DIGITAL DEFENDERS

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Jockeying for genetic advantage
Faculty entrepreneur uses DNA analysis to evaluate Thoroughbreds
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From the President

Since my arrival at Binghamton in January, I have been impressed by the quality and diversity of the University’s robust research portfolio. As you’ll see in this issue of Binghamton Research, our faculty members make a difference in numerous disciplines, from information security to Thoroughbred genetics. Our students also make meaningful contributions, in fields ranging from French history to user interface design.

We’re working to leverage these strengths for the good of our community and the state through our NYSUNY 2020 plan, which calls for a new focus on smart energy research and development. This exciting proposal will build on our work in solar and thermoelectric energy harvesting, energy storage technologies, energy-efficient electronic systems and sensing devices. It has the potential to revive the Greater Binghamton economy while making a transformational impact on our society.

We also have some exciting new construction on campus. The steel is up for our Center of Excellence building, researchers have begun moving their labs into our new vivarium and our first facility built for research from the ground up opened last fall. Turn to Pages 38-39 to check out the unique features of the Engineering and Science Building.

Harvey Stenger

From the Interim Vice President for Research

Binghamton prides itself on being an entrepreneurial university. We encourage faculty and students alike to innovate, to be creative, even to start a business. We stress the ways that entrepreneurial thinking can benefit students in fields ranging from cinema to public administration.

Looking through our roster of research sponsors, I’m struck by the number of industrial partnerships we have developed. Indeed, some 17 percent of sponsored research at Binghamton is supported by industry, outpacing the national average of just below 6 percent. We recently established a new non-exclusive, royalty-free, express license for some of these partners (details of the BEST Deal are on Page 6). And this year, technology transfer and licensing fees will hit an all-time high.

In my own work as a mechanical engineer, I’ve seen how a relationship between the academy and industry can pay off. Real-world problems spur researchers to reach higher. Students and the marketplace alike can benefit from this interaction, too. That’s one reason I’m so excited to be a part of Binghamton’s new Industry/University Cooperative Research Center in Energy-Efficient Electronic Systems. The center, supported by both member companies and the National Science Foundation, is poised to contribute important discoveries in information technology, telecommunications, electronic systems and cooling equipment (learn more on Page 7).

Bahgat Sammakia
Breakthrough may have implications for superconductors

Sometimes your worst enemy can become your best friend.

That idea provided motivation for the latest breakthrough from Binghamton physicist Michael Lawler and his colleagues, who are searching for the mechanism of high-temperature superconductivity.

“Bad” metals, ones that have trouble carrying any electrical current, can become superconductors under the right conditions. "How is it that something that doesn’t conduct normal electricity well becomes such a great superconductor?” asks Lawler, a theorist. He hopes to answer that question, in part by studying materials called cuprates and examining their electronic structure.

The data he and his colleagues analyzed have been available for several years, but have not been well understood. Their findings, that liquid crystal phenomena appear active in cuprate materials, were published last year in the journal *Science*.

Superconductors are materials that conduct electricity without resistance below a certain temperature. For decades, it was thought that these materials could conduct electricity only at temperatures far below freezing. Since 1987, however, scientists have discovered several compounds that superconduct at much higher temperatures. Development of this technology could lead to dramatic advances in the delivery of electricity to homes and businesses as well as to improvements in cell phone towers and even high-speed trains.

In low-temperature superconductors, the vibration of the atoms is the mechanism of superconductivity. Put simply, Lawler says: “Electrons like to do things together.” Positively charged atoms and negatively charged electrons work together to produce the effect. In high-temperature superconductors, on the other hand, how the electrons begin to work together is not clear.

Lawler and his colleagues believe that the “pseudogap phenomenon,” the vanishing of the low-energy electronic excitations in high-temperature superconductors, is the key to understanding these materials. The team developed a theory related to electronic liquid crystal patterns in these materials and then put it to the test.

What they found can be compared to the design of the American flag. Think of the stars; that’s a crystal pattern. Now think of the stripes; that’s the sort of pattern formed by atoms in “smectic” liquid crystals. It turns out that such “stripes” also arise in cuprate superconductors — keep in mind that each one is only a few atoms thick — but are frequently disturbed by tornado-like vortices. These disturbances take the form of an added or missing stripe in the pattern.

When the physicists examined the sites of these disturbances using a scanning tunneling microscope, they found that there was a connection between the vortices and another pattern they discovered earlier. The earlier study revealed a broken symmetry in which electrons flow more easily in, say, the X-direction than the Y-direction.

“In a problem that has gone unsolved for more than 20 years, it is remarkable to find a connection between theory and experiment at this level,” Lawler says. “It is possible that the patterns we focus on inhibit the regular flow of electricity but also help electrons act together to overcome this obstacle. In other words, this could be an enemy that becomes a friend.”

— Rachel Coker

Michael Lawler, who joined Binghamton’s faculty in 2008, collaborated on this work with researchers at Cornell University, Brookhaven National Laboratory, Harvard University and institutions in the Netherlands, Japan and the United Kingdom. To read their paper in the journal *Science*, visit go.binghamton.edu/cuprates.
Training a critical eye on a British ideal

Praseeda Gopinath critiques what she calls the “English gentleman ideal.” She has studied this ideal in the British Empire for years and is interested in how the ideal transforms in modern-day Great Britain.

“My research is about what happens to the ideal as the Empire declines because it is so tied to the Empire,” says Gopinath, an assistant professor of English. “What happens to that ideal, which was an embodiment of the imperial nation, in the second half of the 20th century?”

It’s a question she answers in her book Scarecrows of Chivalry: The Literature of English Masculinities after Empire, to be published later this year.

Gopinath is interested in the idea of the well-mannered, leadership-driven “good Englishman” who was turned out by boarding schools with a certain set of traits to be used to rule the country and the Empire. These traits, she notes, only emerged in hierarchical relation to those considered inferior: the colonized, the working class and women.

The subject attracted her attention when she read P.G. Wodehouse novels as a teenager. “They were comedic, entertaining novels about the upper crust of England, full of style and wit,” she says. “But still, no one talked about the Empire, or how and where Wodehouse’s silly, rich gentlemen were getting their money or how they got away with being such idiots.”

Gopinath has written on diverse topics, from James Bond to George Orwell. She has also covered case studies of modern-day representations of the “likeable” Englishman, like Hugh Grant in his many romantic comedies. In her next project, she will examine the relationship between the BBC and the British Empire.

Kafka scholar links teaching, research

Neil Christian Pages does more than encourage his undergraduates to engage in research. He gives them the tools they need to demystify the literary academy.

A figurine made of thread — a student’s representation of the character Odradek from Franz Kafka’s The Cares of the Father of the Family — hangs in Pages’ office. It’s material proof of the way his students engage with Kafka in the classroom and beyond.

“I’m astounded by the extent to which they are able to bring to bear critical approaches to representation based on their readings,” he says. “They are inspired by the texts in such a way as to understand how the texts have inspired others.”

With support from the National Endowment for the Humanities as well as Binghamton’s Institute for Advanced Studies in the Humanities, Pages recently had time to consider his work at the intersection of teaching and research. “As Paul de Man once said, ‘All scholarship has to be eminently teachable in order to be scholarship,’” Pages says. “The two have to be intertwined. Good teaching comes from research.”

Pages is interested in Kafka’s continuing influence not only on literary scholarship but on musicians, artists, writers and others. He helps undergraduates see how critics construct arguments and understand the background that scholars such as Harold Bloom and Jacques Derrida bring to Kafka’s work.

Even those who read Kafka in English seem excited by what they find. “That’s one of the interesting things about Kafka,” Pages says. “An American audience feels it has access to him without going through a translator, even though he is translated.”
Can evolution lead to better cities?

Evolutionary biologist David Sloan Wilson’s latest book, *The Neighborhood Project: Using Evolution to Improve My City, One Block at a Time*, follows him through a somewhat radical experiment: He adopts his hometown as his study organism.

“I’m studying my city of Binghamton not as an aloof scientist but because I think my expertise can make a difference,” Wilson writes. “Just as we need the physical sciences to build the physical structure of the city, we need evolutionary science to understand and manage the life that takes place within the city. … If we can improve the quality of life in Binghamton, then we can become a model for cities everywhere.”

The book, which is part memoir, part how-to guide, was published last fall. It has created a stir in the scientific community and beyond, with reviews in *The Wall Street Journal, The New York Times* and the journal *Nature*, among other publications.

Wilson, a distinguished professor of biology and anthropology, is also the director of Binghamton’s unique Evolutionary Studies program, which takes an integrated, multidisciplinary approach to teaching and research related to evolution.

Industry gets the ‘BEST’ deal

Binghamton University now can offer companies that collaborate on R&D projects a simplified way to use inventions arising from sponsored research.

The Binghamton Express Square Terms (BEST) Deal License is a non-exclusive, royalty-free, paid-up license.

“This is an innovative way for us to engage industry partners,” says Bahgat Sammakia, interim vice president for research. “We are eager to remain a leader in developing research collaborations with companies around the world, and the BEST Deal can help us do just that.”

