Alumni Newsletter - Spring 2012

Atanasoff Today

Connor Schenck
2012 NSF
Graduate Student Fellow

Also inside:

Atanasoff Today

Spring 2012

Atanasoff Today is published once per year for the alumni, friends, and faculty of the Department of Computer Science at Iowa State University, an academic department in the College of Liberal Arts & Sciences.

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Cover: Connor Schenck stands at the top of the staircase in the north section of Parks Library, ISU Campus

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Message from the Chair

Greetings all! We are pleased to connect once again with our alumni, friends, faculty and students through this issue of Atanasoff Today. Following on the heels of last spring's ISU Game Development Competition, in which several of our Computer Science students were very successful, we are reporting in this issue on our recently developed courses in computer gaming programming and development. Our dedicated lecturers Steve Kautz and Jim Lathrop are leading new course offerings in computer graphics and console gaming. So far, the student response to those offerings has been overwhelmingly positive. Many report that they truly enjoy putting together all of their skills from previous classes towards fun, interactive projects in gaming. In the future we hope to establish an interdisciplinary curriculum in multimedia interactive computing so that students not only in our discipline, but in other LAS and Design College programs get involved in the design and production of one of the most popular activities of the Millennial generation. We have been impressed with the projects we have seen so far, especially one from undergraduate student Brittany Oswald, whose game was developed for very young children. You can read about *The Dinosaurs Game* on page 11. Student interest has sparked the creation of a new student club for computer game development, which will be advised by Dr. Lathrop.

Computer Science isn't all just fun and games, however; Connor Schenck, Goldwater Scholar and MS student in Computer Science, just won a 2012 NSF Graduate Student Fellowship. This is a world-class accomplishment from a distinguished student.

We are also highlighting some of our graduate students who have gone on to careers in medicine, working at the forefront of healthcare research. Fadi Towfic is a recent graduate from Dr. Honavar's laboratory, now working towards identifying disease mechanisms, developing new drugs, and improving patient outcomes at the MIT/Harvard University Broad Institute. Jyotishman Pathak, former PhD student of Dr. Honavar and Dr. Basu, is with Mayo Clinic. He works at the cutting edge of research in personalized genomic medicine. Both students, as well as many others, demonstrate the quality of graduate education in our department, and exemplify how *All Science is Computer Science* - in this case, medical science is computer science!

Once again this year, we have a team of students traveling to the ACM ICPC World Finals. This year's winning team was formed from the three main technology majors across three different colleges at ISU and include MIS student Devon Eilers, CS student Bryce Sandlund, and ECpE student Kerrick Staley. We wish them the best of luck at the World Finals, and thank Dr. Simanta Mitra, Senior Lecturer in Computer Science, for coordinating the effort to train another world class team for the ICPC.

Les Miller and the department's Recruitment and Retention Committee have been hard at work this academic year to train the next generation of talented programmers. One problem with recruitment in computer science across the country is that K-12 students lack exposure to programming. After many presentations and workshops on computational thinking and Scratch programming, the department will be hosting the Computational Thinking Competition on April 14 for Iowa K-12 students. This project based competition will bring needed visibility to computational thinking and programming as a critical skill for college-bound students in our public schools. We look forward to seeing the variety of projects by the students, many of whom are still in elementary school. We have one entry by a first grade student!

Our department tries to span the range of skills - teaching computing to kids as young as first grade, all the way to the most advanced study in the fields of computing. Ting Zhang, our newest faculty member and NSF CAREER Awardee, is working hard to impress upon students the importance of theory and understanding complexity, as more and more software systems are subject to safety and security risks that depend on developer competence in such areas. Read about his research efforts on page 8.

One of our most recent visitors to campus was Larry Smarr, the 2012 Robert Stewart Distinguished Lecturer and a world-renowned expert in scientific computing and supercomputing. Each year, we hold this lecture in honor of our first department chair, Dr. Robert Stewart. The lecture series is sponsored by one of his former students, Dr. Long Nguyen, who was a distinguished academic before founding Pragmatics, Inc. in 1985.

If you will be visiting campus, please stop in and see us! We are always happy to see our former students and faculty!

Do you have news for Atanasoff Today? We are interested in hearing about alumni accomplishments!
Send in your story to csdept@iastate.edu

Farrington, Taylor, and Gustafson Honored at Homecoming Awards, Fall 2011

The LAS College and the Department of Computer Science presented Norm Farrington and Rebecca Taylor with Alumni Achievement Awards in fall 2011, and the LAS College presented John Gustafson with the John V. Atanasoff Discovery Award. The awards ceremony took place on October 20, 2011. In addition to recognizing their individual achievements, the CS department thanks the awardees for their contributions and involvement with our faculty and students!

John Gustafson: John V. Atanasoff Discovery Award
The John V. Atanasoff Discovery Award was established in 2005 to honor alumni of the College of Liberal Arts and Sciences who have furthered scientific knowledge of the nation and the world through laboratory accomplishments and/or management. Gustafson is a former faculty member at ISU and US DOE Ames Laboratory, founder of the ISU Scalable Computing Lab, inventor of Gustafson's Law, and leader of the ABC Reconstruction Team. John is Director at Intel Labs Santa Clara. He is also a member of the Computer Science External Advisory Board.

Norm Farrington: Alumni Achievement Award
Norm Farrington (BS 1970 and MA 1972) was honored for his achievements and longtime relationship with the Computer Science department. The winter 2008 edition of our alumni newsletter features Norm on the cover, with a story about his long history with our department. In the closing lines of the article that was written, Norm says that once upon a time, he didn't want the credit for giving to his university. Now, he says he is more comfortable with the recognition. We are proud to offer it to a deserving alumni whose gifts have enriched our faculty, students, and our collaborators, and whose relationship we highly value.

Rebecca Taylor: Alumni Achievement Award
Rebecca Taylor (BS 1984), an outstanding role model for entrepreneurship in technology, was recognized for her career achievements. Our departmental relationship with Rebecca was re-established last March, when she was invited to campus by the Pappajohn Center as part of the 2011 Reiman Entrepreneur Speaker Series. In Computer Science, we see many students who hope to engage with entrepreneurship, start their own companies, and direct their creativity and expertise towards problems that are interesting, compelling, and important not only to them but to our society and our world. Rebecca has met with some of those students and talked with them. We hope to be able to introduce her to more of our entrepreneurship-minded students in the future. She is an outstanding role model for them, and in that spirit, we were pleased to present her with a 2011 Computer Science Department Alumni Achievement Award.

Connor Schenck Wins 2012 National Science Foundation Graduate Research Fellowship

The NSF Graduate Research Fellowship Program (GRFP) provides Fellowships to individuals selected early in their graduate careers based on their demonstrated potential for significant achievements in science and engineering. Three years of support is provided by the program for graduate study that is in a field within NSF's mission and leads to a research-based master's or doctoral degree.

