Cyber Operations Strength and Recognition Expand

New designation of excellence, undergraduate curriculum, and grant enhance cyber security education and research

Call it a trifecta. Northeastern has now earned its third designation for excellence in cyber security. But that’s only one of three new developments related to this priority area for the university and the United States.

Northeastern was also awarded a $4.5 million National Science Foundation (NSF) grant to train the country’s future cyber security workforce, and the College of Computer and Information Science (CCIS) has introduced a cyber operations specialization in its Bachelor of Science (BS) in Computer Science program. Each of these initiatives involves CCIS faculty, students, and programs.

Already designated a National Center of Academic Excellence in Information Assurance Education and Research by the National Security Agency (NSA), Northeastern is now a National Center for Academic Excellence in Cyber Operations. To achieve this recognition, the university went through a rigorous application and review process that examined faculty research and ensured that academic programs cover essential topics in cyber operations, such as reverse engineering, wireless networks, and ethics. Northeastern was one of only four institutions in the country to earn the designation for cyber operations excellence.

“This complements the other designations,” says Agnes Chan, the CCIS associate dean and director of graduate programs who has led the successful efforts to bring national attention to Northeastern’s cyber security strengths. “Cyber operations focuses on the technical and intelligence side of cyber security.”

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When I look at our college today, I see excellence across the board. Our faculty, students, and research grow more impressive each year. Our undergraduate and graduate programs are strong and innovative. We contribute to both core computing knowledge and matters of importance to society. We enable our students to pursue new challenges and fulfill their goals. And we seize new opportunities to expand our reach and impact.

I am not alone in my positive view. In just the past year, members of our faculty have been honored for their teaching, research, and professional achievements by organizations such as the National Science Foundation (page 6) and the Association of Computing Machinery (page 3). We also have been recognized for excellence in cyber operations (page 1). Meanwhile, our students are showing employers they’re prepared to take on increased co-op responsibilities (page 4) and distinguishing themselves in activities such as cyber security competitions (page 12). Companies and research laboratories are realizing the value of what we do, and their increased support benefits our college, our faculty, and our students (page 15).

We are successful, but we continue to build on our accomplishments. This fall, we welcomed the first students in our PhD in Personal Health Informatics program (page 7) and introduced a new game design curriculum for our undergraduates (page 5). And our college is taking a leadership role in online graduate education at Northeastern’s new regional campuses (page 16), a venture that will also help us enhance our students’ learning experience in Boston through innovative use of technology.

Once again, we have seen our faculty grow in size and capabilities. We’ve added seven new faculty members whose teaching and research involve core computing areas as well as our high-priority interdisciplinary initiatives in cyber security, health informatics, and game design (page 8). Recognizing the rapid rise of data in every aspect of society, we’ve made significant hires in the area of data mining and information retrieval.

We’re already looking ahead to next year and growing even stronger. We’re assessing our information science curriculum to assure it takes full advantage of our newer faculty members’ expertise and captures emerging developments in the field. We’re also in the midst of a search for three additional faculty members who will add to our expanding expertise in network and systems, software, and “Big Data.” At the College of Computer and Information Science, our forward momentum continues.

Larry Finkelstein
Dean

Presenting the Latest Ideas in Programming Languages

For the second year in a row, Assistant Professor Amal Ahmed was among the internationally recognized researchers invited to lecture at the Oregon Programming Languages Summer School. The annual session is designed to expose its primary audience of first- and second-year doctoral students to current problems and research in programming languages. The summer school also attracts advanced undergraduates, master’s degree candidates, and more seasoned doctoral students.

Nearly 100 people from around the world attended in 2012, including two of Ahmed’s own doctoral students, William Bowman and Phillip Mates. A third College of Computer and Information Science (CCIS) PhD candidate, Ian Johnson, also participated.

“They saw an excellent cross-section of topics, from the foundations of type systems and logic to applications in compiler verification and language-based security. This will help them develop better research ideas of their own. Many of the lectures covered recent developments, the topics and techniques that are too new to be taught at every university,” says Ahmed, who gave a series of presentations about the foundations and applications of logical relations.

Ahmed, who joined the CCIS faculty in 2011, is known for her research in logical relations, a technique for reasoning about a wide variety of programming language and compiler properties. Her work is applicable to verifying the correctness of compilers that transform safety-critical programs to machine code. It also provides an alternate technique to the widely used progress-and-preservation method of proving type safety in programming languages. She says, “There is emerging consensus in the programming community that it’s important for graduate students to know about this.”

Ahmed believes involvement with the Oregon Programming Language Summer School helps her have greater impact. She says, “It’s a wonderful opportunity to hone my teaching skills, and it’s helping an important technique gain wider use.”

With the next session still months away, Ahmed already knows she’ll be back in 2013 and that both she and CCIS will have even greater visibility. Ahmed explains, “I’ve been invited to help organize next year. It’s quite an honor.”
Two years ago, the Association of Computing Machinery (ACM) chose Matthias Felleisen as the winner of its Karl V. Karlstrom Outstanding Educator Award. Earlier, he was named an ACM Fellow. Now, the College of Computer and Information Science (CCIS) Trustee Professor has earned two more ACM awards recognizing his work in programming languages.

Felleisen is the 2012 recipient of the ACM Special Interest Group on Programming Languages (SIGPLAN) Lifetime Achievement Award as well as its Most Influential Paper Award. He shares the latter honor with his co-author, Associate Professor Robby Findler of Northwestern University.

The ACM Lifetime Achievement Award goes to an individual who has made a significant and lasting contribution to the field. The award citation described Felleisen as “an exemplary researcher whose work covers theory, practice, and education, with each reinforcing the others.” It went on to note, “He has made fundamental contributions across the entire spectrum of the programming language field.”