About 17 percent of Binghamton’s research awards come from business and industry. Industrial support accounted for just 6 percent of academic R&D funding nationwide, according to the National Science Foundation.

The time-saving and cost-effective licensing process is a natural result of Binghamton’s ongoing work with the private sector, says Eugene Krentsel, assistant vice president for entrepreneurship and innovation partnerships. “We listen to industry and are interested in understanding their needs,” he says. “Companies say simplicity and predictability are their biggest concerns about licensing.”

Participating firms pay a one-time license fee of $1,000 for each U.S. or foreign patent application filed and made part of the license. They also compensate the University for expenses related to acquiring patent rights they request. Krentsel says the low-cost deal fits companies large and small. “Our nominal fee is a trivial expense when it comes to protecting potentially important discoveries,” he says. “Firms could easily spend more than that just on legal fees related to negotiations.”
Binghamton University will be the focal point for this collaborative effort; partners Villanova University and the University of Texas at Arlington will have support centers on their campuses as well.

Focusing initially on data centers, the center will seek ways to allow electronic systems to monitor and regulate the amount of energy they use. As it stands, the energy spent on running data centers in the United States is about 2.5 percent of the total national energy expenditure, which is enough to power a couple of medium-sized cities for most of the year.

As the number of data centers increases with demand for online services, the need for greater energy efficiency becomes more apparent. Reducing energy consumption in data centers will save millions of dollars and may offer solutions to energy consumption problems in many areas of the electronics industry — from cell phones to e-commerce.

The center is also looking to the future by providing industry-relevant training opportunities. “The center is committed to strengthening the United States’ competitiveness in the electronics industry,” says Kanad Ghose, chair of Binghamton’s computer science department and E3S site director. “By attracting talented and motivated students to work with outstanding researchers and industry leaders, we can train the next generation to be the kind of broad-based scientists and engineers that the industry is going to need in the future.”

Industry center members have identified a few promising projects, including research associated with energy-efficient scheduling of workload, servers and cooling systems, the design of micro-scale servers and analyzing the effects of airflow and dynamics.

“E3S will play a key role in establishing deep partnerships between industry and academia,” says Kushagra Vaid, general manager of datacenter hardware engineering at Microsoft. “Our goal is to jointly deliver breakthrough concepts for next-generation cloud infrastructure. Microsoft is proud to be on the advisory board for this research center.”

— Gail Glover

Universities, industry team up for ‘greener’ electronics

Led by researchers at Binghamton University and its partners, the new Industry/University Cooperative Research Center in Energy-Efficient Electronic Systems (E3S) links the fields of information technology, telecommunications, electronic systems and cooling equipment. The center’s holistic approach to energy efficiency could save millions of dollars and lead to a “greener” electronics industry.

Funded in part by the National Science Foundation, the center’s primary support will come from the industry center members with whom researchers will work on projects of mutual interest. Fifteen companies representing the entire supply chain for data centers — from hardware manufacturing and software development to end-users — have signed up as members. The list includes industry leaders such as Microsoft, IBM, Facebook, Bloomberg, General Electric, Corning Inc., Endicott Interconnect Technologies and Emerson Network Power. The New York State Energy Research and Development Authority is also involved.

“The center will address energy efficiencies in a way that has not been tackled before,” says Bahgat Sammakia, interim vice president for research at Binghamton University and E3S director. “By looking at energy efficiency problems holistically — that is, from all angles and across many disciplines — the center will provide the kind of answers that leaders in the electronics industry are looking for.”
DIGITAL DEFENDERS

From Nanny Chips to Data Dogs, Binghamton innovations will make computing safer
Information security matters to anyone who uses a computer. These days, of course, that includes not only engineers at major corporations but artists and even kindergartners. We strive to think of clever passwords, take pains to back up our data and buy virus protection for our computers.

Consider, however, the ways that the term “computer” is expanding. Cell phones, tablets and other devices are part of this landscape, too. What happens if you lose your smart phone? Maybe you’re concerned about your password for online banking or the contents of your address book. Now imagine your worries if you work for the Department of Defense.

Binghamton University researchers work through these and numerous other scenarios every day in hopes of protecting individuals and the nation alike from hackers. And while traditional approaches have often relied on software modifications, several of the latest innovations aim to provide built-in security with improved hardware.

“Every day, hundreds of thousands of hackers try to attack America’s cyberinfrastructure,” says Yu Chen, assistant professor of electrical and computer engineering at Binghamton. There are already real-world examples of cyber warfare, he notes, citing conflicts between Israelis and Palestinians and between Russia and Georgia in the last several years.

Chen develops hardware that can be integrated into a network and detect attacks automatically. It’s vital to raise the alarm quickly, he says, given that an attack can affect hundreds of thousands of machines in seconds.

Nael Abu-Ghazaleh and Dmitry Ponomarev, both associate professors of computer science at Binghamton, collaborate on a variety of projects. Like Chen, they envision a future in which wars are fought digitally, potentially without a single soldier on a battlefield. They believe it makes sense to engineer systems for security, rather than “build a dam and try to plug the holes later,” as Abu-Ghazaleh puts it.

“Security is a classic example of evolution,” he says. “There’s a constant battle between black hats and white hats, and it’s not even clear who the black hats and the white hats are a lot of the time.”

Ponomarev and Abu-Ghazaleh say it’s shortsighted to focus on performance...
without attention to security. They’d like to arm devices with a “Nanny Chip” and other features that make life more difficult for would-be attackers.

The ‘Nanny Chip’

Ponomarev and Abu-Ghazaleh see new threats as well as new opportunities as computer architecture undergoes a period of rapid change.

Moore’s Law, which predicted that the number of transistors on a chip would double every 18 months to two years, has held up for decades. But many experts now expect a breakdown in Moore’s Law, which is driving manufacturers to place processors with multiple cores onto a single chip. This “multi-core” approach improves speed and performance but can open new avenues of attack.

“Things have been really, really good,” Abu-Ghazaleh says. “Computer architecture performance has been improving at such a rapid rate, eclipsing probably any other human system. But physics and some other developments have put us at a point where we can’t do things the way we have been. Moore’s Law is coming to a screeching halt.”

Most modern processors run multiple programs at the same time. The main program is running, but there is also hardware available to run something else. Abu-Ghazaleh and Ponomarev propose using the “spare” hardware as a baby sitter — a “Nanny Chip” or “Nanny Core,” if you will.

When computer programs run, there are expected behaviors. You can check up on them just like a nanny would check on a toddler who has been told he can play in a certain section of a playground. “It’s OK if we let our kids do something wrong as long as we catch them soon after, right?” asks Abu-Ghazaleh. “Permanent changes to the system are done at something called the system call boundary. As long as we’re OK when the system call happens, it’s all right.”

This kind of protection is called reference monitoring. As instructions exit a program, the “Nanny Core” makes sure that the program follows the established rules.

Ponomarev and Abu-Ghazaleh are also working on a related defense against a major class of vulnerabilities called code injection. Let’s say you have a Web form in which you ask for someone’s name and address. A hacker can put in not just that type of data but files from which she’s able to generate a new program within your machine. Her code has been “injected” into your server.

In this scenario, the “nanny” assumes that any data coming from outside the program is not to be trusted.

“Let’s say I have a Web server and the bad guys connect to it and provide some garbage,” Abu-Ghazaleh says. “I want to treat that data carefully. What we do is mark that data as untrustworthy, and any data that it touches is also suspicious. Then, as we are running our program, we check what it is doing with this bad data. We catch, let’s say, a branch that is generated by this bad data, and we know this data should never cause a branch.”

There’s a major drawback to this approach, known as “information flow tracking,” however: It can slow down a program considerably.

Glossary

Computer architecture: The design of a computer system. It sets the standard for all devices that connect to it and all the software that runs on it. It is based on the type of programs that will run (business, scientific) and the number of programs that run concurrently.

Encryption: The reversible transformation of data from the original to a difficult-to-interpret format as a mechanism for protecting its confidentiality, integrity and sometimes its authenticity.

Multi-core chip: A computer chip that contains more than one CPU (processing unit). Multi-core chips allow for greater increases in computing power than a single CPU continually made to run faster.

Source: PC Magazine
Ponomarev says they’re proposing one small change in hardware that doesn’t touch the rest of the carefully designed architecture. It’s a small box at the back end of the processor pipeline, and they’ve even built the necessary VSLI circuits using Sun Microsystem’s public core as a demonstration.

Essentially, they propose using several cores for security purposes only, rather than having a machine fire up every core to run programs. The security cores would be activated on demand, rather than being “on” all the time, which would demand more power.

“Architecture changes are difficult except if they are not difficult,” Abu-Ghazaleh says. “If they’re small and don’t touch the major structures that Intel and AMD have spent a ton of their energies optimizing, then it becomes feasible. That’s a principle we stick to. Yes, we have to make these changes, but let’s do them in a way that makes it possible for these companies to adopt them.”

A ‘Data Dog’
Across campus, Chen has many of the same motivations that drive Abu-Ghazaleh and Ponomarev. They also share research sponsors: Both the National Science Foundation and the Air Force have taken an interest in this work.
Chen’s latest project is a scheme to improve data security for mobile devices, a “Data Dog” that would stand guard and protect a cell phone or tablet even if it is lost or stolen.

