advisor to start planning and preparing your application!

APPLICATION TIMING

- March 15th deadline for fall consideration
- October 15th deadline for spring consideration

Please visit cs.umn.edu/integrated for full eligibility requirements and application procedures
In its almost 50 year history, the Department of Computer Science and Engineering at Minnesota has benefitted significantly from the partnership and determination of an insightful network of donors, alumni, and friends who share our drive for creative problem solving and bold leadership. Because of the generosity of our donors, we have the flexibility to ignite innovative research and the competitive edge to attract and retain world-class minds.

With our 50th Anniversary as a department on the horizon and as part of Driven: The Campaign for the University of Minnesota, Computer Science and Engineering, we invite you to join us in investing in the future of computing at Minnesota and beyond. 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 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 equipment 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; and
- Funding for student enrichment programming such as lecture series, industry workshops and seminars, and travel to conferences.

On the next page, we celebrate those who have contributed generously over the past year to our department. We thank you for investing in our excellence and our future and invite all of you – our alumni, friends, volunteers, and supporters – to give what you can in 2019. Thank you!

— Emily Strand, CSE External Relations
Many thanks to our supporters

We would like to express our sincere gratitude to the following companies, alumni, and friends of CS&E who have provided generous financial support for our work. We look forward to continuing this partnership.

Gifts listed are from July 1, 2015 to June 30, 2016

Leadership Donors

3M
Adobe
Best Buy
Cisco
Dell
Driscoll’s
Ernst&Young
Facebook
Google
Huawei
IBM
Intel
Makkah
Medtronic
Microsoft
National Center for Women & Information Tech
Optum
QuangTran
Supervalu
Target
Thomson Reuters
Toshiba
Unisys
Veritas
Vital Images
Mark A. Bakke
Janet A. Christenson
Giovanni A. Galasso
Joseph E. Gliniecki
Robert E. Greiling, Jr.
Richard J. Hedger
Sandra L. Johnson
Shyong K. Lam
Yan Sang & Eunice Lee
Lishin Lin
Lee-Chin H. & Chung Wen Liu
Steven C. Peterson & Kalli M. Bennett
Luong B. Tran & Minh-Tam T. Lu

Annual Donors

Adventium
Ameriprise
AT&T
BlackRock
CAPmation
Emerson
Intersoll-Rand
Medtronic
Network for Good
Pearson
Process Assessment
Procter & Gamble
Raytheon
Securian
Tightrope
United Way
Gagan A. Awhad
Tien T. Bach
John D. Backes
Lee J. Barrington
Janet L. Bellinger
Eugene A. Burd
Po-Chun Chang
Peter D. Clark
Howard B. Coleman
Roger L. Collinson
Ralph M. Conrad
Michele L. Dahlberg
Bhaskar DasGupta
David W. DeHerder, Jr.
Lori L. Dietrich & Steven J. Piazza
Prasanth V. Duvvar
Michael D. Ellestad
Steven R. Englund
John J. Feigal
Fanchon F. Finucane
David C. Fu
Rao Fu
Biao Gao
Lee R. Gordon
Kathy F. Hacmac
Gregory A. Hansen
John G. Harley
George F. Heyne
Steven N. Hidy
David L. Hintz
J. Andrew Whitford
Holey
Joseph J. Holiday
Kurt A. Indermaur
Stephen G. Jewett
Miao Jiang
Verlyn M. Johnson
Norman E. Johnson
Jeremy E. Kallstrom
Varsha K. Kelkar
Dan C. Knutson
Carol D. Kompelien
Frank J. Kumor
James L. Lester
John P. Little
Paul M. McDougall
John C. Miller
Abedelaziz S.H. Mohaisen
Mitchell E. & Jodi Morehouse
Todd A. Murray
Srihari Nelakuditi
Randal J. Ness
Linda J. O’Gara
Sharon & Patrick J. O’Toole
Robert S. Ogren
Paula E. Pahos
Sally L. Palm
Eric J. Panken
J.J. Parker
James M. Plasek
Daniel S. Poznanovic
Vijay Rajagopal
Jon M. Rask
Mark A. Reker
Alina Rimbu
Robin S. Ehrlich
Michael J. Rogalski
Richard J. Roiger
Frederick W. Roos
Bruce D. Rovner
Paige Rudnick
Matthew E. Sanders
Cassandra M. Scharber
John J. Shackleton
Erik A. Shimshock
Raymond L. Slisz
Marc G. Smith
Warren R. Smith
Christine M. Sorenson
Reza S. Sorour
J. Tyler Sperry
John P. Strait
Steve Jiahuan Sun
Paul H. Thai
Vicraj T. Thomas
Venkateswaran
Udayasankar
Kurt M. Vandenberg
Zachary D. Varberg
Anna Vaynerman
Steven T. Vinge
Beth & Gerald A. Voermans
Bruce E. Wachs
Ethan C. Waytas
Susan C. Webb
Benjamin M. Weseloh
Hewitt A. White
Wayne Xin
Li Xu
Soundbyte is produced twice yearly by the University of Minnesota’s Department of Computer Science and Engineering.

Please direct all questions or comments to:

Soundbyte Editor
Department: (612) 625-2424
Fax: (612) 625-0572
E-mail: cscicomm@umn.edu
http://www.cs.umn.edu

The University of Minnesota is an equal opportunity educator and employer. This publication is available in alternate formats upon request; call Mark Rapacz at (612) 301-9515. For disability accommodations, call (612) 626-1333.

© 2017 by the Regents of the University of Minnesota. All rights reserved.

Yes! I want to support Computer Science and Engineering at the University of Minnesota!

Amount (please circle):

$25  $50  $100  $200  $500  $1,000  Other: ______

Please choose a payment method:

Credit Card:
Type: VISA _______ MasterCard _______ American Express _______ Discover _______
Number: ___________________________________________
Expiration Date: _____/_____
Signature: ______________________________________

Check: Please make checks payable to the University of Minnesota Foundation.

Name: __________________________________________________________________________
Address: _______________________________________________________________________
City: ___________________________________ State: _______ ZIP: _____________________
Phone: ____________________ E-mail: ___________________________________________

Please return to:
University of Minnesota Foundation
500 McNamara Alumni Center
200 Oak Street S.E.
Minneapolis, MN  55455
Fund # 1596