Felleisen received his award in September at an ACM conference in Copenhagen. He says of the recognition, “It’s delightful that people across the programming languages community can see that I’ve done a lot of work and that it’s influenced other people in their work. But I actually don’t think about awards. What I really enjoy is the process. When I’m sitting at my desk, thinking about problems and finding better ways to resolve them, that’s the joy.”

Among the many things he’s accomplished, two stand out for Felleisen. The first is his early theoretical work developing a descriptive framework defining a programming language and what it does. He recalls that at first this framework was largely dismissed. But today, he says, “It’s become part of the fabric of how people think.”

He points to his shift from theory to practice as another key moment in his career. Felleisen developed the Racket programming language, initially as part of a project to change how middle and high school students view math. Today, companies as well as students use Racket, and Felleisen gets inquiries about it from people around the world.

“You never know where a little idea that you and a graduate student come up with on an overnight flight might lead. A small system to help people teach turned into a real product,” he says.

The Most Influential Paper Award also validates ideas Felleisen first explored years ago. It’s intended to honor work that was presented at an ACM conference 10 years earlier and has withstood the test of time.

The award citation for the 2002 paper “Contracts for Higher Order Functions” read, “Assertion-based contracts have proven very useful for dynamically enforcing first-order program invariants in procedural languages, but until 2002 they had not been supported in languages with higher order functions. Findler and Felleisen’s paper filled this gap, presenting the first assertion-based contract checker for languages with higher order functions.”

The paper examined the contract monitor—what Felleisen describes as being much like a judicial system enforcing third-party contracts. Since 2002, Felleisen has followed up with research exploring the mathematical foundations of this idea. He also estimates that the paper has been cited 200 to 300 times.

“People have built experimental programming languages based on our insights. Many people have come to the field and discovered all kinds of ways to use these monitors,” Felleisen says. “The award is an additional acknowledgment of observations I’ve been working on for years, that we need contractual agreements for software in higher order programs.”
What defines a high-quality co-op position? Students and employers may volunteer a variety of opinions, but there's a key factor: It must be challenging. A high-quality College of Computer and Information Science (CCIS) co-op position offers responsibilities that match students' technical, developmental, and professional abilities as well as supervisors who provide them mentoring and opportunities to excel.

That's good news for CCIS undergraduate and graduate students because more of them are prepared for challenging assignments than ever before. In their initial positions, undergraduates now take on responsibilities that only students with prior co-op experience once had the capacity to assume.

“Some students come in with significant programming experience. They've developed software and other apps on their own,” says Mark Erickson, who directs the CCIS co-op program. “They’re ready academically and intellectually for more challenging jobs. They can move into software development positions much earlier. We’ve always had excellent co-ops and excellent students, but now students at every level are finding higher quality co-op assignments.”

Typical entry-level positions of the past have largely disappeared. Instead, CCIS students are working for technology start-ups and prominent companies that are selective in their hiring. For a co-op success story, Erickson points to Amazon in Seattle, where the number of CCIS students has grown from 5 to 21, all involved in software development and software engineering.

“There’s a large shortage of talented, trained tech workers in the United States, so companies are trying to set up a pipeline of college hires,” says Erickson.

That enables today's co-op students to fulfill another of their goals: to sample a variety of work environments rather than returning to the same company each time. Erickson says, “Students want exposure to different environments so they can determine the best fit and make a decision about where they want to work later. Many students are very interested in small start-ups because these companies work with new technologies, including app development.”

Strong students and greater responsibilities translate into higher paying positions, reports Mel Simms, a long-time co-op faculty member who works closely with CCIS master’s degree students and has studied the changes in co-op opportunities at both the graduate and undergraduate levels. He’s also found that more employers want to hire co-op students for projects they need to complete immediately.

“This makes assignments challenging. Our students have strong technology skills and the ability to learn and adapt quickly,” says Simms.

Nearly all of those in the Master of Science in Computer Science program are international students who are legally limited to what is known as curricular practical training. As a result, they can complete up to 11 months of co-op—typically two assignments—rather than the three 6-month co-ops typical for CCIS undergraduates. But many more graduate students are choosing to participate.

“Co-op has expanded dramatically at the master’s level. Fifteen years ago, about five graduate students did co-op. We now expect 200 to 220 students will participate,” says Simms. “Students come for academics, but they also come for co-op. It’s a powerful combination.”

A co-op seminar that focuses on interviewing and communication skills prepares graduate students for the U.S. workplace. Simms also points to Program Design Paradigms—the programming course also known as “Boot Camp”—as effective in developing essential skills that help graduate students obtain high-quality co-op positions.

The success of both undergraduate and graduate students explains why Erickson and Simms can boast of a 100 percent co-op placement rate for the past eight years. Erickson says, “Employers focus on results. What we’re finding across the board is that employers say our students are phenomenal.”
Game Design Combined Major Evolves with Industry and Student Needs

The game industry is changing rapidly, and the combined major in computer science and game design is evolving along with it. The undergraduate program introduced in 2009 has undergone a transformation, with a newly redesigned curriculum for this year’s entering freshmen.

“We wanted to provide a deeper foundation in computer science. Some students who took my class last year didn’t feel strong enough computationally,” says Associate Professor Magy Seif El-Nasr, who both teaches and conducts research in game design and holds joint appointments in the College of Computer and Information Science (CCIS) and the College of Arts, Media & Design.

She identified several specific needs, noting, “A lot of companies require students to understand the programming language C++. Network programming is also very important for social and multiplayer games. More interdisciplinary skills were needed as well. We want to make sure students have a foundation in one area, but also the collaborative skills to do an interdisciplinary project like a game.”

The revised curriculum features new requirements, including a C++ programming course that will be offered for the first time in fall 2013. Replacement courses in game programming and game algorithms are more rigorous than before. Systems & Networks is now a required course because a deep understanding of networks and operating systems is increasingly important to an education in game design. Calculus I has also become a requirement to ensure students understand the calculus related to motion.