“Mobile devices are concerned with computing power and memory,” Chen says. “A cell phone doesn’t normally have the power to fend off a strong attack.”

He proposes using a technique called “out-of-order data division” to strengthen security for these devices. Normally, once a hacker breaks a device’s encryption — a sort of secret code — he can access all of its data by using this key. But “out-of-order data division” involves storing information in segments, making it harder to reassemble even with the encryption key.

Chen’s “Data Dog,” a mechanism with a high degree of flexibility, could be a special chip or a function incorporated into another chip. There’s also a software version that can perform the same function.

The chip, Chen notes, wouldn’t conflict with existing encryption standards. “You can use our Data Dog on top of that, for an extra level of encryption,” he says.

Closing the ‘side channel’
Ponomarev and Abu-Ghazaleh are also looking at novel ways to protect an encryption key, though their focus...
is on keeping it safe in a multi-core environment rather than in a mobile device.

They’re interested in preventing so-called “side-channel” attacks, in which a hacker gains access to information that’s unintentionally revealed in a space shared by two chips. For example, one chip can’t “see” what another has put in the small storage area known as the cache, but it can detect what line of code in the cache was accessed. From there, it’s possible to reconstruct an encryption key.

Hackers have figured out how to capitalize on these small scraps of information that leak out while a processor is performing other functions. The attacker doesn’t even have to have any privileges on the machine to do it. Some experts have even demonstrated a way to get the encryption key just from the sound of a printer. “Side channels are everywhere,” Abu-Ghazaleh says. “What we want to do is like putting a silencer on the printer.”

Their technique, called non-monomial cache, prevents the attacker from taking over the cache. “We reserve small portions of the cache to be private to each processor,” Ponomarev says. “The rest of the cache is shared. The private partition is sufficient to keep most of the side-channel information from an attacker. About 1 or 2 percent of the sensitive information could leak, far from enough information to reconstruct a key.”

The approach does not call for hiding 100 percent of the information, Abu-Ghazaleh notes. “For that, you have to completely separate the cores,” he says. “We keep the sharing, but this small private partition is enough to filter out most of the critical information.”

Ponomarev and Abu-Ghazaleh say their solution is inexpensive and easy to do with just a few extra transistors and less than a 1 percent cost in terms of performance. They collaborated on a prototype evaluated with a colleague at Intel as well as on a paper published this year in the journal *ACM Transactions on Architecture and Code Optimization*.

“Side channels are everywhere,” Abu-Ghazaleh says. “People are just becoming aware of their impact. But they’re powerful enough that we have to be aware of them as we build these machines.”

— Rachel Coker

**IN GOOD COMPANY**

Binghamton’s Department of Electrical and Computer Engineering is home to a number of internationally recognized experts in information security, including Scott Craver, Jessica Fridrich and Victor Skormin:

- Craver, a recipient of the prestigious Presidential Early Career Award for Scientists and Engineers (PECASE), specializes in evading, breaking and reverse-engineering digital watermark security.
- Fridrich has developed technology that links digital images to the camera with which they were taken, in much the same way that tell-tale scratches can link bullets to the gun that fired them.
- Skormin is interested in the use of biologically inspired methods to improve computer security. His book *Immunocomputing* laid the mathematical foundation for applying immune methods in computing.

In Good Company

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Hardware concepts developed at Binghamton could lead to improved information security.
FACULTY ENTREPRENEUR USES DNA ANALYSIS TO EVALUATE THOROUGHBREDS
When you buy a racehorse, you pays your money and you takes your chances. Top yearlings at Keeneland’s 2011 Thoroughbred auction, for instance, averaged nearly $350,000 and hadn’t yet raced a step. Odds are that some of them never will.
Steven Tammarielo, a molecular geneticist, has targeted genes linked to athleticism in Thoroughbreds.
Now it’s possible to boost the odds of getting a winner with a simple genetic test. ThoroughGen, founded by Binghamton biologist Steven Tammariello, performs genetic testing on horses. The company is one of four competing in the equine genetic-testing business.

ThoroughGen offers a basic three-gene test for Thoroughbreds at a cost of $175. It screens for one gene that is vital to energy production and two tied to muscle function. Energy production is linked to stamina, muscle twitch to speed. For an added fee, the company will check for additional genes associated with behavior and soundness, including bone density and heart size. The behavior genes indicate whether a horse is likely to be trainable, and soundness is a critical concern since some racehorses are prone to breakdown.

“This is just the tip of the iceberg,” says Tammariello, noting that the horse has some 21,000 genes.

The business really takes off at horse sales, where potential buyers want to find out if they’re getting a horse with promise. ThoroughGen and its partner, Performance Genetics, deliver results overnight, a critical consideration at a horse sale where buyers have to make up their minds quickly. Tammariello carts a portable testing device to sales. “If I receive a sample by 4 p.m., I can give clients results the next morning,” he says. Just one strand of hair from the horse’s mane is all he needs.

The field is so new that it’s still fighting pockets of resistance. “If someone comes to a sale expecting to sell their horse for $400,000, I can understand why they would be nervous that we might say the horse has a flaw,” Tammariello says. Still, for many breeders in the Thoroughbred industry, genetic testing is the future.

And it’s the future for other breeds of horses as well, not just the racers. “If buyers want to find out what makes the strongest Belgians, we can do that,” Tammariello says. “I’ve been contacted by an Argentinean group that wants to figure out which gene variants are found in a top polo pony. We can look at any variation that anybody wants to look at, in any breed of horse.”

Of course, the tests aren’t foolproof. The right genes don’t guarantee a winner; the wrong genes don’t guarantee a loser. But the tests do boost the odds of picking fast horses and avoiding slow ones. “Only a small percentage of horses overcome genetic flaws,” Tammariello says.
Tammarielo grew up near Erie, Pa. His father, a geneticist, taught biology at nearby Edinboro University of Pennsylvania. When he had time, young Tammarielo would watch Thoroughbred races at Erie’s Commodore Downs.

Tammarielo earned a Ph.D. at Ohio State, where he studied molecular genetics, and did postdoctoral work at the University of Kentucky, where he looked at the molecular regulation of Alzheimer’s disease. Afterward, he joined Binghamton’s faculty, focusing on research in Parkinson’s disease and related neurodegenerative illnesses. “I wasn’t trained as a horse geneticist,” he says. “But I’ve always been a fan of horse racing, and my wife and I have owned partial interest in nine horses.”

One day Tammarielo wondered if there was a way to look at a horse genetically in order to get a predictor of its racing potential. “I assumed that someone would have already done genetic testing on Thoroughbreds,” he says. Yet when he did an Internet search to find genetic-testing services, he came up with none.

So Tammarielo, with help from a small group of researchers, began to look for Thoroughbred genes linked to athleticism. “If we found a gene that was important to athleticism in greyhounds or humans, we looked to see if we could find the same genes in the horse,” he says. Gradually, they found some.

They also compared breeds of horses to one another. “We looked at genes that were important to muscle twitch and energy in breeds from Belgian draft horses to Thoroughbreds,” Tammarielo says. “We found a variant in draft horses that was also found in slow Thoroughbreds. A lot of our clients have brood mares and they want to know whether they carry the variant for slower muscle twitch. Slower twitch is useful for muscular power, but not for speed. We can test a whole bunch of Thoroughbreds and predict which ones aren’t going to make it to the track.”

This gives breeders a new option. They can continue to breed top horses to top horses, or they can use the tests to figure out which horses might make the best breeding match. That should produce more good horses, though not necessarily faster times. “Honestly, I don’t think speeds will get faster,” Tammarielo says. “I tell my clients that this is not a way to breed superhorses. What we are trying to do is decrease the number of substandard horses that are produced.”

Texas Thoroughbred breeder and veterinarian Jim Ward has used Tammarielo’s services. “Genetic testing is probably going to be a game changer,” Ward says. “I’m familiar with beef cattle and dairy cattle, where they made big strides in breeding after identifying genetic traits. I don’t see why it couldn’t work the same in horses. The logic is good.

“If buyers want to find out what makes the strongest Belgians, we can do that. I’ve been contacted by an Argentinian group that wants to figure out which gene variants are found in a top polo pony. We can look at any variation that anybody wants to look at, in any breed of horse.”

— Steven Tammarielo, biologist and founder of ThoroughGen
“If you can eliminate those horses that don’t have a chance, you’re going to save yourself a lot of money,” he adds. “Training race horses is expensive. You’ve got to do it for a year or so before someone tells you that your horse can’t run. We’re talking about $25,000 a year in training and veterinary expenses.”

There is, as you might expect, a parallel genetic testing movement for human athletes. A growing number of companies offer tests that suggest which children might excel in which sports and which aren’t likely to excel at all. But if a child proves to be a washout in sports, he or she can go onto other things. Racehorses aren’t so lucky.

“Right now, there are more Thoroughbreds produced than ever make it to the track,” Tammariello says. “In fact, about one-third of the Thoroughbreds born each year will never race. Some are not sound enough. Some are not fast enough. So there’s a whole population of horses that they don’t know what to do with.”

