NEW YORK UNIVERSITY

FALL/WINTER 2008
Volume 6 - Number 1

Courant Institute of Mathematical Sciences

Yann LeCun and Sylvain Cappell named Silver Professors

Sylvain Cappell has been a professor of mathematics at Courant since 1978. He is one of the world's leading experts in topology, the study of structural properties of spaces, and its relations to other fields of mathematics. He has written ground-breaking papers on singularities, deformations, geometric surgery, stratifications, characteristic classes and group actions.

A native of Belgium, Professor Cappell holds a B.A. in Mathematics from Columbia and a Ph.D. from Princeton. After several years on the faculty at Princeton he moved to NYU. Highly active in University committees, he is serving a second term as chair of the Faculty Senators Council. He is currently serving as a member of both the Executive Committee and the Council of the American Mathematical Society. Deeply committed to mathematics education, he has mentored many talented high school students, and worked closely with the city's schools and professional organizations on curricular issues.

Professor Cappell has been a Fellow of the Sloan Foundation and of the Guggenheim Foundation, and his many honors include an invited address to the International Congress of Mathematicians.

Yann LeCun has been a professor of computer science at the Courant Institute since 2003. LeCun is a leading expert on machine learning and the acknowledged authority on neural networks and their applications. A native of France, he received the Electrical Engineer Diploma from Ecole Supérieure d'Ingénieurs en Electrotechnique et Electronique (ESIEE) in Paris, and a Ph.D. in Computer Science from Université Pierre et Marie Curie (Paris). After a postdoctoral fellowship at the University of Toronto, he joined the Adaptive Systems Research Department at AT&T Bell Laboratories in Holmdel, NJ, in 1988. He was named head of the Image Processing Research Department at AT&T Labs-Research in 1996. In 2002, he became a Fellow at the NEC Research Institute in Princeton.

Professor LeCun's research interests include computational and biological models of learning and perception, computer vision, mobile robotics, computational neuroscience, data compression, document image analysis, digital libraries, and the physical basis of computation. His image compression technology, called DjVu, is used by numerous digital libraries and publishers to distribute scanned documents online, and his handwriting recognition technology is used to process a large percentage of bank checks in the United States.

Faculty: Recent Arrivals

Patrick Cousot, Professor of Computer Science. Dr. Cousot is the inventor of abstract interpretation, a theory of sound approximation of mathematical structures, in particular those involved in the behavior of computer systems. It allows the systematic derivation of sound methods and algorithms for approximating undecidable or highly complex problems in various areas of computer science.

Edwin Gerber, Assistant Professor of Mathematics in AOS. His research concerns atmospheric dynamics, climate variability, and climate change. Specific areas of interest include atmospheric modeling, intraseasonal variability in the extratropics, stratosphere-troposphere coupling, and links between internal variability of the atmosphere and the climate response to external forcing. His honors include a Fannie and John Hertz Fellowship.

Bruce Kleiner, Professor of Mathematics. His research interests include geometric analysis, geometric evolution equations, and geometric group theory. In the last 5 years, he has been particularly interested in Ricci flow, and was part of the team which elucidated Perelman's work on Ricci flow and the Poincare Conjecture. His current work includes analysis on singular spaces and its applications to computer science and group theory.

Denis Kosygin, Clinical Assistant Professor of Mathematics. He got his Ph.D. at Princeton University and taught at New York University, Princeton University and Northwestern University. His research interests lie in fields of Probability Theory, Dynamical Systems and Mathematical Physics. Dr. Kosygin was a recipient of Paola Caderoni Prize for young researchers in mathematical physics and a Sloan dissertation fellowship.

Matthew Leingang, Clinical Associate Professor of Mathematics. Matthew Leingang's Ph.D. work was in differential and symplectic geometry, and he currently focuses on undergraduate mathematics education. He is also interested in semantic web applications to teaching and learning. Dr. Leingang was a recipient of NSF postdoctorate and graduate fellowships, and the Paul R. Cohen Memorial Prize in Mathematics from the University of Chicago.

Olga Sorkine, Assistant Professor of Computer Science. Dr. Sorkine is interested in theoretical foundations and practical algorithms for digital content creation tasks, such as shape representation and editing, artistic modeling techniques, computer animation and digital image manipulation. She has also worked on fundamental problems in digital geometry processing, including the parameterization of discrete surfaces and the compression of geometric data.

Inside This Issue:

Your News in the CIMS Newlsetter

The Courant Institute invites all Alumni to keep colleagues and friends up-to-date on life events. All items submitted (such as career achievements and family milestones) will be considered for publication in the Newsletter or online. Please send the details to alumni.news@cims.nyu.edu.

