Professor Kathleen Fisher's teaching and research specialty is programming language design, with a focus on domain-specific languages. Basically, that's adapting general-purpose programming languages—the most well-known ones include C++ and Java—for specialty areas. She and Associate Professor Samuel Guyer are collaborating on a project to improve the tools and structure for building these domain-specific languages—essentially software that is embedded in everything from semiconductor fabrication plants to refrigerators and cars.

Before Professor Fisher came to Tufts full-time, she spent a three-year stint as a program manager for the Defense Advanced Research Projects Agency (DARPA). At DARPA, she worked on two areas in her specialty: one involved creating programming languages related to machine-learning applications—how computers can learn from large amounts of data—while the other focused on ways to make motor vehicles less vulnerable to hacking.

Modern cars, after all, are pretty much computers on wheels, with vital functions that rely on software: antilock brakes, for example, or cruise control. The typical late-model car has anywhere from

**Networked embedded systems are vulnerable to remote attack, and such attacks can cause physical damage while hiding the effects from monitors.**

*Continued on page 3*
I am pleased to report that we are on track to graduate the most undergraduate majors in the history of computer science—more than 100 students will graduate with CS degrees in May 2015. This number reflects nearly a 100% increase in our last graduating class and mirrors the national trend of increasing numbers of computer science graduates. With additional resources from Provost David Harris and the support of Linda Abriola, dean of the School of Engineering, and Jim Glaser, dean of the School of Arts and Sciences, we continue to actively manage enrollments and grow the major.

I am thrilled by the research achievements of our faculty and students. Remco Chang will receive a National Science Foundation early CAREER award for his research on user interaction in visual analytics. Several of our other professors were awarded new grants this fall including, Diane Souvaine, Ben Shapiro, and Matthias Scheutz. I am also proud to announce that Professor Souvaine, Vice Provost for Research, has been reappointed to the NSF’s National Science Board for another six-year term.

Our students continue to thrive. Special congratulations go to Professor Rob Jacob’s students who were part of the team that won the $7,500 Ricci Prize. Members of our Tufts Computer Science Exchange (CSX) continue to support each other academically and socially. They have hosted a number of tech talks, internship training sessions, and they maintain an active presence on Facebook facebook.com/TuftsCSX.

Our graduates have also had remarkable achievements. Our undergraduates continue to land jobs at prestigious companies such as Google, Microsoft, Amazon, Trip Advisor, and many others. Among our doctoral recipients: Evan Peck is now an assistant professor position at Bucknell University; Jordan Crouser is working at Lincoln Laboratory; Yuyang Wang is working as a Machine Learning scientist at Amazon; and Andrew Winslow and Noah Daniels are postdoctoral researchers at MIT CSAIL and the Université libre de Bruxelles, respectively.

We look forward to seeing all our alumni at the upcoming end of year celebration. Please keep in touch!

—Soha Hassoun

Notables...

At the end of the fall semester, we said goodbye to a dear friend and administrator. Department manager Gail Fitzgerald left Tufts to join Professor Carla Brodley at Northeastern University’s College of Computer and Information Science. Gail provided invaluable guidance and leadership, and we know she will do amazing work at NU. We welcomed Sarah Richmond to the front office to take on the role. Sarah, a Tufts veteran, comes to Halligan Hall after a more than 10-year stint in the School of Engineering dean’s office. We know that Sarah will be up to the tasks ahead of her.

Associate Dean of Engineering Karen Panetta presents computer science graduate student Aaron Tietz with an award for Outstanding Graduate Contributor to Engineering Education at the 16th Annual Graduate School of Arts and Sciences and Engineering Student Awards at Granoff Music Center. (Kelvin Ma/Tufts University)

COMP150: Lecturer Jason Wiser is teaching a new course that covers a software development cycle through game design, prototyping, production, and marketing.