But by genetically testing stallions and mares, breeders may get a better idea which matches are likely to pay off. “We wanted to improve the chance of horses running well,” Tammariello says. “At the same time, we wanted to decrease this surplus of horses. If you have a good idea of what you will get, you may forgo breeding horses that have a high probability of failure as racehorses.”

— Doug McInnis

ThoroughGen founder Steven Tammariello watches horses on the track during a September 2011 sale at Keeneland, a Thoroughbred auction company based in Lexington, Ky.
THE UNFILTERED TRUTH

Nurse crafts a smoking-cessation message for pregnant women
Most pregnant smokers know that cigarettes can harm their babies. But stern lectures from authority figures won’t help them quit.

That message came through loud and clear when Binghamton researchers went into the field to learn how to deliver information about tobacco use to pregnant women. Based on insights from front-line experts — pregnant smokers and their healthcare providers — the investigators created a video that they hope will succeed where other interventions have failed.

Twenty-six percent of women in upstate New York who gave birth in 2009 smoked during the three months before they conceived, and 12.24 percent still smoked in the last three months of their pregnancies, according to the Pregnancy Risk Assessment Monitoring System at the federal Centers for Disease Control and Prevention.

In some rural areas the problem is worse, says Geraldine Britton, assistant professor at the Decker School of Nursing and director of Binghamton’s Interdisciplinary Tobacco Use Research Program (ITURP). In western Steuben County, for example, 52 percent of women enrolled in Medicaid, Obstetrics and Maternal Services (MOMS) in 2009 said they smoked during the three months before they became pregnant.

Even that figure may not be telling the whole story. “Rates of smoking during pregnancy are profoundly under-reported,” Britton says.

Binghamton launches Healthcare Initiative

The State University of New York identified healthcare as a major focus of its strategic plan, The Power of SUNY. Binghamton University has responded with the development of a campus-wide Healthcare Initiative, combining expertise in life sciences with research teams from chemistry, physics, computer science, mechanical engineering, systems and industrial engineering and other areas.

The initiative will advance research and scholarly activity in health and related sciences and engineering, bring multidisciplinary faculty teams together, seek areas that have a broad impact on society, enhance related educational programming and establish Binghamton University, the region and New York state as a center for research on healthcare innovations.

Faculty teams are forming around several topics: neural systems/addiction research, cancer and other diseases, healthcare systems engineering, technology/device development, biofilms and health behaviors.
Hoping to devise better smoking-cessation strategies, Britton and her colleagues in ITURP, supported by a March of Dimes grant, conducted a series of nine focus groups. Three of those groups consisted of pregnant smokers and six of healthcare providers. “The purpose was to increase the understanding of the pregnant smoker, including the motivation to quit,” Britton says. The researchers also asked for ideas about how to communicate the message.

One important insight that emerged from the groups is that it’s hard to appreciate a risk you can’t see. Unlike a baby born with fetal alcohol syndrome, the child born to a smoker may look like any other newborn. But a mother’s smoking can create a host of hazards for the baby, including low birth weight, nicotine withdrawal, asthma, cognitive delays and attention deficit hyperactivity disorder (ADHD). “We had to somehow put a face to the problem,” Britton says.

The idea of a video appealed to both the groups of expectant mothers and to the healthcare professionals. One nurse, for example, mentioned that New York state requires all new parents to watch a video on shaken baby syndrome before leaving the hospital, says Pamela Manktelow, coordinator of the MOMS program at Saint James Mercy Hospital in Hornell, N.Y. “She said, ‘If we had a smoking video for pregnant women, so they would know what they’re doing to their baby as they watch it, I think that would help.’”

A video also allows you to control the tone of the message — an urgent concern that emerged from the focus groups. “The pregnant women have an absolute cynicism, or even fear, about being lectured,” says ITURP co-investigator Sean McKitrick, former assistant provost and director of the Office of Institutional Research and Assessment at Binghamton University.
Having analyzed the themes from the focus groups, ITURP contracted with White Knight Productions of Vestal, N.Y., to shoot the video. The researchers then returned to groups of pregnant women and nurses for ideas about content. To provide maximum impact, focus-group participants decided that the video should feature real people, not actors. For example, in one vignette, a woman who smoked during her pregnancy describes how she and her family resuscitated her weeks-old infant, who had stopped breathing — and then cautions pregnant women against smoking. “Her little girl is 4 years old and has severe asthma now,” Britton says.

Recruiting women to participate was easy, Manktelow says. “The women feel that they’re helping other people quit.” Even when the crew filmed a newborn howling his way through nicotine withdrawal, the mother didn’t hesitate to let ITURP use the footage, she says.

Along with mothers from participating hospitals and clinics, Manktelow and several other nurses, including Lucy Keith from Arnot Ogden Medical Center’s MOMS, appear in the video. The producers also used children to talk about the dangers of smoking. “The pregnant women felt that this message was probably better delivered by children,” Britton says.

With production complete, members of ITURP are seeking funds to help them test the video. They plan to show the segment, which runs about 10 minutes, to pregnant women during their prenatal visits. Researchers will measure whether women who see the video, compared with a control group, are more likely to quit or cut down on cigarettes and less likely to resume smoking.

Besides producing a new smoking-cessation intervention, the project has helped to solidify ITURP’s partnership with community healthcare providers. Such alliances are crucial for developing effective solutions based on real-world evidence, Britton says. “I like to call it the ‘triple helix’ — practice, research and theory,” she explains. “You need to start in practice in order to develop questions, design effective interventions and conduct research to test and build theory. Then you must return the findings to practice.”

— Merrill Douglas

Geraldine Britton, assistant professor of nursing, hopes that showing pregnant women a new video will lead them to quit smoking or cut down on cigarettes.
SPRING Awakening

YOUTH MAY BE KEY TO FUTURE OF ARAB DEMOCRACIES
A year after the Arab Spring, it’s easy to say that politics in the Muslim world have changed forever. It’s much harder to say what the Mideast and North Africa will look like a few years from now, or whether the revolutionary spirit that spread from Tunisia and Egypt to Libya and beyond is good news for the United States and its security.
Binghamton scholar Ricardo René Larémont, an expert in political Islam, says it’s hard to overstate the impact of the recent uprisings: “Everything that we thought we knew about the region has been upended.”

Larémont, a Carnegie Corporation Scholar on Islam, has been an advisor to the U.S. and European governments on political Islam in North Africa and the Sahel. Most recently, he testified before Congress in late 2011 about the Nigerian sect known as Boko Haram.

He has drawn several key conclusions about the Arab Spring and its consequences:

- Youth in North Africa and the Mideast will be the most important players in these new democracies.
- Very conservative yet non-violent Islamist parties will win the support of approximately half the population in these new democracies.
- The new Islamist parties will have to learn to negotiate with secularists to govern effectively.
- Declining fertility rates and improving levels of education will result in increasing peace and stability for the region in the long term.
- The United States should welcome the growth of democracy in northern Africa and the Mideast, even as it recognizes that power vacuums in certain places — especially Libya — may pose new security threats.

A unique expertise
Several years ago, Larémont received a $1.5 million grant from the U.S. Navy Office of Naval Research to study political and religious ideologies in North Africa and the Sahel, a pivotal region of Africa that lies between the Sahara and tropical Africa.

It is in part his understanding of this region that distinguishes him from other scholars and analysts, says J. Peter Pham, director of the Michael S. Ansari Africa Center at the Atlantic Council, a think tank in Washington, D.C. “There aren’t that many people out there in the field who work with a more holistic understanding,” Pham says. “We tend to have an artificial division in academia between North Africa and sub-Saharan Africa. In fact, they interact dynamically.”

Larémont is at home on either side of the Sahel, Pham says, and brings a unique combination of linguistic skill, academic training and experience on the ground in these countries. Indeed, Larémont’s research and lectures have taken him around the world in the past few years, with stops in Algeria, Brussels, Canada, France, Mali, Morocco and Tunisia.

“What’s unique about him is not only a great sensitivity to the context and nuance of what’s going on, it’s also research that’s grounded in practical implications,” Pham says. “He distills it down to its relevance for formulating and carrying out public policy in the real world.”

Pham says the U.S. government is open to outside-the-box thinking and scholarship, especially if it has a social utility. He points to an essay Larémont co-authored in 2006 for Military Review, the U.S. Army’s professional publication and obligatory reading for high-level officers. The 11-page academic article with footnotes, titled “Political Islam in West Africa and the Sahel,” reminded everyone of the relevance of the Sahel. “It’s really the thing that binds Africa together,” Pham says. “The neat little lines we draw, either in government or academic departments, sometimes fail to recognize that things overlap. There are real security and other strategic concerns, and one has to understand this dynamic. It was a wake-up call. And when the U.S. Africa Command was established, it was set up to include all of Africa.”

During the past year, Larémont has established a network of scholars — historians, political scientists and sociologists — in Algeria, Egypt, Jordan, Libya, Morocco, Syria, Tunisia and Yemen. With contributions from that network, Larémont is editing a book to be titled Revolutions, Revolts, and Reform in North Africa.