Courant Faculty Honors and Awards

Elections this year for Courant Faculty members include **Helmut Hofer** to the National Academy of Sciences and as a foreign member of the Academia Europaea, **Steve Childress** to the American Physical Society, and **Lu Ting** as a member of the "Nordrhein-Westfälische Akademie der Wissenschaften."

Assaf Naor, who joined Courant in 2006, was recently awarded a Packard Foundation Fellowship "to develop a structure theory for metric spaces and the applications of geometry and analysis to the theory of computing" and has also received a European Mathematical Society Prize and a Professor Ernst D. Bergmann Memorial Award.

Subash Khot and Naor are the NYU anchors of a multi-university team that has received a ten million dollar grant from the National Science Foundation in order to address, as written by Michael Stasiak of Washington Square News, "algorithmic intractability and the inevitable plethora of questions it inspires." Khot is also a 2008 recipients of a SIAM Outstanding Paper Prize, for his paper "Ruling Out PTAS for Graph Min-Bisection, Dense k-Subgraph, and Bipartite Clique."

Chris Bregler, along with J. Malik, received a Longuet-Higgins Prize for their paper "Tracking people with twists and exponential maps."

Ken Perlin received a Computer Graphics Achievement Award from ACM SIGGRAPH, an award "given each year to recognize an individual for an outstanding achievement in computer graphics and interactive techniques." Perlin received the award for "broad contributions and impact across computer graphics."

Olga Sorkine, a new arrival to Courant's Computer Science department, received the Eurographics Young Researcher Award, "in recognition of her outstanding contributions to interactive geometric modeling, shape approximation, and shape and image manipulation."

Raghu Varadan and **Margaret Wright** both received honorary degrees; Varadan from Chennai Mathematical Institute, and Wright from the Royal Institute of Technology (KTH). Varadhan also received the "Padma Bhushan" award, given by the Government of India, in the area of "Literature and Education."

Andy Majda, who received an honorary professorship at Fudan University in Shanghai this year, is the 2008 Margaret and Herman Sokol Faculty Award recipient. Majda gave a talk for the award on "Climate Change and Modern Applied Mathematics." The Sokol award is presented annually to a member of the science faculty in recognition of excellence in his or her work for the University as a teacher, scholar, and colleague.

Staying Connected to the Institute

Keep in touch with colleagues and friends via two new web resources: University Development and Alumni Relations provides VioletNet, (violetnet.nyu.edu) a searchable directory of all NYU Alumni and an "interactive community designed especially for NYU alumni."

There are also several groups related to the Courant Institute on LinkedIn.com, a career networking site, such as an all-inclusive Courant Network, an Alumni group, and a Mathematics in Finance group.

Courant Shirts, Mugs, and Hats

The NYU Bookstore now has Merchandise bearing the Courant Institute name for sale. Each of the items--shirts, mugs, and hats--are available in store and also online by clicking on "schools" at:

http://nyubook.collegestoreonline.com.

WinC Receives Presidential Service Award

President Sexton presenting WinC with a 2008 Presidential Service Award.

Courant's Women in Computing club has received a 2008 Presidential Service Award, for "extraordinary and positive impact on the New York University Community." The purpose of the Presidential Awards is to recognize "distinguished service" by students or student organizations for "their promotion of leadership, and quality of student life."

Founded in 2005, WinC has quickly become an active participant in the Courant and NYU Community, pursuing its mission "to support women interested in computers and technology." Activities since its inception have included offering a full-day of engineering and computer science instruction for high school girls in coordination with Princeton's GWISE this past May, hosting IBM's Fran Allen, the 2007 Turing Award recipient, and the first woman to receive the award, and organizing a number of workshops, talks, and visits with major companies such as IBM, Google, Goldman Sachs, and Microsoft.

President Sexton presented the Award to WinC's president, Shaila Musharoff, officers Nicole Weber and Rebecca Davidson, and Faculty Advisor Sana' Odeh at a special ceremony on April 15th, 2008.

Holiday Puzzle: A Better Alarm Clock

by Dennis Shasha, Professor of Computer Science

My digital alarm clock has many responsibilities. First, it has to wake me up at 6:30 to get my kid to school. Next, it gets reset for the various 10 minute naps I take during the day.

Resetting the alarm clock for a new time entails changing the hour one hour at a time on a 24 hour clock and then changing the minute value one minute at a time. In the worst case, the minute value must be changed by clicking 59 times.

So, I thought that it would be nice to have an extra button that would advance the minutes more than one minute with each click. The question then is: how many clicks would be necessary adding up the single minute button and the multi-minute button clicks?

Warm-up: Suppose the multi-minute button always advanced by 5 minutes.

Then what is the worst number of clicks necessary to reset the minute value?

Solution: 59 minutes would require 11 clicks of the 5 minute button and 4 clicks for the minute button, or 15 clicks. This is a big improvement over 59 clicks.