Let us know how you’re doing. Send an e-mail to csadmin@cs.tufts.edu. Be sure to save the date for the end of the year party on May 1, 2015.
30 to 100 embedded control units, and all cars sold in the United States since 1996 are required to have diagnostic ports under the steering wheel through which the vehicle’s “brain” can be accessed. Having such heavily computerized vehicles makes life easier for drivers. It also means that thieves can now steal cars by hacking into them—no more smashing a window and hot-wiring the ignition. It means that someone with malicious intent could gain control of a car without ever touching it—by infecting it at a repair shop or hacking the Bluetooth or roadside assistance systems, or even by using malware hidden on a CD played on the stereo system.

Fisher’s DARPA project—known by the acronym HACMS, for High Assurance Cyber Military Systems—was devoted to finding ways to build vehicular software that would be invulnerable to outside attacks. Of course, the Department of Defense’s first priority wasn’t safeguarding our Subarus and Buicks, but rather the thousands of military vehicles—on land, sea and air—and drones that rely on similar technologies.

It’s easy to see how the fruits of this work will affect more than military endeavors, in the same way, for example, that the development of voice recognition software by DARPA paved the way for the iPhone’s Siri and other popular consumer products.

—excerpt from “Joy of Tech” by Helene Ragovin

Read more of the story that appeared in TuftsNow: http://now.tufts.edu/articles/joy-tech
Robust Real-Time Biologically Plausible Speech Recognition for Outdoor Robotic Application Domains
PI: Matthias Scheutz
Funding Agency: Office of Naval Research

The goal of the project is to evaluate and further develop our existing promising neural network-based speech recognizer prototype, which consists of a biologically plausible cochlear model combined with a liquid state machine (LSM) auditory processing system to perform recognition at the level of phrases or sounds instead of words. The advantage of this approach is that the system can naturally cope with various kinds of disturbances, omissions, word errors, and other infelicities of the speech signal and retrieve the correct phrase or sound even when the signal is quite distorted or deteriorated. Moreover, the prototype system runs in real-time and makes available intermediate results at any time, thus allowing for faster responses of the natural language processing system.

Reconfiguration Algorithms
PI: Diane Souvaine and Csaba D. Tóth, California State University, Northridge
Funding Agency: National Science Foundation

This research project develops new algorithms and data structures for modifying geometric configurations in three areas: (1) Optimization problems in the configuration space of geometric objects, including graph augmentation, variations of the classical TSP tour problem, and network design for multiple criteria. (2) Reconfiguration through discrete moves, where current challenges include designing efficient data structures to support shortest path computation in the configuration space, approximating the diameter and radius of configuration spaces, and deciding whether reconfiguration is possible. (3) Modeling continuous motion, which includes motion planning algorithms and corresponding dynamic data structures for bar-and-joint frameworks, hinged polygons, and disk arrangements, motivated by applications in protein folding. A unified approach to discrete and continuous reconfiguration problems allows breaking down complex systems into elementary operations, which in turn leads to more efficient computational tools. The collaboration between faculty members and students from two universities ensures a high quality of training and opens new opportunities for all participating students.

Design Tools and Their Experimental Validation for Synthetic Biological Systems
PI: Soha Hassoun and Nikhil Nair, Department of Chemical and Biological Engineering
Funding Agency: National Science Foundation

The broader aim of synthetic biology is to design and build organisms specialized to perform pre-designated functions ranging from production of commercially desirable fuels, chemicals, and pharmaceuticals to remediating contaminated soil and water. This project develops and validates computational tools to increase the role of automation in designing synthetic biological systems. These tools are aimed at creating a streamlined methodology that integrates biochemical, regulatory, and phylogenetic information into a single platform to expedite the design and creation of function-based organisms. These tools will significantly shorten the time taken to re-engineer organisms and will enable wider usage of synthetic organisms. Students will be engaged in this research through novel course material, hands-on experimentation through the iGEM (International Genetically Engineering Machines) competition, and relevant research projects with the principle investigators.