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Roots of the revolutions
Larémont says he observed an erosion of support for violent jihadism in the Muslim world, starting around 2003 or 2004. “People who had been part of al-Qaida started expressing real reservations in tracts that were written in Arabic, distancing themselves from Osama bin Laden and Ayman al-Zawahiri,” he says. “That’s on the elite level. What we’re only now beginning to comprehend because of the Arab Spring is what’s happening at the non-elite level.”
Ricardo René Larémont, a professor of political science and sociology at Binghamton University and Carnegie Corporation Scholar on Islam, earned a doctorate from Yale University and a J.D. from New York University School of Law. His principal books include Islamic Law and Politics in Northern Nigeria; Islam and the Politics of Resistance in Algeria, 1783-1992; The Causes of War and the Consequences of Peacekeeping in Africa; Borders, Nationalism, and the African State; and the forthcoming Revolutions, Revolts, and Reform in North Africa.

A survey of more than 1,000 Moroccan youths that Larémont conducted shortly before the Arab Spring revealed that this change in attitude was happening at the grassroots level as well. “We were able to determine that there was a mass shift away from sympathy toward the views espoused by al-Qaida toward more moderate expressions of Islam,” he says.

He’s working on a similar survey in Tunisia now, with plans for others throughout 2012, and he’s eager to see what the new configuration of social and political forces will be. “Going forward, the research that needs to be undertaken is a scientific and comprehensive study of exactly what youth across North Africa are concerned about,” Larémont says. “What are their aspirations? What kinds of government do they want to create?”

New governments
One question that interests him is whether moderate and Islamist youths can work together as they have in Tahrir Square in Cairo.

“What we’re seeing emerge is that the narrative of al-Qaida, which was used to recruit people to engage in violent activities, has been undermined by both the Tunisian and Egyptian revolutions that were peaceful,” Larémont says. “So what you have in the post-Arab Spring environment is a political landscape in which institutions like the Muslim Brotherhood, which are conservative but not jihadist or violent, are going to capture the sympathies of between 40 and 60 percent of the population.”

Larémont’s view is that the hardest of the hard core have been swept away, partly as a result of revulsion for their tactics toward Muslims themselves. “Moving forward, the moderate Islamists and the secularists are going
Alerts are in a period of crisis now, what I next couple of decades. “While we North Africa, which allows him to particularly his demographic analysis of of what he sees is encouraging, par- of the Arab Spring nations. Some Larémont places enormous impor- to have to negotiate for the construc- tion of the new democratic state,” he says. “The question that lies before us, then, is can they actually negoti- ate and form a society and a state that embraces two tendencies that are somewhat oppositional?”

He sees the beginnings of that in Tu- nisia, where he traveled in November 2011.

“There’s hope on the leadership level,” Larémont says. “What we don’t know yet is what’s happening at the grassroots youth level. What will happen among those 18 to 35? These are the people who led the revolutions in Libya, in Tunisia and in Egypt.”

Looking to the future Larémont places enormous im- portance on the young people in each of the Arab Spring nations. Some of what he sees is encouraging, par- ticularly his demographic analysis of North Africa, which allows him to forecast far less turbulence within the next couple of decades. “While we are in a period of crisis now, what I predict is that 20 years from now this will basically pass,” he says. “Fertility rates are dropping rapidly in the region.”

For example, Tunisia’s fertility rate — the average number of children born to a woman over her lifetime — is 1.8, below the replacement rate. In Algeria, it’s 2.1, which is close to the replacement rate. That brings socioeconomic stability. “If the fertility rate is 2.8 and higher, the economy simply can’t catch up with a burgeoning population,” Larémont says. “If the fertility rate drops to 2 or 1.9, that means that as long as the economy continues to grow, you’ll be able to satisfy demands.”

In addition, he says, levels of educa- tional achievement are rising in North Africa, particularly for women, which enables them to exercise more control over their fertility. Based on fertility rates, Larémont says, he can predict stability in most of these countries except for Egypt.

That country’s large population and troubled tourist economy will pose serious challenges to the new govern- ment there. Meanwhile, there has been a shift of investment in favor of Morocco, which is comparatively stable and closer to the European market.

The U.S. perspective Larémont sees the Arab Spring as a positive development for the United States and its interest in democracy around the world. “These are move- ments that were initiated by ordinary citizens who are basically saying they have had enough of authoritari-anism,” he says. “It looks a lot like the Eastern European revolutions of 1992. In that way, it’s a very good thing for us.”

There will be challenges as American diplomats and security analysts work to understand the dynamic between the secularists and the more moder- ate Islamists, Larémont says. “The assessment that has to be made is whether you’re going to yield more results working with these democrat- ic movements or working to sustain authoritarianism,” he says. “And the old security architecture is gone. In the final analysis, what is happening here is the expression of the will of the people.”
Larémont worries that a series of recent crises will prevent the United States from focusing on the situation in Africa and the Middle East. “When you look at the economic crisis of 2008 and the failure to develop an educational strategy to deal with the deindustrialization of America, and you couple that with a military adventure in Iraq that yielded more costs than benefits, it’s like being punched first by Muhammad Ali, then by Joe Frazier and then by Mike Tyson,” he says. “You have three crises in a row.”

He believes that Americans have the ability to understand that these crises occurred as well as the resources, both material and human, to deal with them. But it’s going to take time. “The U.S. budget is essentially broken, so we obviously have to take care of this home front,” Larémont says. “But even while we focus on this home front, we have to realize that there are things happening overseas that may affect our security. The urgent task is to remain focused on threats developing overseas while at the same time finding a way to jump-start this economy. Until that’s done, we won’t get security here or security overseas.”

— Rachel Coker
Republican presidential candidates have called for repealing some or all of the 2002 Sarbanes-Oxley Act’s provisions. President Obama has mentioned easing its restrictions, even as the Public Company Accounting Oversight Board, established to oversee compliance with the law, considers ways to improve transparency requirements.

New research from Binghamton University suggests that strengthening parts of the law, enacted in the wake of the Enron meltdown and other corporate scandals, would improve corporate performance and shareholder value.

Yan Zhang, an associate professor of accounting, has found:

- Companies with greater accounting transparency have greater cash value and less wasted spending.
- The independent and expert audit committees required by Sarbanes-Oxley — or SOX — are only as effective as a firm’s chief executive is weak: The stronger the CEO, the less effective the audit committee.
- Measures meant to improve financial reporting quality have unintended costs.

“SOX is good, but it doesn’t solve the problem entirely,” Zhang says.

Before the passage of Sarbanes-Oxley, big accounting firms such as Arthur Anderson (Enron’s auditor) lacked independence. A key provision of SOX is removing conflicts of interest for these firms. In fact, it’s now unlawful for auditors to perform various non-audit services for their audit clients. The Public Company Accounting Oversight Board has been seeking public comment on how to further improve the independence of the outside auditing firms retained to examine companies.

“Every now and then, inspectors can trace an audit failure to a competence issue, such as in the design of the audit methodology or in its execution,” says James R. Doty, chair of the oversight board. “But on the whole, these firms are highly competent. And yet the failures continue to occur, in spite of firms’ remediation efforts. I am left with the inescapable question whether the root of the problem is auditor skepticism, coming to ground in the bedrock of independence. The loss of independence destroys skepticism.”
“WE DO SEE FINANCIAL IMPROVEMENTS AND AN IMPROVEMENT IN EARNINGS QUALITY, BUT REGULATORS NEED TO DO MORE.””
— Yan Zhang

Glossary

Expertise rents: The trading benefit gained from superior information-processing skills and financial experience.

Information rents: The benefit, particularly in trading, that investors, board members, auditing panels and others can gain from knowledge of a company’s financial situation.

Insider trading: The trading in stock and securities by a company’s directors, officers and employees. The practice is generally legal, but can be illegal if it breaches the investor’s fiduciary duty, or uses material, non-public information.

SOX: The Sarbanes-Oxley Act, adopted in 2002 in the wake of accounting scandals at Enron and other firms. Under the law, publicly held companies must enhance financial disclosure, require auditor independence, reduce conflicts of interest and improve transparency.

SOX 407: The section of the Sarbanes-Oxley Act that requires audit committees to include financial experts, but allows experts to be either accountants or a more generic financial expert, such as a chief executive, investment banker or venture capitalist.

Transparency: The measure of how public a firm’s accounting practices are, using more than 20 metrics, including financial and governmental disclosures, timeliness, accounting policies and credibility.

The impact of CEO power
Zhang’s research suggests that the board should consider limits to the influence a chief executive can have on the audit committee, in addition to the outside audit firms.

In the post-SOX era, stock exchanges prohibit CEOs from being directly involved with selecting members of the audit committee, but that doesn’t guarantee the committee will be free of a CEO’s informal influence. Zhang and her colleagues set up a metric to gauge how powerful a chief executive is, measuring prestige, expertise, corporate ownership and structural power.

The data showed that CEO power weakens the effectiveness of audit committee financial expertise in reducing earnings restatements — an indication that a supposedly independent and expert audit committee could still be influenced, even if informally, by a chief executive. A chief executive could refuse to provide necessary information or obfuscate details the audit committee requires. And a strong CEO can get away with it.