“We’ve added significant courses to the curriculum and created a very demanding program on par with the best in the country. The program is packed with computing foundations,” says Associate Dean and Director of Undergraduate Studies Richard Rasala. “We’re driven by industry needs and student needs. If evolution is necessary, evolution will happen.”

According to Rasala, approximately 25 entering students choose the combined major in computer science and game design each year. The new curriculum will enable them to complete their core courses earlier than before. They’ll have more preparation for advanced courses and more to include on their résumés when they interview for co-op positions.

“I was at the Game Developers Conference and talked to the people who would hire our students. They were all very positive about the changes we were making to the curriculum,” says Seif El-Nasr. “The previous program was a mix of things. With this new curriculum, it’s much clearer that we’re providing a computational perspective on game design and depth in computer science. For those who are more focused on the aesthetics of game design, we’re building another path through design so they can go in that direction.”

She believes the increased emphasis on computing skills will also give students more flexibility after graduation. Seif El-Nasr explains, “The game industry is growing, but it’s not big. We want to make sure that our students are prepared for a career in software engineering and programming in games. But they can still work for companies like Google or Microsoft; they have career options.”

New game design faculty are adding further strength to the combined major. Rasala says, “The people we’ve hired have an analytical sense of how to understand, plan, and build games as well as a respect for the artistic, intuitive, and creative aspects of games. We have a plan and people in place, and we think we’re poised to have an extraordinarily exciting program.”

“With this new curriculum, it’s much clearer that we’re providing a computational perspective on game design and depth in computer science.”

— Associate Professor Magy Seif El-Nasr
Two More Faculty Members Earn CAREER Award Recognition

Marsette “Marty” Vona and Peter Desnoyers join the growing list of National Science Foundation (NSF) Early Faculty Career Development Award winners at the College of Computer and Information Science (CCIS). Better known as a CAREER Award, this is among the NSF’s most prestigious honors. It recognizes and supports junior faculty who excel in their research, teaching, and integration of education and research.

Vona is developing robots with the “intelligence” to see and step skillfully when they encounter uneven surfaces. Desnoyers, who focuses on solid-state storage, is examining algorithms and architectures to transform how flash memory performs. With the five years of NSF funding that accompanies a CAREER Award, the assistant professors will be able to continue and make new advances in this work.

The Next Step for Robots

“I’m interested in robots that can navigate rough terrain to help people,” says Vona, whose experience creating software for NASA’s Mars rovers inspired this research now supported by a CAREER Award.

Vona imagines nimble robots enabling NASA to explore new areas of planets, freed from its limit to only relatively flat surfaces. He envisions these robots at work in hazardous environments such as nuclear clean-up zones, where today only people can traverse the rubble and other obstacles on the ground. He theorizes that his work could lead to new insights about how humans use their eyes and legs to walk and navigate terrain.

But first he’s developing the algorithm for the software underlying these robots. He’ll also build a robot, equipping it with features resembling a biological system. A camera or other type of vision system and flexible legs will give the robot the ability to “decide” where to step.

“To convince ourselves and the scientific community that this will work, we have to implement it,” says Vona. “Initially, we’ll use simulated robots to test the programs and algorithms. Then we’ll build a real, physical robot in our lab.”

Vona hopes to complete the initial version—a robot with 12” legs that can cross a table scattered with rocks—within a year. Meanwhile, he’s developing another robot for educational purposes. With it, he says, students in his Introduction to Robotics class will experience “the essence of a robot reaching out and touching what it just looked at with a camera.”

Higher Performance Storage

Backed by his CAREER Award, Desnoyers is seeking breakthroughs in solid-state drives, the storage devices that use flash memory. He says, “Flash right now is just substituting for disk. My ultimate goal is to take advantage of flash in ways that we couldn’t before.”

He’s started with math. A computer program becomes less efficient as it uses its storage flash drive more randomly—but how much more efficient could it be? Desnoyers says, “The empirical research hadn’t looked at why algorithms work and what makes one more efficient than another. If you analyze the mathematics—the algorithms—you find out how well you can do.”

Desnoyers has now established how to mathematically predict the performance of solid-state drives. What’s more, he says, “We’re able to identify the optimal flash-management algorithm for many real-world cases and are working on expanding the range of results.”

Desnoyers earned a best paper award at the 2012 International Systems and Storage Conference for this work. But he’s moved

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Focusing on the Personal in Health Informatics

With its PhD program launching this fall, Northeastern University is attracting new attention for education and research focused on personal health informatics. The program offered jointly by the College of Computer and Information Science (CCIS) and Bouvé College of Health Sciences has now welcomed its first group of doctoral students. The program’s creation also contributed to the decision by the National Institutes of Health (NIH) to hold its mHealth Summer Institute at Northeastern.

The new PhD in Personal Health Informatics program has enrolled five students who share an interest in being at the forefront of understanding how technology can help people monitor and improve their health and wellness at every stage of life. All have professional backgrounds related to health or technology, though their experiences and reasons for pursuing the program vary widely.

“Some are interested in mobile applications, including those for the developing world,” says Associate Professor Stephen Intille, who has led the program’s development. “One has a computer science degree and an MBA and wants to use health informatics to solve problems in hospitals. Another has a background in industrial design and applied that expertise to creating health technology measurement devices. One of our students is interested in the use of mobile devices for weight loss. Another worked for a small start-up company in the health field. This student has a background in psychology and is interested in behavioral monitoring for autism. Almost all have done health research before.”