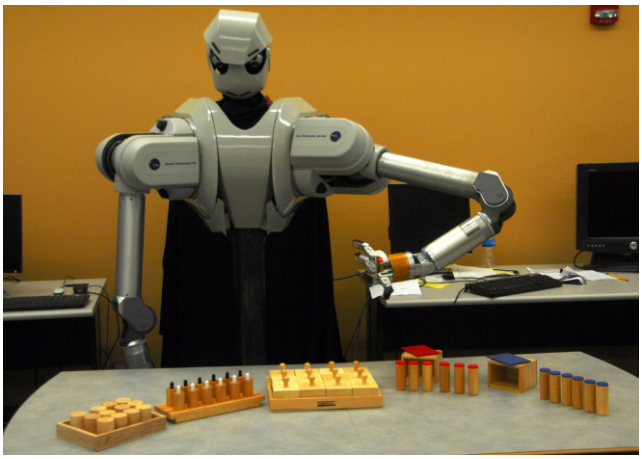
Connor Schenck, MS student in Computer Science, has been selected by the NSF as a 2012 Graduate Student Fellow. His research work will take place at the Developmental Robotics Laboratory under lab Director Alex Stoytchev. Developmental Robotics is a field that is grounded in the belief that in order to be truly intelligent and useful to humans, robots must have the ability to learn from their environment much like humans do.

Connor's NSF proposal focused on how the robot can learn different structures in small groups of objects. "Basically, in developmental robotics we try and find ways for the robot to learn different things - anything that a 2-year old child might learn. In one recent project we taught the robot how to match up pairs of objects. Eventually, we would like to be able to teach the robot relative concepts such as the difference between a heavy or a light object, or what object in a group is not like the others in some way" he says. "Regardless, what is really important is that the robot learns from its own perspective. It doesn't know about an object because someone just programmed it to know."

Connor has always been interested in Artificial Intelligence, but like many students in Iowa schools, he did not have much formal learning in computing until he came to ISU. "A lot of it I did on my own. Taylor Bergquist [also in CS at ISU] was a student at my high school. He was the one who first showed me a TI-84 calculator, and how you could program it. I took that and ran with it. I was also on the debate team in high school, and our advisor was the IT guy at the high school. He told me to learn C++, so I found a book and learned it. I have pretty much always been interested in AI, and anything autonomous. When I came to ISU, developmental robotics seemed really interesting and a good fit for me."

Jim Lathrop remembers Connor's early classes. "He was in my CS 228 course, and his scores were consistently at the top. He just understood computing from the start, and has always managed to impress the faculty in the courses he took."

The NSF Fellowship is not Connor's first major award. He was a Goldwater Scholar in 2010-11. The Goldwater Scholarship is the premier undergraduate award in mathematics, natural sciences and engineering. Connor graduated from the Computer Science BS program in fall 2011, and moved into the MS program in spring 2012. His future goals have yet to fully form, but they will involve continued research in AI.



Left: This humanoid robot is the platform for Connor's research in AI and developmental robotics. Alexander Stoytchev, Director of the Developmental Robotics Laboratory at ISU, has already mentored one NSF Graduate Student Fellow, Shane Griffith, who received the award in 2009.

For more information on Connor's work, please see:

Sinapov, J., Bergquist, T., Schenck, C., Ohiri, U., Griffith, S., and Stoytchev, A., "Interactive Object Recognition Using Proprioceptive and Auditory Feedback," International Journal of Robotics Research, Vol. 30, No. 10, pp. 1250-1262, 2011.

Bergquist, T., Schenck, C., Ohiri, U., Sinapov, J., Griffith, S., and Stoytchev, A., "Interactive Object Recognition Using Proprioceptive Feedback,", In Proceedings of the IROS 2009 Workshop: Semantic Perception for Mobile Manipulation, St. Louis, MO, October 15 , 2009.

Faculty Grant Productivity Continues with Added $1,699,592 in 2011

2011 was a productive year for faculty engaged in grantwriting. Grant contracts support over 2/3 of the graduate student research performed in the CS department. Grants also support faculty summer salary and travel to conferences to present research results. In 2011, faculty received $1,699,592 in new grant contracts for research and teaching, mostly from the US National Science Foundation.

Samik Basu (PI), **Robyn Lutz** (Co-PI) and **Vasant Honavar** (Co-PI) *Decision Support System for Reasoning with Preferences*. NSF (2011-12) $111,393

Samik Basu (PI) *Formal Analysis of Distributed Interactions*. NSF (2011-14) $164,966

Ying Cai (PI) *Development & Integration of a Generic Mobile Computing Platform into Graduate and Undergraduate Curricula in Computer Science and Software Engineering.* LASCAC (2011-12) $32,900

Xiaoqiu Huang (PI) *Development of an Assembly Program for Illumnia Reads*. Monsanto (2011-12) $103,297

Jack Lutz (PI), **Robyn Lutz** (Co-PI), and **Ting Zhang** (Co-PI) *Modeling and Analysis of Molecular Programming and Nanoscale Self-Assembly*. NSF (2011-12) $189,016

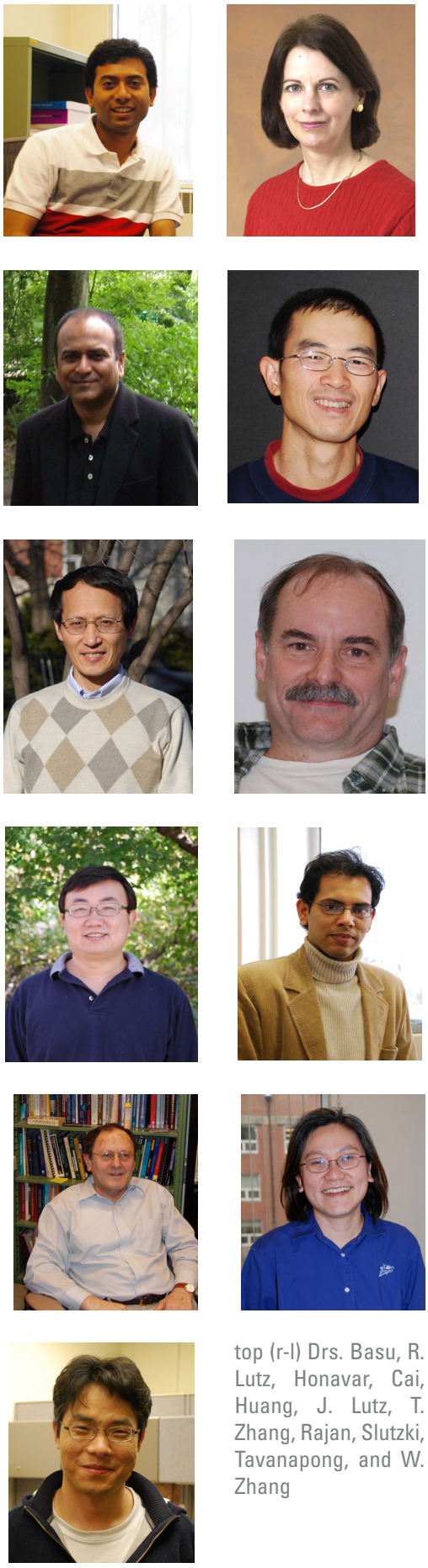
Robyn Lutz (PI) *Travel Support for Software Design & Productivity Summit*. NSF (2011-12) $40,000

Hridesh Rajan (PI) *Phase-Based Tuning for Better Utilization of Performance-Asymmetric Multicores*. NSF (2011-14) $400,000

Giora Slutzki (PI) *Secrecy-preserving Reasoning: Foundations & Algorithms*. NSF (2011-14) $450,895

Wallapak Tavanapong (PI) *Supplement: Real-time Analysis & Feedback During Colonoscopy to Improve Quality.* NSF (2011-12) $16,000

Wensheng Zhang (PI) *Self-sustaining Networking of Survivability-Heterogeneous Sensors*. NSF (2011-14) $191,125



top (r-l) Drs. Basu, R. Lutz, Honavar, Cai, Huang, J. Lutz, T. Zhang, Rajan, Slutzki, Tavanapong, and W. Zhang

Software Engineering Update

A dynamic program bringing together the fundamentals of science, engineering and computing, and their applications, the Software Engineering program is working to prepare students for a wide range of employment opportunities. Recent graduates have secured positions at traditional computing companies like Microsoft, IBM, Oracle, etc. and have also held key positions in companies serving the health-care industry. High starting salaries and plentiful job opportunities make Software Engineering one of most attractive programs in science and engineering, and one of the fastest growing undergraduate programs at Iowa State University. The program has seen rapid increase in enrollment in the past year with the current enrollment number being approximately two hundred.