Adaptive, Reinforced, Interactive Visual Analytics
PI: Remco Chang
Funding Agency: MIT-Lincoln Laboratory

Understanding how users think about visualizing data—their mental models—is as important as the visualization itself. This project develops visualization and data analysis techniques that aid in the collection and encapsulation of users’ mental models of large, high-dimensional data sets. The first phase of this work will focus on generating a survey outlining possible interactive visualization and machine learning algorithms for high-dimensional data exploration, including projection methods, interaction techniques, and feedback mechanisms. Specialized algorithms will then assist users in selecting specific data points that are “model critical”, which will minimize the training time required for the developed integrated visual machine learning approach. These algorithms will provide the basis for developing and evaluating the effectiveness of a prototype system that integrates sampling techniques.
Piinch: Social Networking App

**Ariel Luque, E17**, is the lead software developer for a new social networking app called Piinch—a location based network that facilitates real world social interactions amongst college students.

“Maybe you’re at the library studying and you would like friends to be with you,” says Luque. “Instead of texting them all, you just hit two buttons and your friends on Piinch will be able to see your location and how long you will be there, and then decide to join you or not.”

Learn more at [http://piinch.me/](http://piinch.me/)

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**PhD recipients**

- **Jordan Crouser**
  “Toward Theoretical Measures for Systems Involving Human Computation”
  Advisor: Remco Chang

- **Jingjing Liu**
  “Clustering With Domain Knowledge”
  Advisor: Carla Brodley

- **Yuyan Wang**
  “Nonparametric Bayesian Mixed-Effects Models for Multi-Task Learning”
  Advisor: Roni Khardon

- **Andrew Scott Winslow**
  “Staged Self-Assembly and Polyomino Context Free Grammars”
  Advisor: Diane Souvaine

**Mona Yousofshahi**

“Computational Methods for Pathway Synthesis and Strain Optimization”

Advisor: Soha Hassoun

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**Master of Science**

- Robert Abbott
- William Alexander
- Boxia Feng
- Jason Jacob
- David Kalbfleisch
- Quan Lin
- Zhe Lu
- David Mancinelli
- Kelly Moran
- Jingjie Ni
- Paul Nixon
- Christopher Pietras
- Tomoki Shibata
- Megan Strait
- Jeremiah Via
- Enhao Zhao
- Xiuji Zou
- Shiwan Zuo

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**ALUMNI UPDATE**

This fall, doctoral alumnus **Evan Peck** joined Bucknell University as an assistant professor of computer science and taught his first introductory computer science course. Evan’s research on adaptive information delivery systems that respond to user cognitive workload has been featured in *New Scientist*, *Discovery News*, and *ACM TechNews*, as well as other magazines and blogs. Evan and advisor Professor Rob Jacob’s work was also covered by *The Boston Globe* WBUR Radio Boston, and the BBC.

Peck, EG14, now teaches at Bucknell.
Grace Hopper Celebration

Thirteen computer science undergraduate and graduate students attended the Grace Hopper Celebration of Women in Computing held October 14–16, 2014.

Representatives from the department’s Association for Computing Machinery—Women (ACM–W) chapter, as well as other female students, attended the three-day meeting held in Phoenix. Lecturer Chris Gregg was also in attendance.

The theme of this year’s Grace Hopper Celebration “Everywhere. Everyone.” sought to “capture the universal nature of computing in the digital age,” according to Alexander Wolf, ACM President and CS professor at Imperial College London. “Computer technology is everywhere in our lives. Everyone is involved somehow in computer technology design, development and deployment. Everyone can connect everywhere,” said GHC co-chairs Wei Lin and Tiffani Williams, Senior Director for Mobile Endpoint Protection and Associate Professor at Texas A&M University, respectively.

Shafi Goldwasser, RSA Professor of Electrical Engineering and Computer Science at MIT, gave the keynote address. Goldwasser, a co-recipient of the ACM A.M. Turing Award—widely considered the “Nobel Prize in Computing” for advances in modern cryptography—talked about the past, present, and future of cryptography.