They are beginning with the Theoretical Foundations of Personal Health Informatics course taught by Assistant Professor Matthew Goodwin, who like Intille holds a joint appointment in CCIS and Bouvé College. Students in the program will subsequently learn about personal health interface design, development, and evaluation as well as the standards for health data systems. They’ll also acquire the technical skills needed to prototype and assess their ideas to improve care and introduce technologies in health-care settings. A user interface practicum course will allow students to shadow health-care professionals and identify possible research projects.

“Students will come out of this program with very strong research skills in an area that’s important to the country,” says Intille. “They’ll have the resources of Northeastern available to them to do outstanding research that provides patients with more information and makes hospitals more efficient. We’re focusing on the personal because we believe technology intended to help people help themselves can improve health and health care, and that will become increasingly important.”

Northeastern isn’t alone in its views about the future of health care and the potential of technology. The NIH has been bringing together researchers from multiple disciplines to explore how mobile technologies can advance health and wellness. This summer, it chose to hold its mobile health training session at Northeastern.

Intille was one of four organizers and core faculty members of this year’s mHealth Summer Institute, and he advised one of the interdisciplinary teams developing prospective research proposals during the five-day meeting. Goodwin, who attended the December 2011 NIH institute, was also present at the summer session.

“It was a thought-provoking meeting with a lot of good ideas discussed by high-caliber people from very different backgrounds,” says Intille, noting that the NIH event also afforded CCIS increased visibility. “Everyone was in the computer science building the entire week. They were aware of Northeastern’s efforts and our new PhD program, and the feedback was positive. I think they know interesting things are happening here.”
The College of Computer and Information Science (CCIS) is once again welcoming several faculty members who merge computing knowledge with understanding of another discipline. Their work also crosses the boundaries of research areas within computing, reflecting the nature of inquiry in the field and their broad interests.

The 2012–2013 contingent adds to the college’s core strengths in cyber security and health informatics, as well as to its expertise in artificial intelligence, social networks, and game design. The new professors also enhance education and research in data and information retrieval, another area of growing importance to society.

Seeking Greater Security
With threats to cyber security on the rise, the number of CCIS faculty members who focus their research on preventing and detecting breaches continues to grow. Assistant Professors Christo Wilson and Daniel Wichs are the latest additions to their ranks.

Wilson researches the properties of user interactions on social network sites to detect malicious activity. He says the type and frequency of behaviors on social networks are revealing.

“If you never look at photos, that indicates you’re not interacting with friends. If you never use instant messaging, that’s very strange,” explains Wilson, who recently completed his PhD at the University of California in Santa Barbara. “Also, the speed at which people navigate a Web site—the cadence—tends to be bursty. If there’s a fake account, people tend to use automated software and have different patterns. You can take this information and build detection systems.”

He developed such a system for Renren, China’s largest social network. In its first year of use, it successfully detected more than 1 million fake accounts.

Wilson also looks at other aspects of social networks, a subject he began to study after learning about an early project by Alan Mislove. Now that they’re both CCIS faculty members, they’re working together to explore the Internet filter bubble, a term social scientists coined to explain how searches using the same keywords can produce different results.

Wilson’s expertise extends to networks more broadly. He’s examining ways to improve network protocols for data centers and also teaching an introductory course on networks.

Wichs, who comes to CCIS in January, focuses on cryptography, applying deep mathematical insights to practical security concerns. His most recent research relates to leakage resilience cryptography, which involves preventing hackers from gaining useful information from devices. Wichs is interested in building cryptography systems that can be maintained even when attackers obtain partial information. He’s also examining the security and integrity of data stored on the cloud rather than a private computer or network.

Wichs earned his PhD in computer science at New York University in 2011 and is completing a postdoctoral fellowship at the IBM Research T.J. Watson Center, home of one of the world’s major cryptography groups. He says of joining the CCIS faculty, “This provides a great opportunity for new inspiration.”

Graduating to Health Informatics
When Andrea Grimes-Parker arrives from the Georgia Institute of Technology in January, she’ll be new to the faculty but not to CCIS. Grimes-Parker first arrived as an undergraduate, earning a BS in
computer science and national honors as the Computing Research Association’s Outstanding Female Undergraduate for her potential as a researcher.

The opportunity to combine her knowledge of computing and interest in promoting health drew Grimes-Parker back to Northeastern. Her doctoral research in human-centered computing focused on health technology design. Now, she’ll help shape the research agenda and curriculum for the new PhD in Personal Health Informatics program (page 7) as an assistant professor with a joint appointment in CCIS and Bouvé College of Health Sciences.

Grimes-Parker designs locally tailored information and communication technologies to help communities come together to promote health. Currently, she’s examining how information and communication technology can increase media and health literacy among adolescents in low-income communities.

“I found my way to human–computer interaction because it seemed like a good way to marry my interests,” says Grimes-Parker, whose research enables her to combine her computer science training and community outreach experience. “I have a personal interest in nutrition and diet-related health issues in lower income and minority communities. I wanted to look at how technology could address these issues. It’s a passion for me. I feel blessed to do work that I care about personally and academically.”

Crossing the Cyber and Physical Worlds

Raymond Fu doesn’t fit neatly into a single category. The assistant professor’s work crosses multiple fields and interests. He considers machine learning and cyber-physical systems his primary research areas but then applies them to health informatics, security, robotics, human–computer interaction, and social networks. And he holds a faculty appointment in two colleges at Northeastern, CCIS and the College of Engineering.

Fu joins Northeastern in January following three years as an assistant professor at the State University of New York in Buffalo. Earlier, he completed a PhD in electrical and computer engineering at the University of Illinois at Urbana-Champaign.

Fu not only explores a wide range of areas, but also has earned recognition in them. His work has merited three best paper awards, most recently at the IEEE International Conference on Data Mining in 2011.

He also has several active research grants, including a $1.2 million National Science Foundation (NSF) grant to investigate technology to reduce the cost and increase the comfort of knee therapy and another from the Office of Naval Research to apply manifold learning techniques to large-scale data. The latter research will provide tools for use in cyber security, social media, and cyber-physical systems.