1. Still, 5 minutes may not be the best interval to choose for the multi-minute button. What might be better to reduce the worst case number of clicks? What is that worst case?

2. Suppose that the first click of the multi-minute button advanced a certain number of minutes, the second click a possibly different number of minutes, and so on. Then what should those numbers be to minimize the worst case number of clicks?

3. Suppose you were given two multi-minute buttons but each advanced the time by a fixed number of minutes. What should those two fixed numbers be for the two buttons to minimize the worst case number of clicks? How many is that worst number?

Hint: Suppose one button advanced the minutes by say 32, then two clicks of that button advances the minute hand by 4 without changing the hour value.

We now have three buttons that advance the time, one by one minute and the others by other amounts. Many variants are still possible. For example, we could take away the constraint that all buttons advance the time and the constraint that one button must advance by one minute. If you have a cool variant that you can solve, then please send the variant and solution (and how you did it) to shasha@courant.nyu.edu.

For the solution email courant.alumni@nyu.edu.

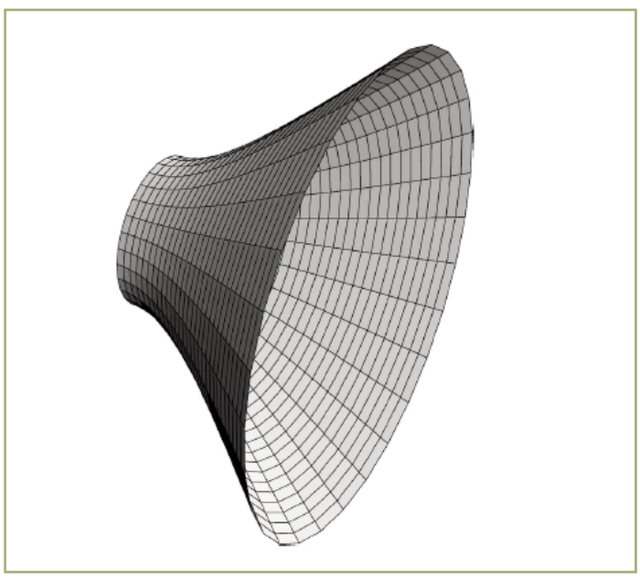
After 50 Years at Courant, Jerry Percus is still 'A little crazy'

By M.L. Ball

"What you want is to be a little bit crazy," stated Jerry Percus, Professor of Mathematics and Physics. "You want to think of things that sound like nonsense to start with and then when you get deeper, they're not nonsense at all."

A mathematician/physicist/engineer/chemist/biologist all rolled into one, Professor Percus has made indelible contributions as a scientist and a friend to a number of communities. To quote from the Preface to the Journal of Statistical Physics, Vol. 63 in 1991, on the occasion of his 65th birthday, "Some of us have known Jerry for a very long time. What we all have in common is, first, a great personal affection for Jerry and second, a great appreciation of his scientific abilities and contributions. Where would the modern theory of classical fluids be today without the Percus-Yevick equation and Jerry's other contributions to the field? There is hardly anyone else around who has had such a deep impact on this subject. Jerry has also made seminal contributions to density functional theory, to exact solutions to dynamic models, and together with Ora Percus, to mathematical biostatistics."

Trained originally as an engineer at Columbia University, Percus began his career by earning a Masters in Mathematics from Columbia, then a Ph.D. in Physics, also from Columbia. After two years of teaching engineering, he decided what he really wanted was to understand life, which meant biology. He explained, "You have to start out with the basics: mathematics, which is the language you're going to use; then physics, which looks at things from a fairly elementary point of view; then move on to chemistry, which is about combining things; and then approach the field of biology. That's the path I've followed, but by addition, not replacement. And of course, I always like to have an image of what I'm doing, sometimes mental but often pictorial."



Hyperboloidal cone with cylindrical symmetry, an extreme model to test approximations for diffusion in a structured channel.

"The first popular paper I wrote was in econometrics," he continued. "One of my friends was at a Wall Street firm in the bond bidding department. He didn't like the techniques they were using; they were getting answers but maybe not the right answers. I looked at their techniques and saw how to solve their problem – one of the few cases in which non-trivial linear programming actually can be solved on almost one page. The resulting paper received over 2000 citations the first year. My friend brought this to the directors of his department who said that if they followed this, it would bring in so much business they wouldn't know what to do with it. Not surprisingly, I guess, he was shown the door . . . one consolation is that this firm's in trouble now."

When asked if he preferred one field of study over another, Percus said that his strength is really statistical physics. "I see everything from that point of view. Much of my career has been devoted to analyzing systems which are artificial but nonetheless share characteristics with real systems that you can identify and solve exactly. I trained as a physicist and an engineer; to me, these are simply examples of the use of mathematics, which I always enjoyed. But I'm probably known best in the chemistry community – theoretical chemistry."