“The purely independent nominating committee doesn’t solve the problem,” Zhang says. “It merely mitigates the problem.”

Says oversight board spokesman Brian Goodnough: “Anything pertaining to CEO and CFO power over the company is an area we’ve particularly gotten into.”

Zhang’s study didn’t consider the potential effects of limiting audit firm tenure, but her first suggestion in countering the effect of a powerful CEO is more direct: Rebalance the power other directors have to counter the chief executive, regulation that would require action by the Securities and Exchange Commission.

More transparency, less waste
Doty and other members of the oversight board are concerned about transparency, but were under pressure in late 2011 to ease disclosure regulations, even though Securities and Exchange Commission Chairman Mary Schapiro has called for increased transparency in the capital markets to protect investors. Zhang’s research suggests they should stay the course, or even force increased transparency.

Zhang and a colleague examined the cash on hand of a number of companies and found that opaque (less transparent) companies had a perceived discount for their cash levels: Investors valued cash on hand as low as 45 cents per $1. Transparent firms saw that value around $1.05 per $1.

“Taken together, our findings suggest that managers in firms with fewer disclosure activities are less subject to scrutiny of capital markets and thus are more likely to expropriate cash assets,” they write. And that can lead to empire building.

The logic is this: A CEO is looking to expand the company, because a larger company brings greater compensation. With little transparency and a large amount of excess cash, a CEO may be tempted to squander cash on weak acquisitions. “A lot of firms are sitting on too much cash right now,” Zhang says.

“The empire-building motive is particularly severe when managers control cash levels in excess of those needed for operations and investment,” she writes. “Lending further credence to the monitoring effect of disclosure activity, we find evidence that the negative effect of major expansion on shareholder value is reversed when the firm has sufficient disclosure activities.”
SOX and insider trading

One section of Sarbanes-Oxley requires audit committees to include financial experts. Originally, SOX 407 narrowly defined a financial expert as an accountant. Later the SEC broadened this definition by allowing others with financial expertise, such as a chief executive, investment banker or venture capitalist, to serve in this capacity as well.

Zhang’s research shows that the current broad definition comes at a price. She first found that audit committee financial experts outperform nonfinancial experts on audit committees in their trades of a firm’s stocks. She further divided audit committee members into two groups, accountants and nonaccountant financial experts, and found that these “expertise rents” are driven by the nonaccounting financial experts. Accountants, she says, made fewer trades and gained less value than the nonaccountants, and the nonaccountants were more likely to have abnormal returns.

That suggests one of the following options:

- Accountants and CPAs, governed by professional ethics that require them to place their fiduciary duty ahead of their own gain, forgo opportunities to earn expertise rents.
- Nonaccountant committee members — venture capitalists, CEOs and others — may be more experienced in investing in the capital market and thus trade more aggressively than accounting financial experts.
- The nonaccountant financial experts may be more likely to engage in inappropriate insider trading. (Zhang’s research has not delved into this possibility.)

“This is the first study, to our knowledge, that demonstrates a negative aspect of mandating a financial expert on the audit committee,” Zhang says.

Her solution? Require all financial experts on the audit committee to be accountants, supporting the law’s original approach. “Overall,” she says, “our findings suggest that by restricting financial expertise on the audit committee to accounting financial experts, expertise rents earned by audit committee financial experts will be significantly reduced.”

With SOX up for debate, Zhang’s work suggests ways that additional reforms can rebuild investors’ faith in the market. Her findings are forthcoming in top-tier publications, including the Accounting Review.

“Is the reform good enough? Is it working?” she asks. “We do see financial improvements and an improvement in earnings quality, but regulators need to do more.”

— Todd R. McAdam
New ideas in the study of turbulent fluid mechanics may help integrate issues related to social justice into the practice of engineering and engineering education.

How so? After all, in the past, the study of turbulence has led to advances in high-speed weaponry.

Turbulent fluid mechanics has been the central focus of my research career. At each stop, I wrestled with the mysteries of turbulence. Dealing with the ambiguities and uncertainties of the physical phenomenon that I was attempting to model and ultimately unravel led me first to a crisis of purpose in my life and then to new areas of scientific thought and philosophical reflection.

That crisis intensified during the second war in Iraq. Engineering journals, trade magazines and websites were filled with articles, photographs and sketches glorifying high-tech weaponry. It occurred to me that many of my students were involved in the design and development of these weapons.

This recognition led to what Dante beautifully described in The Divine Comedy hundreds of years ago as “a dark night of the soul.” Ultimately, it was turbulence or the “physics of
“noise” of the sea. She is order born from disorder and carries that disorder as part of her makeup. Her form is exceptional, one probability in a sea of probabilities. In counterpoint, he also introduces the French film La Belle Noiseuse, in which an artist covers the represented beauty in paint until only a foot remains visible in the chaotic swirls of color and matter. Serres produces a model of thinking that moves beyond categories of unity and rational order; one where it is important to listen to the “noise” — the sound and the fury — that underlies matter and thought. Order is the exceptional circumstance in a noise of whatever else may have been and may be. Serres also appreciates that chaos has a double aspect, both productive and destructive.

**A nexus with social justice**

A new approach to the question of turbulence may be found in the new methods of complex systems science. Complex systems are networks of many components with nonlinear interactions, which arise and evolve through self-organization, such that the system is neither completely regular nor completely random, permitting the development of emergent behavior. We study their structural/dynamical properties to obtain general, cross-disciplinary implications and applications.

Adoption of this approach provides a link to integrate issues of social justice in engineering practice and education. This nexus occurs among the tenets of complex systems science and the principles of an evolving or unfolding universe, as outlined by Thomas Berry in *The Sacred Universe: Earth, Spirituality, and Religion in the Twenty-first Century.*

Berry has derived an understanding of the psychic-physical character of the unfolding universe. If there is consciousness in the human and if humans have evolved from Earth, then from the beginning some form of consciousness or interiority is present in the process of evolution. Matter is not simply dead or inert, but a divine reality consisting of a physical and spiritual dimension. Consciousness, then, is an intrinsic part of reality and is the thread that links all life forms. There are various forms of consciousness and, in the human, self-consciousness — or reflective thought — arises.

Berry also suggests that as things evolve from simpler to more complex organisms, consciousness also increases. Ultimately self-consciousness or reflection emerges in the human order. This gives humans a special role in the evolutionary process. We are part of, not apart from, Earth.

**A new engineering ethic**

How might Berry’s ideas impact the engineering world? The implication of his work is that we will never be able to use an approach based on a deterministic world to adequately address problems such as turbulence that are replete with ambiguities. It is not simply a matter of being more clever or having better computers. We need a fundamentally different approach. Perhaps complex systems holds some promise. Several researchers are now approaching turbulent fluid mechanics in this way, most notably the group at the Santa Fe Institute.

Perhaps Berry’s ideas may have an even more important effect on the ethical basis for the engineering pro-
profession. With our new understanding of the principles of the universe, a new engineering ethic can now be formulated.

Engineers, in the fulfillment of their professional duties, shall:

- Recognize the universe as complete and connected throughout.
- Be cognizant of the filters through which each of us experiences what we claim to be our reality.
- Understand that a totally unexpected result may emerge from systems no matter how carefully and tightly controlled the systems and the inputs might seem.
- Recognize that various elements in a system may have a desire to organize themselves in ways that cannot be anticipated from the outside.
- Promote diversity rather than seeking to move toward homogenization.
- Nurture the sense of a community rather than seek to destroy communities, societies or cultures.

The proposed new engineering ethic is fundamentally different than what we have used so far in the practice of our profession. The ideas presented here are a call for a new conversation focused on our profession and how we view our responsibilities. Engineering is a value-laden profession with a strong ethical foundation. My hope is that we can begin to ask additional questions when confronted with a new design or in meeting an engineering challenge.
The $66 million Engineering and Science Building, which opened in November, allows for the expansion of the Thomas J. Watson School of Engineering and Applied Science. The facility houses the dean’s office, the departments of electrical and computer engineering and mechanical engineering and facilities for academic and industrial meetings. Space has been set aside for new business start-ups. The facility will meet LEED (Leadership in Energy and Environmental Design) standards, with a number of “green” features. It joins the Biotechnology Building at Binghamton University’s Innovative Technologies Complex, where a third research facility is under construction.
Facilitating Collaboration and Discovery

The core model and joint laboratory environment encourage researchers to share ideas and techniques, while placing utilities in “skycaps” allows spaces to be rearranged quickly.

Security technology expert Scott Craver, winner of the Presidential Early Career Award for Scientists and Engineers, is one of the lead researchers in the Seymour Kunis Media Core.

Mechanical engineer Pong-Yu (Peter) Huang, whose research focuses on micro- and nanofluidics, works at a microscope in the Transport Sciences Core.
Historian probes French treatment of Algerian immigrants

Jaime Wadowiec’s timely doctoral dissertation does more than unearth the origins of migrant segregation in post-colonial France; it also highlights ongoing issues about the integration of Muslims and the status of Muslim women.