Though his interests are broad, some stand out above others. Fu says, “Manifold learning is one of my favorite topics. I did my PhD on this topic and published two books in this area.”

Gaming Creatively

Game design is both a growing field and among the most popular of the combined majors for CCIS undergraduates. Along with a renewed curriculum (page 5), game design has gained a new faculty member, Gillian Smith.

She comes to Northeastern from the University of California in Santa Cruz, where she recently completed her PhD in computer science. Smith’s research focuses on the impact of procedural content generation on game design, specifically on how it can be used to create content that wouldn’t be possible without a computer.

“A game is a very visual and creative medium, but it also concerns how humans interact with computers,” says Smith, whose appointment as an assistant professor is in CCIS and the College of Arts, Media & Design.

In addition to pursuing game design research, Smith is teaching courses on artificial intelligence and computer graphics this year. She says, “All of my training is in computer science, but I have a very deep interest in design. At Northeastern, I can do both.”
Digging for Data, Retrieving Information

Data is everywhere, and there’s more of it every day. The growth of the Web and social media provides new opportunities to develop sophisticated algorithms and automated tools that make it possible to learn from vast quantities of data and form better predictions. It also creates a tremendous need for fast and reliable means to sift through countless documents and retrieve meaningful information.

These developments are leading CCIS to expand faculty expertise in both data mining and information retrieval. With that comes the potential for large research projects and grants or even a “Big Data” center, says CCIS Professor Javed Aslam, who specializes in information retrieval and machine learning.

“We’ve always had people here with an interest in data. Now we’re actively hiring people whose focus is data and building a critical mass,” says Aslam, whose own recent project involved gathering data in Singapore that can be used to model and predict traffic patterns.

The drive to deepen education and research in data mining and information retrieval has led to hiring Yizhou Sun and David Smith, who joined CCIS as assistant professors this fall.

Sun recently completed her computer science PhD at the University of Illinois in Urbana-Champaign. Interested in both data mining and information network analysis, she sees Aslam’s work in information retrieval as relevant to her own research. She explains, “His output could be the input of my research in network analysis.”

Sun is currently investigating two areas of information analysis: building fast query systems for information networks and mining heterogeneous information networks. She’ll also teach a data-mining course in the spring.

“My general goal is to use math, statistics, and computing to solve interesting real-world problems,” she says.

Though he also works in data mining and information retrieval, Smith has a very particular focus: building statistical models of language. He is the co-principal investigator on grants from the NSF and Defense Advanced Research Projects Agency (DARPA).

“In natural language processing, we’re working on models to map different writing styles and languages into common representations,” says Smith. “Intelligence analysts are interested in public opinion in different countries. Analyzing text in different languages can determine whether certain language communities are disproportionately interested in particular topics.”

Language is a logical interest for Smith. He studied classical Greek as an undergraduate at Harvard before earning a PhD in computer science at Johns Hopkins University and becoming a research assistant professor in computer science at the University of Massachusetts in Amherst.

At Northeastern, Smith is starting new projects with faculty colleagues in the English and history departments as well as David Lazer, who holds a joint appointment in CCIS and the Department of Political Science. One project, with Ryan Cordell of the English department, involves looking at 19th century U.S. newspaper articles and reprint patterns to detect evidence of political, religious, and economic networks.

“This presents interesting cultural and algorithmic problems. With millions of historical books and billions of articles, you can’t simply compare everything to everything else,” Smith says. “The ease of sharing in online culture today bears a resemblance to 19th century reprint culture.”
New technologies are continuing to emerge, and new security risks are arising with them. College of Computer and Information Science (CCIS) faculty members Engin Kirda and William Robertson are tackling security challenges in two of today’s ubiquitous technologies: mobile phones and Web applications.

The professors were awarded a $2 million grant from the Defense Advanced Research Projects Agency (DARPA) to examine vulnerabilities in Android smartphone applications. They’re collaborating with researchers at the University of California in Santa Barbara to develop tools to identify and defend against malicious activity.

“DARPA is using Android-based devices in the field and wants to make sure these devices aren’t hiding any malicious artifacts. They’re not being attacked yet, but there are concerns that this will soon happen,” says Kirda, the Sy and Laurie Sternberg Interdisciplinary Associate Professor who also serves as the director of both Northeastern’s Institute for Information Assurance and the International Secure Systems Lab.

Their is one of a handful of research teams selected by DARPA to develop solutions to the security concerns. The CCIS professors are taking an approach that differs from many of the others.

“Instead of taking a cooperative approach, we assume the adversarial mindset. We take a worst-case scenario,” Robertson explains. “Our approach is a little more difficult but also more realistic. We’ll look at arbitrary apps without having access to the source code, run a static analysis, and reason about possible problems.”

There’s reason to assume the worst: Often, third-party code is added to an app after the writer develops its core functionality. Robertson says, “You can’t assume the app won’t include any malicious code even if the app writers aren’t malicious themselves. The transit of trust model breaks down.”

By the end of the 42-month funding period, Kirda and Robertson expect DARPA will be using the tools they’ve developed. They also envision others benefiting from their work—especially with Android activations outpacing others in the smartphone market.

As for the potential to help secure these other phones, Robertson says, “Some lessons will be transferable to other platforms in the mobile space, but some things are specific to the Android market. Android is a more open platform that makes it easier to share apps, and you can customize it. There’s a lot more opportunity to do harm.”

The professors’ second security project results from another technological change: Most code today runs in browsers rather than on servers.

“A lot of research has been done on what runs on servers, but there’s not a lot of work related to browsers,” says Kirda, who received a $750,000 grant from the Office of Naval Research to investigate client-side vulnerabilities in Web applications. Kirda is now working with Robertson to develop automated tools to both identify vulnerabilities and make the execution of client-side components in Web applications more secure.