In 2011, the participating departments and colleges created a new administrative structure for Software Engineering program and identified 8 faculty members from Computer Science, and Electrical and Computer Engineering as the Software Engineering faculty. SE faculty include Samik Basu, Suresh Kothari, Robyn Lutz, Andrew Miner, Tien Nguyen, Hridesh Rajan, Srikanta Tirthapura, and David Weiss. Samik Basu, Associate Professor with joint appointment in Computer Science and Electrical and Computer Engineering, is appointed as the first director of Software Engineering Program.

A new Software Engineering Student Advisory Council was created to act as a direct interface between the Software Engineering student body, the faculty members and advisors. Members include Dalia Abo-Sheasha, Cyle Dawson, Katie Githens, Alexander Jones, Rob Lourens, and Michael Naughton. The advisory council is responsible for providing constructive feedback on curriculum and mode of instruction, and for assisting faculty and advisors in organizing events involving Software Engineering students.

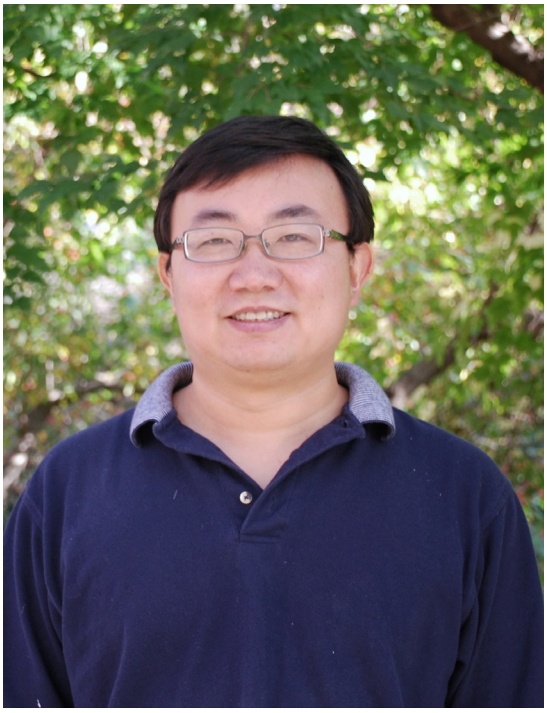
A new Software Engineering External Advisory Board with eight prominent members from the Software Engineering industry has been created. The Advisory Board provides valuable insights on the needs and the current trends of the Software Engineering industry, and helps to further improve the curriculum and the Software Engineering program. Members include Bill Boswell (Siemens), Sam Ellis (IBM), John Gustafson (Intel Labs), Shawn Hanson (Microsoft), Brett Harper (WebFilings), Tom Miller (Microsoft Research), Nicholas J. Multari (Boeing), and Ron Wolf (independent consultant).

At present, the Software Engineering program is seeking outstanding candidates for tenure-track or tenured position that will commence in Fall 2012.

Software Engineering undergraduate program is administered jointly by the College of Liberal Arts & Sciences' Department of Computer Science and the College of Engineering's Department of Electrical and Computer Engineering.

SE faculty include (top, left to right): Samik Basu (Director), Suresh Kothari, Robyn Lutz, Andrew Miner, Tien Nguyen, Hridesh Rajan, Srikanta Tirthapura, and David Weiss (Lanh and Oanh Nguyen Endowed Chair of Software Engineering).

Faculty Profile: Ting Zhang

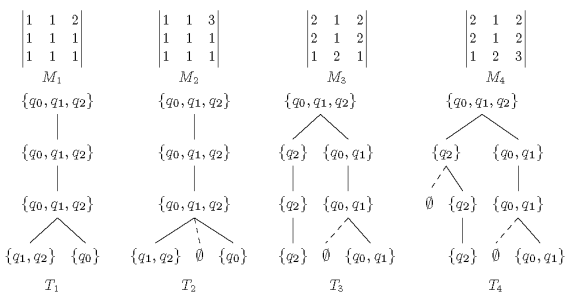


Over the years, the CS Department has developed a strong program in theoretical computing. NSF CAREER Award grantee Ting Zhang is building a research program to guarantee software reliability in large and highly complex software systems, and working towards reaching out to students who resist computing theory in the classroom.

Assistant Professor Ting Zhang is a theory guy. The whiteboard in his office is covered with mathematical symbols; his published papers are half narrative, half mathematical equations, logic trees and algorithms. He teaches computing theory, a subject that many students shy away from because of its difficulty and complexity. "It is unfortunate that some undergraduate students delay taking computing theory to the very last semester of their program, and want to just get through the course as quickly and painlessly as possible. Software complexity is often part of the job these days, as more and more software systems increase in size and complexity, and become safety critical. The companies that develop hardware want good solid code to run their products, but when that code contains millions of lines, and must not fail because failure means endangering human safety or security, we need better ways of verifying that code and making sure that it will work flawlessly. Theory is key in this situation. All of our students need to understand how they can apply computing theory, even though it is difficult to grasp" says Zhang. "I'm afraid that I cannot just make it easy for them, as much as I would like to."

Clearly, Zhang does love theoretical computing. After completing his PhD at Stanford University, Zhang joined Microsoft Research Asia in Beijing, China. The theory group was brand new, and Zhang's work there was not tied to production. "I had a good boss there, and could pretty much research whatever I wanted" he says. "But, one limitation in industry research is that students often come to work only in the summer, as interns. It felt like the collaboration with them was too short, and they were gone so quickly." Zhang made the switch to academia in order to lengthen that collaboration time and to build a research laboratory of his own. "There is more freedom in academia, and I have found that here at ISU the atmosphere is so friendly and open, much more so than I have found in other places. I like that about Iowa State, enough to ignore the cold winters here!" he comments with a smile.

In his research work, Zhang explores the boundaries between the computationally possible and the computationally impossible. One of Zhang's current projects, funded by his NSF CAREER grant, seeks new ways to develop logic-based, computational reasoning techniques to assure correctness, reliability, and security of computer systems. "There are a lot of methods to test for software reliability," says Zhang, "but the current methods are for finite systems, as software systems are finite systems. But," he continues, "what if the software program was an infinite system and therefore testing and verification was likewise infinite? Some of these current software systems we use can seem like infinite systems, especially when it becomes your job to check for bugs! When we define our programming space with mathematics, the potential program space is infinite, and with mathematics and theoretical computing, we can improve our methods, our software, our industries, and our societies."