After Algeria won independence from France in 1962, political unrest and an expanding French economy led hundreds of thousands of Muslim Algerians to migrate to France. The French state’s solution to the unexpected migration was spatial separation of the Algerian population, but that was only the beginning.

Funded by several competitive fellowships, Wadowiec traveled to France and spent months chasing leads and collecting archival evidence of the effects of the mass migration. In colonial archives in the south of France, Wadowiec found the voices of Muslim Algerian women through a chance encounter with some surprising documents, changing the scope of her project entirely.

Before 1962, France had extended citizenship to Algerian men and women. Women in particular took this idea at face value. “There’s this explosion in this brief time period of letters to state officials from these women saying, ‘This is what I want from the state and this is how I view myself as a citizen,’” Wadowiec says. “But after ’62, that’s all gone.”

Wadowiec reframed her project to answer that gap in history: Why aren’t there records of these women after immigration?

“It’s not so much that I’m going to recapture voices that have been lost, because they’re lost for good,” Wadowiec says. “I want to explain the operations of both racism and sexism and how those things overlap in terms of citizenship.”

The French state considered the Muslim Algerians as a specific race rather than a religious minority. The Algerian women were seen as the embodiment of Islam — and as a danger to the identity of the French citizen.

“Women were specifically oppressed in a lot of the ways you see discussions about Middle Eastern women today,” Wadowiec says. “What my dissertation does is work through the roots of that and why we perceive Islam as a cultural racial threat.”

Wadowiec’s research is unique. Not much scholarship exists on this period and the application process to view many of the documents tests a scholar’s patience.

“Jaime is an infinitely creative reader of documents,” says Elisa Camiscioli, associate professor of history and women’s studies at Binghamton. “She uses school books, old-school nationality laws; she has very eclectic, amazing historical instincts.”

With her undergraduate students, Wadowiec stresses the importance of looking beyond what is familiar: “To go out in the world and explore is so important,” she says. “When you’re studying things like race, sexuality and gender, you kind of have to take that world view, adopt an open perspective.”

— Liz Joyce
User interface design drives marketing research

Doctoral student Sajna Ibrahim conducts experiments to judge consumers’ reactions to electronics such as MP3 players, digital cameras and cell phones. Ibrahim, whose research focuses on marketing and product design, says user interface design — or UID — influences how consumers feel about a product before, during and after purchase.

“Ranging from colorful buttons and pointers to touch screens and gestural feedback systems like the Wii, these user interfaces inform the way consumers learn and even ‘talk’ to a product,” she says.

Too many companies, she says, have marginalized product design. When it comes to marketing, most firms focus on form and function and may emphasize brand and price. But the consumer forms all kinds of perceptions about a product’s usability even before she ever picks it up. “User interface design is one of the key drivers of consumers’ purchase intentions and willingness to pay,” Ibrahim says. “I would like companies to build bridges between the marketing and design teams.”

Apple, creator of the iPhone, is an example of a company that understands the connection between user interface design and marketability, she notes. The cell phone industry at large, however, has a huge challenge when it comes to UID: Many phones are returned after purchase, and the majority of cases involve usability problems. The situation, called the “no fault found” phenomenon, offers a classic example of the way UID affects consumers and companies alike. “When a product is returned, it becomes a marketing problem,” she says.

Ibrahim studied electronics and communications as an undergraduate in India and completed an MBA in international marketing. She worked for an engineering design services firm for eight years before returning to school for a doctorate. Now she uses specialized software to make 3D models of product concepts for use in her experiments. She’d eventually like to expand her research to include automotive UID and also take a look at the way user interfaces influence the way people interact through social networks.

Manoj Agarwal, professor of marketing at Binghamton, says Ibrahim is exceptionally self-directed. “I can talk to her at a high conceptual level,” he says. “She also pushes me a lot, which is good. She’s full of ideas.”

Agarwal says Ibrahim has been able to integrate ideas from numerous disciplines in her work, including engineering, marketing and even organizational behavior and leadership. He believes that understanding UID will be increasingly vital in the next few years, as information and entertainment move to cloud-based systems and touch screens become more prevalent.

Ibrahim, who hopes to pursue an academic career after she earns her doctorate, says her work is driven by what she sees in the marketplace. “This is something you can see and feel in your daily life,” she says. “It’s important that these ideas should reach consumers as well as researchers.”

— Rachel Coker
Bioengineer’s work pays dividends, from cancer to agriculture

Chris Paquette’s research in artificial intelligence and machine learning may lead to innovations in cancer treatment. And he recently won a prize for an agricultural application of the same technology.

Paquette, a Binghamton senior, worked last summer with Walker Land, research professor of bioengineering, to analyze gene expression data and predict the recurrence of cancer using a machine learning algorithm called Kernel Partial Least Squared, or KPLS. Similar data mining and artificial intelligence techniques are used by companies such as Amazon and Google to predict searches and rank pages.

“The technology exists and is proven,” Paquette says. “Now it’s a question of: How do we take that and apply it to other fields?”

Apply it he has. Paquette received $5,000 for his application of KPLS research to an InnoCentive project. InnoCentive is a website where industry, businesses and government agencies can tap into a community of problem solvers, and pay a one-time award for rights to the crowd-sourced solution.

The Environmental Defense Fund and Iowa Soybean Growers posted a challenge requesting technology to predict crop yield using nitrogen sensors that would help manage fertilizer use and boost crop productivity. Paquette’s winning idea was to use blimps with on-board sensors that would fly over crops and take nitrogen readings, which would correlate with the vigor of the crop. The information collected would be fed to the farmer’s computer for analysis.

“The guy’s very creative; he can see things that a lot of other students can’t see,” Land says of Paquette. “He thinks about things in a way that most people don’t.”

Paquette plans to pursue a doctorate in machine learning and artificial intelligence. “It’s an exciting field to get into,” he says. “I want to be an expert in it so I can create these systems, maybe make a few bucks and help the world doing it.”

The InnoCentive project inspired Paquette to bring the Web resource to other engineering students. He and some friends started a group devoted to solving InnoCentive challenges. The club facilitates collaborations among students, faculty members and entrepreneurs. “I want to develop a support network for student innovation,” Paquette says. “The University has so many resources, and if you don’t take full advantage of them, what’re you doing? I want to utilize everything I can to my advantage to do something good here.”

Paquette’s summer research inspired a senior design project, too. He’s using the KPLS research to predict the likelihood of lung cancer recurring within five years and to determine whether chemotherapy is necessary.

“Right now, cancer patients are getting chemo when they don’t need it,” Paquette says. “My dad had chemotherapy and it’s terrible. It destroys your quality of life.”

— Liz Joyce
Search for identity drives young sociologist

As a sophomore, Luisa Batiz traveled to Ghana, where she conducted an ethnographic study focused on the effects of structural adjustment programs. She looked at the lives of a taxi driver and a street vendor and how programs put in place during their childhood affected their ability to get an education.

“In order to decrease its debt and get loans, Ghana had to get rid of a lot of social programs,” she says. “The two men I was interviewing grew up around that time. My goal was to tell a story about what had happened historically in Ghana and how it manifested in the lives of these two young men.”

From there, the sociology major’s work took a more personal turn. Batiz’s honors thesis focuses on the Garifuna community in New York City. The Garifuna, including her own family in Brooklyn, are descendants of marooned slaves who were exiled when the British took over St. Vincent. The New York City community has grown to some 100,000 people.

“My inspiration was my own search for identity here in the United States,” she says. “Growing up, people would say to me, ‘You can’t be Latino; you’re black.’ For me, it was that confusion that drove me to write an honors thesis.”

Batiz conducted a survey of Garifuna and used census data to see whether individuals considered themselves black, Latino, both or neither. The results left Batiz with questions about how Americans negotiate race and how culture is transmitted. “Is it your phenotype?” she asks. “Is it the social condition you grow up in?”

Batiz’s advisor, Michael West, considers her self-directed and ambitious. “Her research shows that the Garifuna, as befitting a people spread over several nation-states in Central America, with roots in the Caribbean islands, have multiple identities,” says West, a professor of sociology and Africana studies at Binghamton. “They are at once Hondurans, Belizians, Guatemalans, Nicaraguans, etc., and Americans, and also Latinos, and black, plus of course Garifuna. Along this cultural continuum, there are varying degrees of identification with any of the categories according to class, gender, religion, age, education and so forth. The beauty of Luisa’s thesis is that it speaks to all of these issues.”

Last summer, Batiz traveled to the University of California, Berkeley, as a public policy and international affairs fellow. The program gave her a dynamic view of how to tackle issues, she says. She was part of a team tasked with improving education in Micronesia. The group didn’t find an easy fix, but the experience led her to an insight: “Often when we try to solve a problem, we come up with a Band-Aid when the real issue is that the problem is adaptive,” she says. “You’re only fixing part of the problem.”

Batiz, who will join Teach For America this fall, plans to pursue a doctorate in public policy.

“I do want to do research, but I also want to be sure that I am an advocate for what I’d like to see changed in the world,” she says. “Too many people accept things the way they are.”