Goldwasser said, historically, cryptography has enabled seemingly impossible abilities, such as exchanging secret messages through a public medium without ever meeting or proving a theorem can actually be proven without providing a proof. She discussed the current challenges in cryptography and projected that the future of cryptography will involve the issues of correctness and privacy of remote storage and computation. Among other interesting examples, she discussed the problem of extracting partial information from encrypted data on the cloud without giving the key to the whole database, which will be useful when dealing with law enforcement.

Students had opportunities to network at the Career Fair Lunch and attend leadership workshops led by Jo Miller, CEO of Women’s Leadership Coaching and Denise Brosseau, CEO of Thought Leadership Lab. Students had the opportunity to contribute to the Code-a-Thon for Humanity sponsored by a variety of humanitarian and aid organizations.

“Attending Grace Hopper was one of the best experiences of my academic life,” said Mona Yousofshahi, a 2014 Tufts CS doctoral recipient. “I met many accomplished women active in computer science who inspired me as role models. With rapidly expanding tech industries, it is important to get more women interested in computing and I think the Grace Hopper conference is a great way to spark young women’s interest in the STEM fields.”

Tufts Computer Science has been a longtime bronze academic sponsor of the Grace Hopper conference.
They didn’t just get up and give a pitch, Shark Tank-style. No, this group had to have a real product—working demos of a medical device and iPad app that they were trying to sell to the owners of Jumbo Medical, a firm they were told had missed the mobile boom and was trying to play catch-up at an upcoming trade show.

That was the challenge for the 19 students in Ming Chow and Ron Lasser’s engineering class, Mobile Medical Devices and Apps, heading into the first week of December. They had spent the semester working in teams to develop thermometers, pulse detectors and EKG monitors capable of sending wireless data to an iPad app that displayed patient information in real time.

The assignment was a formidable one. The students had to understand signal processing, iOS app programming and how to make hardware communicate with the app. The problem was, of course, that not a single student coming into the class knew everything that was required to succeed. They had to learn new skills on their own—no lectures here. Probably hardest of all, they had to focus on the customer—the doctors and nurses—all the while making sure the technology they developed would work.

As they got up in front of their classmates and professors in Halligan Hall, the first team gave its pitch, sounding assured. With a minor glitch—waiting for the iPad to connect to the Wi-Fi—they got through the presentation and nodded to the polite applause.

Then came the questions. Why were the app buttons on the bottom of the screen so small—wouldn’t a busy nurse not see them? How exactly would the device hook up to a patient? Why would a hospital want to use this instead of what they were already using? And those were just the queries from fellow students. Lasser, a professor of the practice of electrical engineering, and Chow, E02, E04, a lecturer in computer science, asked more pointed questions. Did the team think about how the wireless patient data would be secured? How would they identify each patient on the display?

The presenters, a mix of undergraduate and graduate students, were getting a lesson in the business of engineering. “This is real life,” Lasser says.

“This is not a test-taking course,” Chow adds. “We enjoy putting the students in a difficult position so they apply what they learned in a real situation. It reinforces the point that not a lot of college students get, which is you have to be responsible for your own learning—learning doesn’t end now.”

Such a lesson will be valuable once students are out in the world. “I don’t think that the students will appreciate what Ron and I are doing until two or three years later, when they are out there doing this professionally,” Chow says. “One of the problems we both see is that they are worried about a grade. That’s just painful for us.”

Read more at: http://now.tufts.edu/articles/engineering-reality
Ricci Prize Winners—Students from the CS department were part of the winning team of the 2014 Stephen and Geraldine Ricci Interdisciplinary Prize. Doctoral students Tomoki Shibata, Samuel Hincks, and Daniel Afergan, in collaboration with undergraduate students Nana Kwakwa and Alex Henry in the Department of Electrical and Computer Engineering, were awarded the $7,500 Ricci Prize for their project “A wireless device to monitor blood oxygen concentration in tissue to aid in developing an adaptive information delivery system.” (L to R: Dan Afergan, Steve Ricci, Sam Hincks, Professor Valencia Koomson, Nana Kwakwa, Alex Henry, Professor Sergio Fantini, Dean Linda Abriola, and Tomoki Shibata)