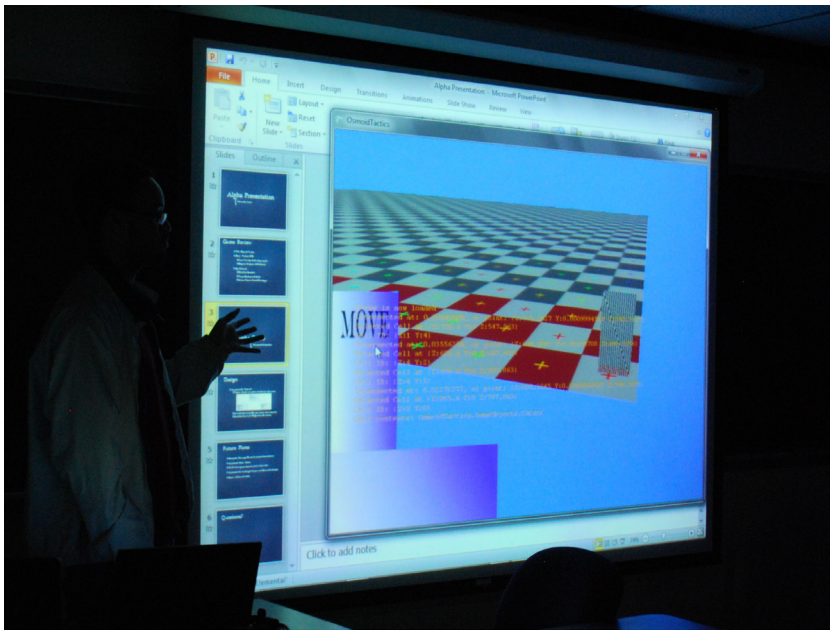
Hierarchical matrix representation, from Cai, Y. and T. Zhang, *Tight Upper Bounds for Streett and Parity Complementation*, Computer Science Logic (CSL) 2011.

As computing students know, theory is sometimes hard to understand, especially when the mathematics involved is complex and requires creative thinking. Zhang uses decision procedures to deal with the infinite domain, which are essentially algorithms that provide a yes/no answer to whether the theory in use, or under examination, holds. Decision procedures help to identify subclasses of logical systems that are decidable, and therefore useful for analysis of software systems. Zhang acknowledges, "sometimes it is very long, and very boring, and people have trouble sticking with it, but, advancing computing theory will make our systems better, stronger, safer, and more reliable." You can visit Zhang's website at www.cs.iastate.edu/~tzhang.

Multimedia Computing Courses Give Students Interested in Game Design Experience and Knowledge in Diverse Areas of Computing

"When I talk about what it was like when our team won the ISU Game Design Competition last spring, their eyes literally light up," says PhD student Titus Klinge, about talking with prospective students who visit the CS department. Game design is one topic in computing that certainly attracts prospective students to the major, but until recently, the department did not have any game-specific training to offer to students. As of spring 2012, we have two experimental courses that been received by students with much success.

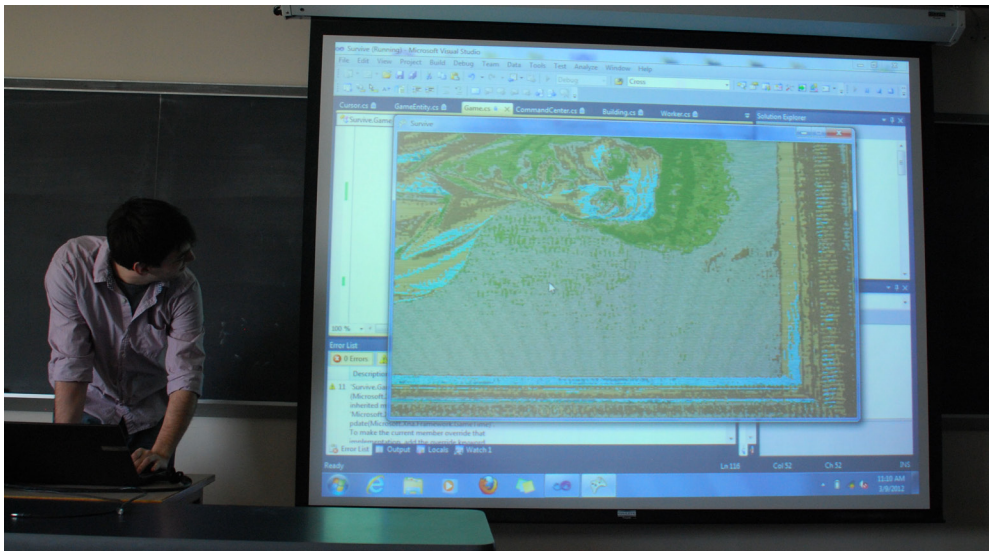
CS 336X, Intro to Computer Graphics, is taught by Steve Kautz, and explores topics including 2D and 3D transformations, 3D viewing, visible surface algorithms, collision detection, illumination models, shading, ray tracing, shadows, transparency and texture mapping. All of these skills are valuable in the next course, CS 437X, Computer Game and Media Programming. "I have been teaching introductory programming for a long time," says Jim Lathrop, one of the leading forces behind establishing gaming courses at ISU. "As instructors, we all have that moment in teaching when we watch students struggle and fight to understand, then finally latch on and produce something that really works... the reaction we see in their faces is incredibly rewarding. We don't always see it again once they learn programming and understand computing. In this class, I am seeing it again, in advanced students. That makes me so excited about leading this effort."



CS437X student Alexander Jones presents a strategy for character movement for a game he is developing as a course project in CS 437.

Department Chair Carl Chang is seeing positive results and supports faculty efforts to establish a more formal program. "Soon, we hope to finalize an interdisciplinary certificate program in Multimedia Interactive Computing, which will give students interested in game design strong training with contextual emphasis in such things as the importance of program response time, interface design, animation, and simulation design, just to name a few," says Department Chair, Carl Chang. "Not only will they gain some knowledge about how a computer game is designed, but at the same time the skills they learn can transfer to other areas such as distributed computing, embedded systems, web development, and any kind of programming that involves simulation." Students who complete the first two years of the CS program and have the basics down will be able to register for courses to work towards the certificate, which will include coursework in the LAS and Design Colleges.

Students are not waiting for the certificate program to formalize a community. They have started their own student club in spring 2012, open to all majors at ISU interested in Game Design.



Left: CS 437X student Sid Pitt shows the class his project, a civilization-like game that includes maps of terrain. The terrain maps will zoom out to show images taken from pop culture, which form the terrain of the game. This terrain is built on Seinfeld's portrait of Kramer.

Advice for Future Computer Game Programmers

Jim Lathrop, the driving force behind the game development courses and curriculum in Computer Science, wants students to know that game development may be comprised of any or all computer science topics, notably networking, graphics, AI, simulations, computational physics, compiler theory, algorithms, game theory, human computer interaction, multimedia programming, distributed computing, among others. Not only do students use their technical skills, but will need to use or develop skills from a number of other disciplines such as art and design, english, film production and business. "Creating games is both challenging and rewarding," says Lathrop, who advises students to polish up their communication skills throughout their degree program. "No matter what industry they work in, these classes will help to develop those extra skills that companies look for in job candidates. The gaming classes are designed to help students strengthen both technical and communication skills, in an environment that brings together much of their prior coursework. Most of all, gaming classes are just a lot of fun!"

Screenshot from Project Tranceploration, third place winner of the ISUGDC, and second place winner of the popular vote. Gregory Hanes was a member of the programming team.