“This is Web 2.0. People have looked at older applications, but the newer ones are more interactive and more complex. There are a lot of dependencies,” Kirda says. “In next-generation apps like Google’s Gmail, a large portion of the code runs in the browser.”

Pointing to JavaScript as an example of a client-side component, he explains that the use of different programming languages further complicates the security of Web applications.

“The government—especially the Navy—is interested in this research because they run their own Web services, but it’s useful to the public in general,” Kirda says. “The concepts and tools we’ll develop will have a wide range of applications, not only for government, but also for companies and anyone who builds Web sites. Our goal is to disseminate knowledge and tools that people can use.”
Increasing Opportunities Outside the Classroom for Students

At a university known for experiential education, it’s only natural that the College of Computer and Information Science (CCIS) would want to maximize opportunities for students to learn outside class. And students are eager to do so, as their recent activities and accomplishments reveal.

Success in Cyber Security Competitions

“One of our major educational goals is to get students involved with practical security issues,” says Assistant Professor William Robertson. “In class, they learn the theory and background of computer security, but nothing can compare with doing it.”

Each week, Robertson meets with members of the Persistent Threat Hacking Club, Northeastern computer science and engineering undergraduate and graduate students who practice their cyber security skills, learn about attacks, and participate in the Capture the Flag (CTF) security competitions. Their persistence paid off: Northeastern teams had strong performances in two major competitions.

For the first time, CCIS students took part in DEFCON CTF, which draws the best hackers from around the world and is considered the world championship of security competitions. Funded by CCIS, the Institute for Information Assurance, and the Department of Electrical and Computer Engineering, the students traveled to Las Vegas, where their team placed seventh among 20 competitors.

“We still have some work to do to get to the top, but for people participating for the first time, it’s a great result,” Robertson says.

For the students, it was both a practical and educational experience. Ryan Rickerts, a student in the Master of Science in Information Assurance program, says, “It was valuable to get hands-on experience. It’s directly applicable to making software more secure and knowing how hackers find and exploit vulnerabilities.”

For junior Amat Cama, a computer science and math combined major completing a co-op as a security consultant, the competition provided a lesson in teamwork. He explains, “Before, I’d never thought about doing it, but working together is helpful. Most of the challenges have more than one way to solve them. You get to hear other people’s points of view.”

Meanwhile, CCIS students newer to hacking took part in another high-visibility CTF competition designed to identify and develop cyber security talent among U.S. undergraduates. Finishing fifth in the preliminary round of the CSAW CTF, a team of four Northeastern students headed to the finals in New York in November.

“We have high hopes for the undergraduates on this team,” Robertson says.

Innovation Leader

When Northeastern’s senior vice president of university relations wanted to find new ways to engage alumni, she turned to CCIS junior Christopher Jelly to manage the project.

Jelly was one of the first students selected for an innovation team that’s developing an interactive giving portal to encourage alumni support for Northeastern. As a freshman, he’d worked with the Office of University Advancement to create a planned giving database. Now, he’s providing the vision and oversight for a project and a team of students involved in Web design and development as well as content creation. He and his team also presented their proposal to a committee of the Northeastern Board of Trustees and President Joseph E. Aoun.

“I wanted a leadership experience on my résumé, and this was an excellent opportunity. It’s helped me build a lot of ‘soft’ skills and connections that I can leverage in the future,” says Jelly, who’s simultaneously completing a product engineering co-op at HubSpot in Cambridge.

Prospective donors who use the interactive giving portal can see multimedia presentations with information, testimonials, and videos about funds they might support. Once they make a selection, they can click through to a check-out “cart.” Integration with social media allows them to share the news of their gift and recommend the fund on Facebook.

“I learned a lot about creating a Web application that’s robust and meets the needs of an organization,” Jelly says of his experience leading the project.

It may be too soon to measure the portal’s impact on alumni giving, but it’s already increased participation in Northeastern’s advancement efforts: After working on the project, Jelly joined the Student Alumni Association.

From Conference to Developer

When Apple unveiled its new iPhone 5 technology in June, sophomore Andrew Barba was inspired. Now he would do what he’d dreamed about since high school: develop his own app for the phone.
Barba was in San Francisco for the Apple Worldwide Developers Conference to hear the announcement in person. Using funds from the Brian Wenzinger Fund established by a 1988 alumnus of the same name, the College of Computer and Information Science (CCIS) was able to match Barba’s cost to attend the weeklong event.

“The Apple conference is very prestigious,” says Barba. “The people I met were amazing, and it was exciting to see the Apple executives on stage that first day. The other four days had sessions on anything a developer could think of for iPhone or Mac.”

Barba had already registered as an Apple developer during his freshman year. Then he spent the summer as an intern with a Silicon Valley start-up called What’s App. San Francisco and the conference were within reach. So was the idea for an app: He and a fellow intern developed Joox, a social playlist much like a personal jukebox that allows users to share songs with friends.

“We’re using the new technology announced at the conference,” says Barba, who waited anxiously for weeks before learning that Apple had approved Joox for inclusion on iTunes. “We had a lot of late nights, but it’s been a lot of fun to put what I learned at the conference to use.”

The designation benefits CCIS undergraduates and faculty members alike. Both will be able to participate in NSA summer workshops offering direct experience with cyber operations issues that affect national security. Students in the BS in Computer Science program can prepare for these challenges by choosing the new specialization in cyber operations, which requires coursework in network security, software vulnerabilities, and the fundamentals of information assurance.