— Rachel Coker
A PIECE OF THE PUZZLE

Professor’s blog helps *New York Times* Crossword fans fill in the blanks

17. Opposite of dull.
Michael Sharp, a Binghamton University scholar of Medieval and Renaissance literature, may now be better known by his online moniker, Rex Parker. Some 20,000 readers a day flock to his blog, Rex Parker Does The New York Times Crossword, in search of answers about the puzzle, his idiosyncratic take on its clues, quality and level of difficulty and, perhaps most important, an opportunity to interact with other crossword fanatics.

“I feel like I’m maintaining a community, a place where people can come and talk about the puzzle,” Sharp says.

His readers include at least a few celebrities, notably actress Dana Delany, who recently mentioned the blog on Jimmy Kimmel Live; Pulitzer Prize-winning Washington Post columnist Gene Weingarten and food writer Ruth Reichl. Will Shortz, crossword puzzle editor of The New York Times, reads the blog and occasionally leaves a comment.

The blog has been joined by a Facebook page and Twitter account, where Sharp riffs on matters only tangentially related to crosswords and his other passion, pulp fiction.

“I prefer the Facebook page as a place to hang out and chat,” he says. “People have conversations and they love each other, and I could practically not exist. There’s opportunity for back and forth, maybe because I only have about 1,400 Facebook fans. Compared to 20,000 readers a day, it’s a smaller group. I feel like I can actually talk to people in a way I can’t on the blog. … At this point, it’s a more intimate space.”

Scroll through the comments and you’ll find readers sharing their favorite words, news of places and people with unusual names and discussions of pop-culture references to crosswords. Of course, there are plenty of threads full of outrage over misspellings or poor grammar.

Sharp works on the blog, which he began five years ago, for an hour or two each day. It might take some people that long just to complete the puzzle, but he can do even the toughest ones in 10 or 15 minutes. (A typical Monday puzzle, the easiest of the week, might be a three-minute challenge for him.) While Sharp says speed isn’t his primary goal, he placed 31st overall and 10th in his division at the American Crossword Puzzle Tournament in 2011. He received a small trophy for being second-fastest in New York state, though he’s quick to note that the category excluded New York City.

“I usually solve it online on The New York Times website proper, which means my time comes up against everyone else’s,” Sharp says. “It used to stress me out because I was being timed and ranked against other solvers. That doesn’t stress me out anymore.”

In 2010, Sharp took on the challenge of constructing original puzzles for the first time. Since then, he’s had a few in The New York Times, one in The Wall Street Journal and a couple in the Los Angeles Times.

“Sometimes I get an idea and it’s done in three or four hours,” Sharp says. “Others take longer to percolate. They pay very little, but it is satisfying to see them and to have people doing them. It’s good validation. If you get it into The New York Times, a lot of people will do it. That kind of audience is nice to have if you’re going to put the time in.”

The notion of readership — for the blog, for his puzzles, for his scholarly work — is one Sharp wrestles with regularly. When he joined Binghamton’s faculty in 1999, a more conventional academic career seemed to lie ahead. Life as Rex Parker, which includes a second blog, Pop Sensation, devoted to Sharp’s collection of vintage paperbacks, has taken him off that course.

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ABOUT MICHAEL SHARP

Alter ego: Rex Parker

Credentials: Bachelor’s degree from Pomona College; doctorate from the University of Michigan; 31st place at the 2011 American Crossword Puzzle Tournament; self-proclaimed King of CrossWorld

Loves: Detroit sports teams, The Simpsons, the letter K, live-blogging Republican debates

Hates: Crossword puzzles with bad “short fill”

MORE ONLINE

Michael Sharp writes two blogs under the pseudonym Rex Parker:
Rex Parker Does The New York Times Crossword, in which Sharp solves each day’s puzzle and critiques the theme, clues and so forth. Find it at http://rexwordpuzzle.blogspot.com.

Pop Sensation, which focuses on Sharp’s collection of vintage paperbacks. For each post, he takes a book from the collection and writes about its cover. Find it at http://salmongutter.blogspot.com.
wrote over all time,” he says. “If you take all the articles I wrote, add my dissertation and anything I had written on paper up to the time I started my blog, today in one day more people read what I have written. That’s not to say that what I write today is more substantive, but having that kind of audience — and it didn’t fall in my lap, it was built over time — it’s not nothing.”

Sharp still teaches Medieval, Renaissance and Arthurian literature, and he does see ways in which the blogs inform that work. “I hope in some way that my approach to teaching is what I do in my own writing,” he says. “You need to be serious about your writing and dot your I’s and cross your T’s. On the other hand, you need to not be bound by conventions and what’s safe, what’s established. There are a lot of reasons, not least of which is that you will be bored. And if you are bored, your readers are going to be bored. You need to take some risks. I try to encourage people to be both serious about their work and daring in terms of how they express it.”

Sharp’s pop-culture expertise has begun to find an academic forum. He gave a keynote address titled “Lurid Liberation: Sex and Social Change in American Paperback Cover Art, 1940-1970” as part of a conference for the 75th anniversary of Hofstra University’s library. The hour-long talk was, he says, designed to be both entertaining and instructive. “It was utterly unexpected because I’ve never done anything academic related to it except for my paperback blog,” Sharp says. “On the one hand, that’s not an academic endeavor; on the other hand, it’s completely an academic endeavor. It’s all about collecting and sorting and learning about the history of the art. I talk about it in irreverent ways, but I’m also lovingly amassing this collection of an important time in American commercial art that’s not well documented anywhere else. So in some ways my interests and my whole approach are academic. I’m showcasing something that would be invisible otherwise, and that’s really what a lot of scholars do. That loving attention to detail and that respect for books as artifacts, all that’s going into my Pop Sensation blog.”

For now, Sharp says he enjoys keeping up with the blogs and teaching literature. The blogs have allowed him to make new contacts, find a voice that’s different from his scholarly writing and experiment with developing an audience. Eventually, though, he expects to take a step back from the blogs to give himself a chance to consider what else he might like to write. He has some ideas for a book, but isn’t drawn to writing about the history of puzzles or anything so obvious. Sharp says he believes the blog has given him the freedom to do something more creative. “You never could have convinced anyone that there was going to be an audience for a daily blog about The New York Times Crossword,” he says. “It would not have seemed like a good idea. It grew because I kept at it and I care about it.”

Sharp says he would like to see greater acceptance of new media and popular forms of writing in the academy. The idea of the monograph as the gold standard for tenure feels dated, he says, and the humanities would benefit if more scholars interacted with the public.

“There’s something to be said for a professor reaching an audience that isn’t scholarly,” he says. “That’s a valuable role for the university. I couldn’t write what I write if I didn’t have the education I have, even though I’m not writing scholarly analysis of Medieval poetry anymore. Everything that went into doing that informs what I do now.”

— Michael Sharp

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ACROSS
1. Philip___, detective created by 17-Across
8. Justice Fortas
11. Detroit-to-Toledo dir.
14. Driver alternative
15. 1973 title role for Al Pacino
17. Author of the quotation starting at 30-Across
19. Prayer ender
20. "___ the ramparts..."
21. Supporters
22. Below
26. Baby
28. Unite
29. Father’s Day mo.
30. Start of a quotation from 17-Across about writing hard-boiled detective fiction
39. Word after oil or railroad
40. They pop up online
41. Wished
42. Part 2 of the quotation
45. T or F, for example
46. ___ Sylvester, tyrannical cheerleading coach on "Glee"
47. The moment of truth, in sports slang
51. Texas state symbol
56. Japanese noodles
57. Top pitcher
59. Woman’s name spelled out in a 1970 hit
60. Part 3 of the quotation
65. Secluded place
66. How some delicate questions go
67. Hosp. workers
68. Color
69. End of the quotation

DOWN
1. Fable feature
2. "What’s in ___?"
3. 2011 N.L. batting champ José___
4. Outlines in detail
5. Spanish gold
6. Finished on top
7. Finish
8. 1975 Wimbledon winner
9. Little den dweller
10. Sea eagle
11. Eliot’s Marner
12. Disturbance
13. Bottom-of-the-barrel
16. Sharable files
18. Strike against
23. Engine type
24. Egg layer
25. Cartoonist "Chas" who created a spooky family
27. When some inspirational pre-game shouts are shouted
29. Exactly this way
30. Fighters’ org.
31. Brother of Shem and Japheth
32. Cause for ‘70s feminists
33. French refusal
34. Dedicated lines
35. Syllable after "boo"
36. Manjula’s husband on "The Simpsons"
37. Meat-free, for short
38. Old English letter
43. Call after the first out
44. Protect
48. More strange
49. Horn sounds
50. "Are you ___ out?"
51. Service do-over in tennis
52. Melting snow
53. Toy truck brand
54. 1979 movie with the tagline, "In space, no one can hear you scream"
55. Dept. focused on innovation
58. Point out
61. Chianti, e.g.
62. "Come again"
63. Singer/songwriter DiFranco
64. Brake neighbor

For the solution, flip over the business reply card inserted to the right.

SNAP TO IT
Dana Delany talks about Rex Parker on Jimmy Kimmel Live: go.binghamton.edu/delany
Spring awakening
Youth may be key to future of Arab democracies
With you wherever you go!

CLICK  POINT  CONNECT

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