Gregory Hanes, also member of one of the prizewinning 2011 ISU Game Development Competition teams, is a TA for the 2012 spring semester offering of Computer Game and Media Programming. He hopes to work in the gaming industry, although, he notes, "getting into the game development industry is pretty difficult. There are a lot of very talented people who want to do exactly that. The general consensus seems to be that working for a large game development company means low salary for level of expertise and extreme work hours. That being said, it is becoming much, much easier to be successful as an independent game developer, which is where I would rather focus my work."

In game development, Hanes recognizes that nearly all of his computer science courses contribute to his skill. "You won't find a course in the computer science department that can't be applied to game programming, and the computer graphics and game programming courses are extremely helpful in learning the essentials and providing a foundation. That being said, coursework alone probably won't be enough. A lot of companies look for experience working on successful shipped titles, so studying and working outside of the classroom is absolutely essential." He recommends that students who want to design games not wait until they are ready to search for jobs to start. "If you think you're interested in developing games, then start making games! You might find you enjoy playing them more than making them, or you might end up making the next Minecraft or Angry Birds."

Taylor Bergquist, CS senior, was part of the team that won a $10K first prize in the console game category at the 2011 ISU Game Development Contest, held in April 2010. He had some experience working as an independent game programmer, working on projects with friends in his spare time. Taylor registered for the initial offerings of 336X in spring 2011 and 437X in fall 2011. "For future students interested in game design, just remember that computer science skills come first. Game programming has to come second." Taylor recalls being genuinely surprised by the student projects generated from the 437 course. "I assumed that most of us would demonstrate the technical skills fairly well, since we were all upper-level computing students. There were actually a number of well rounded games that showed both technical and artistic talents." Just as he notes that computing comes first, Taylor doesn't necessarily seek to work in the in the gaming industry. "Game development is something I like to do, but not something I intend for my life's work. The skills learned are valuable, but there are always ways to transfer those skills to other areas." Bergquist will be transferring his skills to ISU's graduate program, where he will work with Jack Lutz and the Laboratory for Nanoscale Self-Assembly.

Brittany Oswald Takes Computer Gaming Classes, Develops Educational Game for Toddlers

Brittany Oswald registered for Lathrop's 437X course offering in fall 2011 to continue developing her skills and interests in gaming. Her course project involved building a game for her 3-year old nephew, Frank. In *The Dinosaurs Game*, players act as an herbivore dinosaur, eating plants for health bonuses and avoiding collisions with the T-Rex dinosaurs that roam the screens. "They also learn their colors and some reading skills, since the instructions are written in the color they are supposed to focus on to advance to different levels. I plan to incorporate counting and shape recognition as I continue to develop the game" says Brittany, a junior in Computer Engineering.

Her game was unique for the course, as most students develop games that they themselves are interested in playing. Brittany was developing for a very specific audience. "I learned a lot about how to develop for such a young user. They love bright colors and sound effects. Frank loves dinosaurs. At that age, they interact with a computer on a very different level than adults, so I had to think carefully about the game functions and controls. At first I tried using arrow keys to move the dinosaurs, but a 3-year old does not have the hand-eye coordination skills to make that work. They can move a mouse and watch the screen at the same time, so the movement in the game did not involve things like path finding algorithms, which a lot of other students had to use for their games" says Brittany. "I also had to think about what kind of game is appropriate for the age, and consider what kinds of things parents are looking for. While a lot of games involve attack functions, I didn't want any kind of violence in this game. That's why the main dinosaur character is an herbivore. They only eat plants. The T-Rex drains your health when you run into them, but they only make roaring noises—they don't actually attack you. Frank kept trying to hit the T-Rexes with his dinosaur's tail, like they do in *The Land Before Time*. I may need to develop some kind of competition in the game to indulge that desire but still provide a positive environment for it to play out."

Besides her interest in games, Brittany is also passionate about teaching. "As a TA for Computer Science 104 and 227, I found that I really like teaching programming. Now I am taking Curriculum & Instruction 202, which is about Digital Learning in the 7-12 Classroom. This course is for future teachers, and while it isn't as technical as the courses I am used to, I am getting the teacher's perspective about technology in the classroom" she says. Brittany has a year and a half left in her program, but hopes to land a job building educational games. "I think that with the Millennial learners, technology and interaction is a critical concept for maintaining engagement with learning. I look forward to helping support that in the future."

Above: Brittany shows a screenshot from level 2 of *The Dinosaurs Game*, where players must only eat leaves of a specific color. She hopes to continue expanding gameplay by adding multi-player levels, a function for players to learn counting skills, and increased difficulty settings so players can continue developing hand-eye coordination skills as they progress.

Right: *The Dinosaurs Game* Home Screen

Researchers Aim for Small Computation

Laboratory for Nanoscale Self-Assembly

http://www.cs.iastate.edu/~lnsa

Both the number and the complexity of newly invented DNA nanodevices are growing at rates reminiscent of Moore's law. The research activities of LANSA are fun and productive, and they sometimes have a science fiction flavor, but they are a part of real changes in human technology.

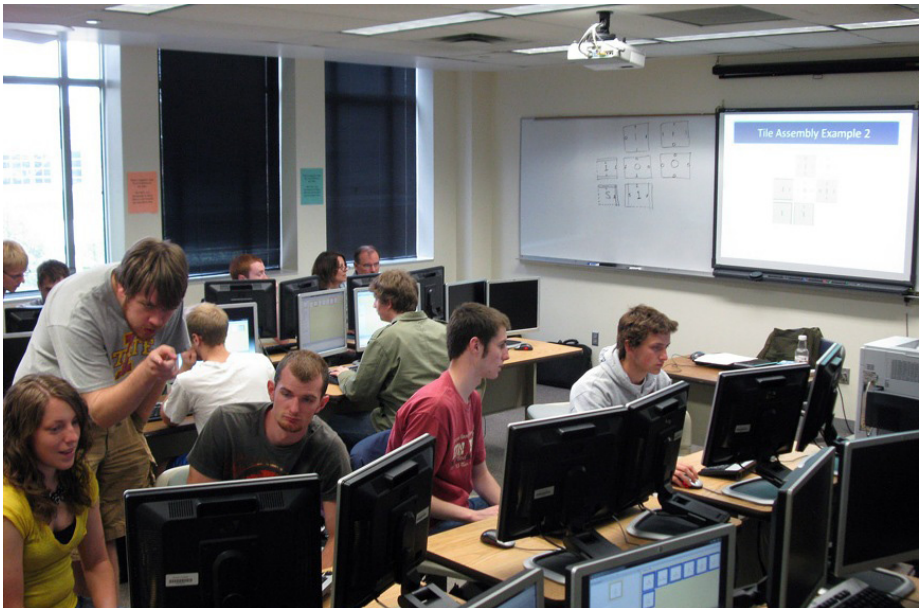
The Laboratory for Algorithmic Nanoscale Self-Assembly (LANSA) is an interdisciplinary group of researchers focusing on molecular programming, also known as DNA nanotechnology. This interdisciplinary new field exploits the information processing capabilities of nucleic acids to design self-assembling, programmable structures and devices at the nanoscale. Research in the past few years has shown how DNA tile self-assembly can implement algorithms; how DNA strand displacement reactions can implement logic circuits, neural networks, and molecular robots; and how DNA origami can create two- and three-dimensional structures that can serve as targeted drug-delivery devices or "nano-breadboards" to which logic gates, sensors, fluorescent signals, or other devices can be attached at up to 200 specified locations at 6-nanometer intervals. (For comparison, a single human cell is typically about 100,000 nanometers in diameter.) The design of molecular programming experiments now requires nontrivial computations involving the dynamics of nucleic acids, and many of the envisioned applications of molecular programming are in systems biology, synthetic biology, and medicine. The research mission of LANSA is to use computer science methods to make DNA nanotechnology more productive, predictable, and safe.