Students will gain additional opportunities for cyber security training now that Northeastern has received a second CyberCorps Scholarship for Service grant from the NSF. Chan is the principal investigator on the $4.5 million grant, joined by co-principal investigators William Robertson, an assistant professor in both CCIS and the College of Engineering, and David Kaeli, a professor and the associate dean of undergraduate programs in the College of Engineering. She notes, “Renewal was not automatic. We had to reapply and compete. We’ve been very successful in training our students.”

An initial grant in 2009 provided scholarships to 20 undergraduate and graduate students interested in becoming the trained information assurance professionals needed to secure the nation’s cyber infrastructure. The new grant enables another 32 students from CCIS and the Department of Electrical and Computer Engineering to participate over the next five years.

Each scholarship fully covers tuition, fees, and living expenses for two years. It also includes an annual stipend for academic and professional activities that ranges from $20,000 for undergraduates to $30,000 for PhD students. In return, recipients must complete an information assurance co-op or internship, and agree to work full time for two years after they graduate at a federal agency, national laboratory, or other approved organization.

Starting this fall, Northeastern has introduced an additional requirement: participation in at least one of the cyber security activities available to students, such as the Collegiate Cyber Defense Team or the Capture the Flag competition. Chan says, “We want these students to have more than classroom knowledge. These activities will broaden their experience in cyber security, and they can learn from each other.”

She notes that the Scholarship for Service program has sparked strong interest in cyber security at Northeastern—from incoming freshmen to President Joseph E. Aoun, who now serves on the Department of Homeland Security Academic Advisory Council. It also has attracted students from a wide range of backgrounds, including those with undergraduate degrees in political science and criminal justice who are combining knowledge of the social sciences and technology in the Master of Science in Information Assurance program.

Chan stresses the importance of this multidisciplinary perspective in tackling cyber security challenges. Pointing to the Scholarship for Service program’s goal of encouraging qualified students with diverse academic and personal backgrounds to enter the information assurance field, she says, “We’re proud that the workforce we’re preparing for the country is very diverse.”
Melinda Kramer ’83 arrived at Northeastern as a business major with little idea about what she wanted to do after graduation. Then she discovered an emerging field that allowed her to combine her creativity and interest in math. She left with a computer science degree and a passion for technology.

A member of the first College of Computer Science graduating class, Kramer says of her education, “It was a lucky discovery and lucky timing for me that the computer science program was there. It provided me with a great awakening about what I could do in the future and how technology could add value to the world. I left with so much energy and desire. That’s what a great college should do for you.”

Today, Kramer is the chief technology officer for a Chicago-based investment management firm, where she works at the intersection of business and computing, strengthening the business through technology. She’s held that position for the past 10 years, after earlier stints as a consultant and Goldman Sachs vice president. Though she shifted from business to computer science as an undergraduate, she eventually went on to earn an MBA at New York University.

Even after leaving Boston and traveling far professionally, Kramer can still easily trace the path she’s taken to her positive experiences at Northeastern. That’s why she’s made another important decision: to include the College of Computer and Information Science (CCIS) and Northeastern women’s crew in her will.

“Every year, I make donations to these two areas—computer science and the crew team. It was time to also think about my legacy and where I wanted to have an impact. I thought I owed a lot in my life to these experiences,” Kramer says now that she’s chosen to deepen her support for the programs she valued most during her time at Northeastern.

Speaking specifically about the outcome she’d like to make possible by naming CCIS as a beneficiary in her will, Kramer adds, “I hope my gift can help someone go through the same discovery process and transformation that I did. I want to provide that opportunity and path to students in the future so they can also gain tremendous satisfaction from their education.”

Kramer recalls how classes and co-op helped her realize her strengths in planning and organizing. She found herself taking a leadership role in class projects. She noticed parallels between computer science and crew, where she became her team’s coxswain—the leader in the boat who ensures plans are executed successfully. It’s unsurprising, therefore, that she spent several years as a project manager en route from her start as a programmer analyst to her executive position today.

From the distance of Chicago, Kramer is continuing her connection with her college and university. She’s active in the local Northeastern alumni chapter and even hired a computer science co-op student at her firm.

“I still believe strongly in the computer science program and feel there’s a lot of opportunity for people who understand and want to apply technology,” Kramer says.

There are many ways to directly support the College of Computer and Information Science at any stage of your life. For information about how to include CCIS in your will and other options that can help you achieve your personal and philanthropic goals, contact Northeastern’s Office of Gift Planning at 617.373.2030 or giftplanning@neu.edu.

Recognizing the Impact of Computer Science Education

Melinda Kramer ’83 values the impact of her undergraduate experiences on her life and career in technology.

Beyond math, explaining, “We’re also working on active storage, a different way of arranging and storing data on a computer. We’re looking at architectures that spread flash memory throughout the computer rather than concentrating disks in one or two locations. This would allow programs to retrieve data orders of magnitude faster than is possible with today’s technology.”

According to Desnoyers, the limits of disk drives are crippling very large computers. The prevalence of data-intensive graphics and society’s deluge of data also drive the need for higher performance. Desnoyers says, “We believe we can handle this type of data efficiently in quantities far higher than can fit into memory today and at speeds far beyond current disks.”

He anticipates developing solid-state storage capable of faster computations than disk-based systems. He also hopes to identify new ways of connecting applications with stored data and have that stored data behave as though it’s in memory.

“The goal in systems research like this is to take a new technology and use it to enable computer applications that weren’t previously possible,” Desnoyers says.
External Support for Education and Research Grows

Organizations from coast to coast and a variety of industries are choosing to support research and education at the College of Computer and Information Science (CCIS).

These supporters include major corporations with familiar names: State Street Bank, Symantec, RIM, Cisco, Google. Gifts have also come from the business powerhouse Bloomberg; the security firm Rapid7; and RSA, the security division of EMC, the global technology company founded by Northeastern alumni Richard Egan and Roger Marino.