Since LANSA was founded by Computer Science faculty members Jack Lutz and James Lathrop in 2006, it has grown into a vibrant, multidisciplinary group of faculty and students. Participating Computer Science faculty now also include Robyn Lutz, Ting Zhang, Samik Basu, and Steve Kautz. Participating biological sciences faculty include Eric Henderson and John Mayfield (emeritus). The lab has already graduated Ph.D. students David Doty (2009, now a postdoc at Caltech), Matt Patitz (2010, now an assistant professor at the University of Texas-Pan American), and Scott Summers (2010, now an assistant professor at the University of Wisconsin-Platteville). Current Ph.D. students in the lab include Titus Klinge (Computer Science), Divita Mathur (Bioinformatics and Computational Biology), and Donald Stull (Computer Science). Undergraduate students Taylor Bergquist (Computer Science), Dalia Abo Sheasha (Software Engineering), Amanda Ranard (Computer Science and Mathematics), and Marjorie Volk (Computer Science and Spanish) are also contributing to the lab's research. LANSA members Jack and Robyn Lutz are visiting molecular programming labs at Caltech and Microsoft Research Cambridge (UK) during the course of their current sabbatical.

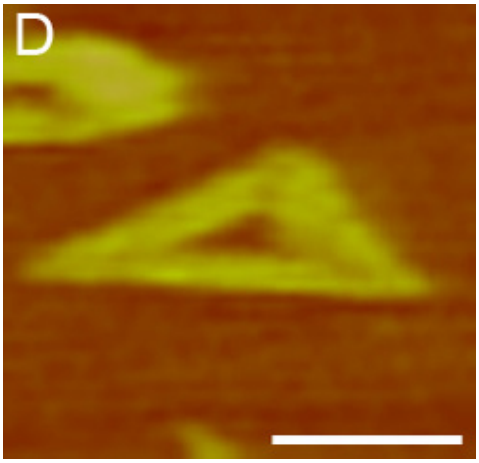
Jim Lathrop leads an ISU - Simpson workshop on DNA tile self-assembly.

A National Science Foundation research grant currently funds LANSA in collaboration with faculty and students at Simpson College in Indianola, IA. The research output of LANSA now includes more than twenty published papers. Topics of these papers include the self-assembly of fractal structures, the power and limitations of various models of self-assembly, the existence of a single tile assembly system that can be initialized to simulate any other, and engineering and verifying requirements for DNA nanodevices. In addition to these topics, the lab's current research is looking for ways to improve the efficiency of DNA strand displacement circuits, increase the number of addressable locations in DNA origami, develop improved software for the design of molecular programming experiments, develop methods for assessing the safety of DNA nanodevices, and determine whether DNA strand displacement reactions can implement arbitrary algorithms.

The faculty members at Simpson participating in the NSF-funded collaboration are Lydia Sinapova (Computer Science), Ron Warnet (Biochemistry), Mark Brodie (Computer Science), and Pat Singer (Molecular Biology). The grant funds educational activities as well as research, and more than a dozen Simpson students are involved. The ISU and Simpson groups have regular joint meetings, alternating the location between their institutions, to coordinate and share results. A recent meeting at Simpson also included a workshop that James Lathrop conducted (with the help of students Taylor Bergquist and Titus Klinge) to give Simpson students a hands-on introduction to in silico tile self-assembly. The workshop was very successful. In fact, one Simpson student designed a completely new tile structure immediately following the workshop. More such workshops are planned. Very recently, Simpson students Joel Garawecki, Adam Smith, Jaris Van Maanen, and Linsey Williams researched, wrote, and submitted a paper on the use of genetic algorithms to optimize tile sets for DNA self-assembly. Each spring at Iowa State (except in 2012 due to sabbatical) Jack Lutz and James Lathrop teach Com S 433/533 (Computational Models of Nanoscale Self-Assembly), a course that changes very, very quickly with the field.



LANSA member Taylor Bergquist helps students at Simpson College understand how to use the ISU Tile Assembly Simulator, a tool developed by lab alumnus Matt Patitz to simulate tile self-assembly in DNA nanotechnology.



Above: Atomic force microscope image of a new kind of DNA origami developed by Divita Mathur and Eric Henderson. This may lead to the design of more complex nanomachines. The white scale bar is 100 nanometers long.

Below top row: Faculty in LANSA include Jack Lutz and Jim Lathrop, Robyn Lutz, Samik Basu, Ting Zhang and Steve Kautz
Bottom row: Students in LANSA include Divita Mathur, Titus Klinge, Marjorie Volk, Donald Stull and Taylor Bergquist

Student Visits to Cargill Help to Dispel the "Cubicle Myth"

"I don't want to work in a cubicle all day" is one of the main reasons students transfer out of the Computer Science program into a different degree program. Despite attempts to help students understand that Computer Science is not a cubicle prison, the myth persists! One of the best ways that we can help students understand what life is truly like in the IT industry is to simply show it to them.

Cargill has been helping us dispel this myth for the past several years by hosting students at IT Headquarters in Minneapolis, MN. Students job shadow Cargill IT employees, many of whom are ISU graduates, and find out that working at their IT headquarters isn't just a solid block of programming hours. "Cargill makes it really easy for our majors to see that there is much more to the job than just writing or fixing programs. Working in the IT industry involves much more! Employees meet with customers, consult with team members, and do a lot of brainstorming and creative work in their jobs," says Gloria Cain, CS and SE undergraduate advisor. "Students really enjoy the trip and learn a lot about what it means to work not just at Cargill but in the IT industry as a whole."

Cargill hosted ISU students from Computer Science, Software Engineering, Computer Engineering, and Finance/Accounting majors on February 17th (photo - right). The day-long trip includes informational presentations about Cargill and the opportunities available for future graduates of the ISU programs that participate. Cargill also uses part of the day to match up students with real professionals who demonstrate their jobs to the students on the actual jobsite.

"It takes a lot of effort for Cargill to coordinate and organize this trip for our students, and they do a fantastic job" says Cain. "The students that do participate in the trip learn quickly to see beyond the cubicle."

Student attendees included (l-r) Dominque Eason, Hannah Hansen, Sarah Kabala, Sarah Baugh, Cassidy Williams, and Elizabeth Baugh.

Six ISU Students Attended 2011 Grace Hopper Celebration of Women in Computing

Six ISU students attended the 2011 Grace Hopper Celebration for Women in Computing in Portland, Oregon. The department thanks Cerner Corporation, who paid the students' registration fees, and faculty sponsors who paid partial travel expenses. The CS and ECpE departments covered the remainder of travel expenses. The Grace Hopper Celebration of Women in Computing is a series of conferences designed to bring the research and career interests of women in computing to the forefront. Keynote speakers in 2011 included Sheryl Sandberg, Chief Operating Officer of Facebook, and Shirley Ann Jackson, President of Rensselaer Polytechnic Institute. Over 2,900 participants attended the GHC 2011. The students enjoyed the career fair at the conference, where they were able to make connections with a range of tech companies, and universities recruiting for their graduate programs. The conference held a wide range of breakout sessions where students could learn about issues affecting women in the computing industries and academia.

Recruitment and Retention Committee Hosting Computational Thinking Workshops, Competition this Spring

The Computational Thinking Competition (CTC) is the final event in spring 2012 for the ISU Computer Science Department Recruitment and Retention (R&R) committee's year-long work to raise awareness of and integrate computing concepts into the Iowa K-12 classroom. All K-12 students in Iowa are welcome to participate in the competition. Faculty in the R&R committee have been busy during the entire school year holding K-12 workshops for computational thinking, visiting schools and holding "family/student programming nights" at many schools in Iowa, participating in elementary and jr. high science nights, hosting exhibits at the mathematics and science teachers state conferences and networking with the central Iowa 4-H organization. Dr. Miller has delivered talks on incorporating programming into existing mathematics curriculum at the Iowa Mathematics Teacher's Conference, and at the Iowa division of the Real World Design Challenge to spread the word. Approximately 250 students attended workshops in computational thinking and Scratch programming this year, making a strong turnout for the competition likely. The faculty team even traveled to Council Bluffs for a Saturday workshop in February. "A lot of kids in Iowa don't get exposure to computational thinking concepts," says the committee, "and this work should help draw attention to the benefits of understanding problems within a computational framework."

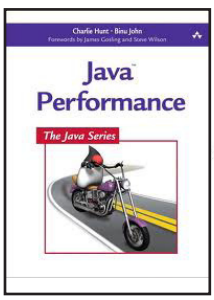
Les Miller conducts a Scratch workshop with junior high students and their parents.

These efforts are intended to help students, parents, teachers, and school administrators recognize the benefits of learning about computational thinking and how it can be used to prepare students for college and future careers in our technological society. Perhaps more important the efforts are intended to make computational thinking a key tool for K-12 students to deepen their understanding of the science and mathematics that the study. In a one on one experiment, Dr. Miller is working with a sixth grade social studies teacher from Perry, Iowa to illustrate how computational thinking can be used in areas other than science and mathematics.

Ultimately, better exposure to computational thinking concepts and basic programming will result in students who understand what computer science is and are prepared to learn more advanced programming concepts in the college classroom. While some students enter the CS degree program with some programming experience, most do not; many high schools offer computer applications classes, but are targeted towards users rather than developers. Future efforts of the committee may involve forming workshops for teachers rather than students, so that they can take their understanding and incorporate it into their classrooms.

The Computational Thinking Competition is on Saturday April 14 in Atanasoff Hall. Over 25 individuals and teams will compete. Prizes for the top three winners in each division of the competition (elementary, jr. high, and high school) include:

1st place: Dell Inspiron 14" Laptop Computer
2nd place: Acer Inspire 1 - 11.6" Netbook
3rd place: Apple i-Pod Nano



IOWA STATE UNIVERSITY
Department of Computer Science

Iowa 4-H

IEEE computer society

The 2012 Computational Thinking Competition is sponsored by the ISU Department of Computer Science, Iowa 4-H, the IEEE Computer Society Educational Activities Board, Charlie & Barb Hunt, Wallapak Tavanapong, and Johnny Wong. Thank you to our sponsors! Visit the competition website at **www.cs.iastate.edu/ctc.shtml.**

ISU Team Wins at Regional ACM-ICPC, Will Travel to World Finals in May

Three students will be traveling as a team to the ACM-ICPC World Finals at the University of Warsaw, Poland this May. Devon Eilers (MIS), Kerrick Staley (Comp Engr) and Bryce Sandlund (Com Sci) placed second at the ICPC Regional Competition at the University of Nebraska-Lincoln last November, qualifying them for the trip to Warsaw. According to the ACM-ICPC organizers, 25,016 students participated in the worldwide regional competitions. Only 336 individuals were invited to the World Finals. Eilers, Staley, and Sandlund will be competing against students from MIT, Stanford, and Carnegie Mellon, as well as other top universities around the globe.

The students credit Simanta Mitra, their faculty coach, for their upcoming trip to Poland. "During the competition, another team requested clarification on a solution to a problem. In response, the judges added a rule that didn't exist at the start of the competition. We had already solved this problem prior to the new rule being set, and our solution had been accepted, and we had solved enough problems that thought we were going to the finals! But this new rule made our solution to that one problem void, so they counted it wrong with only two minutes of time left, and then we *weren't* going to the finals. On our behalf, Dr. Mitra filed a formal appeal with the ACM and he was successful, so then we *were* going to the finals. We were excited, then disappointed, and then excited again. It was like an emotional roller coaster!" they said.

The regional competition was the first ACM-ICPC that the students had participated in. All three say that friends of theirs who participated in previous years had suggested the competition to them. "We organized our team the night before," Staley says. "But that's okay...you can strategize all you want about how you will go about solving the problems. Then, you find out that the problems given in the competition don't fit your strategy, and you have to improvise anyway. The problems got harder and harder as the competition progressed, so that was when it was critical for us to work as a team and use our different skills to finds solutions." Eilers notes that the problems were not like the ones seen in classes or textbooks. "They might look easy, but they were pretty tricky and you really had to think about the problem before writing anything down." Sandlund agrees, "in classes, the problems are all laid out for you, and the solutions are related to things you have learned in the class. You don't have to invent any new approaches, just use the ones you have been taught. So, this competition showed all of us a different way of thinking about problem solving."

Problems were worked out with a variety of methods. Some were worked out all together, some with just two members, and others solved by just one member of the team. Staley did most of the code writing on the computer, with Sandlund and Eilers monitoring and brainstorming. Sandlund solved one problem that no one else at the Lincoln regionals successfully submitted to the judges, and another one on paper that wasn't implemented because of time restrictions. "Our solutions in the regionals were sometimes quick and dirty, but they got the job done. Other teams were writing more efficient code," says Staley. Sandlund sees the best strategy for finding solutions to be the easiest one to code that will complete with successful output in the given time constraints, which is about 45 seconds for each problem. Each team member brings something unique to the process. Staley is good at time management and fast coding, Eilers recognizes underlying difficulty in a seemingly simple problem, and Sandlund is good at balancing thinking and doing - a critical skill for recognizing when to stop planning and start coding. They all have good programming skills.

They all agree that their academic programs and the coursework they have taken have taught them valuable skills that were put to use in the regionals, and will be put to use in the final competition. "We all have worked as teaching assistants for computer science courses, and that has really improved our own coding skills. As TA for Com Sci 207, I have definitely improved my debugging skills by reviewing other people's code," Eilers says. Staley was a TA for Comp E 185, and his job was to help students solve problems with their buggy code. Sandlund worked as a TA for Com Sci 228. All three say that programming on their own is perhaps the best way to prepare for the World Finals.

"They're ready," says Mitra. "They'll do just fine." Best of luck to them from the Computer Science Department!

Devon Eilers

Major: Management Information Systems
Minor in Computer Science
Hometown: Quincy, Illinois
Long term goal: Software development and IT management
Team skills: Recognizing when a problem might look easy, but will involve a complex solution; avoiding common programming traps

"I'm really excited about going to Warsaw! But I still have to get a passport! When we went to the regionals last fall, I wasn't really expecting to travel, but here we are! The ACM-ICPC is a great experience, and I would definitely encourage other students to participate in the future. You might find out all of a sudden that you need a passport too!"