“These corporate gifts are aligned with the major strategic thrusts of our college,” says Dean Larry Finkelstein, noting that many of these companies have shown interest in backing CCIS cyber security initiatives such as faculty research and student participation in the Collegiate Cyber Defense Competition. Other areas, such as network science and programming languages, are also attracting corporate gifts.

Additional funding is coming to CCIS to advance the research of individual faculty members and graduate students. The research arms of Mozilla and Microsoft as well as Draper Laboratories and MIT Lincoln Laboratories are among the organizations providing this support for the college.

“The depth of our corporate relationships and our partnerships shows that we’ve demonstrated our value,” says Finkelstein.

Drawing the interest of this wide range of organizations offers benefits beyond funding: As Finkelstein explains, they also provide a pipeline to co-op and career opportunities for students.

Alumni Notes

1980s

Carla Pereira ’89 is a principal software engineer with CA Technologies in Framingham, Massachusetts, where she has worked since graduation.

1990s

Thomas Cullen ’91 is the chief information officer of Driscoll’s in Watsonville, California.

Dino Oliva MS ’89, PhD ’93 is now living and working in California after joining Google in Mountain View.

Homer Pien MS ’89 PhD ’93 is the chief technology officer and senior vice president for research and technology at Philips Healthcare in Andover, Massachusetts.

Cun Xiao MS ’92, PhD ’94 recently joined Google as a software engineer based in Mountain View, California.

Ivan Judson ’95 is a senior software engineer at Webfilings in Ames, Iowa. He recently visited Boston and Northeastern University as part of his company’s recruiting efforts.

Justin Sheehy ’98 is the chief technology officer at Basho Technologies in Cambridge, Massachusetts.

2000s

Robert Gagne MS ’02 is the vice president of engineering at Nexaweb Technologies in Burlington, Massachusetts.

Mark Logan ’02 and Ian Langworth ’06 are partners and co-founders of newly launched Artillery Games in Mountain View, California. They both previously worked for Google.

Cassandra Robinson ’05 is a business analyst with Apple Computer in Cupertino, California, and a long-time coordinator of the Northern California Alumni Chapter.

Ankit Shah MS ’05 is a technical staff member at VMware Inc. in Cambridge, Massachusetts.

Andrew Swenson ’07 is a software engineer at MathWorks in Natick, Massachusetts.

Helen Finegold, William Nowak, and Erica Simone all received a BS in 2010 and now live and work in California. Finegold is a software engineer at Intuit, Nowak is a site reliability engineer at Google, and Simone is a product manager at Shutterfly.

Pengcheng Wu MS ’06, PhD ’10, who welcomed his second child last year, is now a senior software developer at Amazon in Cambridge, Massachusetts.

Ken McGrady ’11 is a software developer at Hulu in Seattle. He recently represented his company at Northeastern’s Career Expo and Career Fair.

Rudy Mutter ’11 is the founder, developer, and technical director for Yeti, a mobile, social, and Web application development firm in San Francisco.

Alumni are important to the college, and we’d like to hear from you. If you have news you’d like to share, please contact Director of Development Jennifer Wong at je.wong@neu.edu or 617.373.4038.
Northeastern University has been extending into new regions, and now College of Computer and Information Science (CCIS) graduate programs are doing the same. Starting in January 2013, the college will launch an online version of the Master of Science (MS) in Computer Science for residents of Seattle and Charlotte (pending), sites of the new Northeastern regional campuses.

This is the first computer science program the college will offer in conjunction with the new campuses. The online MS in Health Informatics, a joint program with Northeastern’s Bouvé College of Health Sciences, has been enrolling students in Charlotte since January 2012 and will soon expand to Seattle. The college will also make an online version of the MS in Information Assurance available in both locations once this plan is approved by the states of Washington and North Carolina.

“We’re looking to fill a particular niche and a demand currently left unfilled. We’re not coming in to compete with the existing universities,” says CCIS Assistant Dean of Graduate Programs Bryan Lackaye, who notes that fewer professionals in Charlotte and Seattle have earned graduate degrees than in other cities of comparable size.

Why combine online education and a physical campus? Professor Mitchell Wand, who will teach the first course offered online in the MS in Computer Science program, explains, “Market data shows that 90 percent of students in online programs come from within 50 miles of an institution. Having a campus nearby enables us to reach out to the local community and recruit students in a targeted way. In both places, we’ll have a physical presence, so if students need to come together, that can be arranged.”

What’s more, says Lackaye, “Each market is a little different. If you want to make online learning engaging and deliver it in a dynamic format, you have to understand how it will be received in a particular context and a particular culture.”

Wand began preparing for his first class almost a year ago. He’s been working with online education experts at Northeastern to adapt Program Design Paradigms, the graduate programming course better known on campus as “Boot Camp” because of its professional rigor.

“The goal is to make the learning outcome the same for the online and traditional courses,” Wand says. “I also believe Boot Camp changes people’s lives, and I’m eager to expose more people to that change. Boot Camp gives them a toolbox for analyzing the kinds of problems that come up in a software development environment. But the toolbox is not strictly limited to programming. Students tell me they apply it to other courses and in their lives.”

Wand’s first challenge was to tailor the material for online learning. He says, “Rather than having three-hour lectures, the course will be broken into lessons that involve sitting at a computer for 10 to 15 minutes at a time. We’re building on decades of research into what makes online learning effective.”

Courses will use the Blackboard online learning platform. Each lesson will feature guided practice and a short quiz or programming exercise. Wand says, “I’m very excited that students will get immediate feedback. This enables us and the student to correct any misconceptions the student may have about the material—in real time.”

Lackaye says local industry response to the online MS in Computer Science program has been positive in both cities. Wand adds, “We think we have a really good program, and we’d like to see it serve as many students as possible. Reaching out to more students also creates opportunities for other kinds of interactions with industry, and that’s all for the good.”