Kerrick Staley

Majors: Electrical & Computer Engineering, Mathematics
Minor in Computer Science
Hometown: Des Moines, Iowa
Long term goal: Grad school, human-computer interaction
Team skills: Fast programming skills, recognizing buggy code, creative problem solving, and managing time in a competitive setting.

"All three of us have to get passports - none of us have traveled outside of the US before! I am looking forward to meeting and competing with the other teams from such prestigious schools, and visiting Warsaw and seeing the city. And who knows, I was honestly kind of surprised by our success at regionals, maybe I'll be surprised again at the World Finals!"

Bryce Sandlund

Major: Computer Science
Hometown: St. Charles, Illinois
Long term goal: Haven't decided, but something extraordinary!
Team skills: Java API, paper-based programming solutions

"We're getting ready...doing practice competitions online and we're going to another competition in Chicago this April. Thank you Dr. Mitra for helping us get this far! It has been a lot of fun and it was great meeting other students from universities in the Midwest. I look forward to meeting other students from around the world in May!"

Jyotishman Pathak (PhD 2007) Works at the Forefront of Genomic Medicine, Advancing Research in Personalized Medicine

Personalized medicine is a new development emerging from the genomic revolution, promising to improve patient care by enabling doctors to custom tailor treatments to individuals based on their genetic, environmental, and behavioral data. Personalized medicine aims for treatments that will offer the best effectiveness with the least amount of side effects. Jyotishman Pathak (PhD, 2007) is working with doctors, researchers, and other healthcare professionals to achieve that vision at Mayo Clinic in Rochester, Minnesota.

"We are slowly, but steadily, entering into the era of genome medicine, where therapeutics is getting personalized. In other words, instead of adopting a en-masse approach to disease treatment, patients will be offered very personalized treatment plans based on their genetic makeup," says Pathak, whose research work as a graduate student was based in improving web services. Genomic medicine involves massive amounts of data, and Jyotishman's background in computing provided him with the skills to make a profound impact. He works with projects associated with the Cancer Biomedical Informatics Grid (caBIG), the National Center for Biomedical Ontologies (NCBO), and the Mayo Clinic-University of Minnesota Bioscience partnership (The Minnesota Partnership). Specifically, he is investigating research methodologies in ontology discovery, distributed reasoning, collaborative knowledge authoring, and semantic workflow composition. "While I am not directly involved in treating patients, on a daily basis I work with people who are. Informatics and Health Information Technology have become indispensable for the next generation of healthcare. Mayo Clinic, as you may know, is one of the leaders in the healthcare arena. From the institutional environment to the people you work with, Mayo Clinic is simply phenomenal. I have visited several other academic medical centers during my tenure here at Mayo, and yet to come across any institution that can 'pull a Mayo'."

Samik Basu, Associate Professor and member of Pathak's PhD committee, says that Pathak was a great student, particularly because he was driven and aggressive in pursuing his own research agenda. "Jyotishman was focused on web services and information extraction and integration. In 2006, he won best research paper award at ICTAI for his work on the MosCoe project. His research interests brought me, Vasant Honavar, and Robyn Lutz together, and helped us to develop our 2007 NSF project, *Interactive and Verifiable Composition of Web Services to Satisfy End-User Goals*. Most research grants don't start with a graduate student, but in this case, Jyotishman was a critical part of the process."

As a student, Pathak recognizes his own personal characteristics as a scholar that helped him achieve his goals. "I was always very proactive in publishing papers and abstracts during my grad school days, mostly as lead author. I think that has tremendously helped me to hone my writing skills, and I am indebted to my mentors for their motivation and support. Of course, I also got the chance to visit Hawaii, Zurich, and Bremen to attend conferences" he says. At the same time, he recognizes that his training at ISU was invaluable. "Most importantly, ISU provided me with an environment where I could objectively pursue my own research agenda, and yet still benefit from funded grant projects. Dr. Honavar, and in particular Dr. Basu, were excellent mentors. Not only did they help me mature as a student and researcher, but also pushed my boundaries, to make me think independently and often outside the box."

That "outside the box" thinking makes Pathak an excellent fit for the Mayo Clinic, known for its innovative approaches to patient care, research and education. "Being a Mayo Clinic employee, you always put the needs of the patients first. I hope that my work continues to improve the delivery of patient care by making it more efficient, effective (both in terms of cost and treatment efficacy), and innovative" says Jyotishman. His website is www.cs.iastate.edu/~jpathak

Fadi Towfic, a recent PhD graduate from the Computer Science department and the BCB PhD program, has joined Dr. Ramnik J. Xavier's lab at the Broad Institute of MIT and Harvard and the Center for Computational and Integrative Biology at Massachusetts General Hospital. At Iowa State University, Fadi worked under Vasant Honavar and Heather Greenlee, and prior to that had earned dual Bachelor degrees in Computer Science and Biology (Genetics/Biotechnology track) from the University of Iowa, with a minor in Chemistry.

Fadi has always been interested in applying techniques from computer science to problems in biology and medicine. "My main research interest in bioinformatics is in the development of algorithms for identification and comparison of genes and gene interactions that contribute to disease (especially inflammatory bowel disease and Type 1 diabetes). Among the many applications of these algorithms are methods for finding drug action mechanism and disease pathophysiology. I hope to continue to apply what I have learned at Iowa State and the kind mentorship I am receiving from Dr. Ramnik Xavier at the Broad Institute to push forward the state-of-the-art in hypothesis-driven discovery in biology and medicine."

In his new position, Fadi is seeking to address critical problems related to disease, and ways to directly benefit patients by establishing disease mechanism, developing drugs, and more accurate and more early diagnosis for patients. "Through Dr. Xavier's position [as the Kurt Isselbacher Associate Professor of Medicine at Harvard Medical School and the Chief of Gastroenterology at the Massachusetts General Hospital, Director of the Center for the Study of Inflammatory Bowel Disease (CSIBD) and a Senior Associate Member of the Broad Institute of MIT and Harvard] we have direct access to patients as part of one of the top research hospitals in the United States. We can have real patient impact and improve the quality of care and quality of life for individuals suffering from inflammatory bowel disease. "

Fadi believes that his training in computational biology at Iowa State prepared him well for the challenges and opportunities presented by human disease. "Here at ISU, one of the projects I worked on involved developing algorithms for detecting pathways related to how cells develop in the eye, with the goal of understanding how rods and cones differentiate and how such biological processes can break down and lead to blindness. The methods we published have been applied to detect how B cells detect antigens from foreign molecules and genes whose function has been conserved throughout evolution. I hope to continue my research endeavors at the Broad next year as a Computational Biologist and begin to test my methods in real-world settings that impact patients positively."

Fadi names critical thinking and leadership skills as important to his success, in addition to his technical skills as a computational biologist. "My studies at ISU have enabled me to be highly engaged in both research and modern computing applications. The bi-yearly poster sessions, frequent seminars and colloquia held by both the Computer Science Department and Bioinformatics program, and my involvement in the BCBLab (a student-led scientific consulting organization at Iowa State) enabled me to develop a wide variety of necessary critical thinking, collaborative, and leadership skills that are required in the highly cooperative research done today."

Fadi graduated from Computer Science and BCB in spring 2011. He received a 2011 Research Excellence Award for his dissertation *Modular Algorithms for Biomolecular Network Alignment*. His website is www.broadinstitute.org/~towfic/

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ALL SCIENCE IS COMPUTER SCIENCE