Most 82-year-olds who have been published in over 300 publications would have long ago slowed down, but not Jerry. This fall, he's teaching a course in the mathematical aspects of biology (mathematical models in immunology), and still loves coming to work every day. If he's not in Warren Weaver Hall, he's working at home. His wheels always turning, he described that what he's doing now is "looking at systems in which you know what's going on microscopically, so that you ask the question: Does this imply any particular way of analyzing these systems? You can take the macroscopic observations you've made and systematized in some fashion, and express them in a form which actually implies restrictions as to what must be going on microscopically. That's at the physics level. But I'm interested in the biological and chemical levels and there, you deal with models. And applied mathematics is really the study of mathematical models."

After 50 years at Courant, his thoughts on the Institute? "It's a great place," he said ebulliently. "My business is applied mathematics, and the thing I like about that here at Courant is that you darn well better know the field of application. Both of them are really in the forefront; you can't neglect one while you attend to the other. This combination, this kind of strength, you don't find at many places and so I've been very happy here."

He continued, "There's a lot more cross-pollenization than previously. As well as being Professor of Mathematics and Physics, I have a courtesy appointment with Neural Science; there are many people here who have joint appointments in other departments and I think this is fitting and proper."

Another aspect which Percus highly values at Courant is the rich collaborative environment to be found here. He explained, "The atmosphere is great; you'll speak to people in the lounge, for example. There have been a number of occasions when I'll be visiting institutions abroad and they will ask, Is there some way of having communication between mathematics and physics and chemistry…we don't know how to do it. And what I usually tell them is, Number 1, have a common lounge. There has been a lot of research that has developed from conversations in the lounge. People are relaxed and talk about what they're working on, and that sometimes sparks something. They'll say maybe a half-sentence that's very relevant to what they're doing and it'll strike me that it's also very relevant to something that's been bothering me for awhile. That's one reason why this place is so wonderful; there are ideas floating around all the time."

So at the wonderful age of 82, is Jerry Percus still crazy? "I'd be the last one in the world to be able to evaluate this," he said laughing. "You can fail most of the time – that's fine. If you try, then by all means you can fail. But if you don't try, you can't fail and you can't get anyplace. I'll work on something for a reasonable amount of time and keep on advancing and advancing and then, I'm stuck. And I can see I'm stuck. So I switch to something else and meanwhile without knowing it, subconsciously things are ticking along. And then sometime later for no particular reason, I'll say 'Aha!' Now I know what to do about it."

Jerry Percus, we warmly wish you many more years of 'Aha's.'

The Courant Institute recognizes with gratitude the following alumni, faculty, and friends who have made gifts since our last edition went to print:

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We want to challenge you to help us through the Courant Annual Fund. Contributions from our friends and alumni are exceedingly important. They provide unrestricted income that allows us to support student travel to conferences, to enhance the activities of our student clubs, to invite distinguished speakers for both technical and public lectures, to assist with furnishing the newly renovated floors in Warren Weaver Hall, and to create improved public spaces in both Warren Weaver Hall and the Broadway building. Over the past year, the Courant Annual Fund raised $183,000 (our greatest year yet), and the funds have had great impact.

This fall, we had our first Director's Circle dinner to recognize those who have given $1,000 and above, with a special talk by Peter Lax on the history of the Institute.

All donations great and small are much appreciated, and help provide support for a truly extraordinary range of people and programs.

To join our community of Courant donors, please visit the new NYU online giving page at www.nyu.edu/giving or contact Cheryl Sylivant at sylivant@cims.nyu.edu or (212) 998-3321.

Ken Perlin Made Learning a Game and Now Kids Can't Get Enough of It

By M.L. Ball

On October 7th, a highly interdisciplinary and multi-institutional project called the Games for Learning Institute was officially launched. The brainchild of Ken Perlin, Courant Professor of Computer Science and computer graphics expert, and Jan Plass, Professor of Educational Communication and Technology at the Steinhardt School of Education, the project was funded by a three-year, $3 million grant from Microsoft Research. Its goal is to try to determine what is effective when educational video games are used to teach children math and science. "We're focusing on the middle school years, 10-13, because that's when many students lose interest and drop out, particularly minorities and girls," Perlin said.

Perlin will direct the new institute, and Plass will co-direct, joined by fourteen faculty members from six different universities in the New York area: NYU, Columbia's Teachers College, the City University of New York, Parsons The New School for Design, and Dartmouth, as well as several different groups within NYU, including the Steinhardt School of Education, Tisch School of the Arts, and NYU-Polytechnic. "Alongside the computer graphics experts, we've involved psychologists who study science education, the theory of learning, and ethical issues related to education," Perlin explained. "What's exciting about it is that all of these people have agreed that they will work with their graduate students on one coherent plan – which is actually fairly rare to find among a diverse group of faculty.

Children at the NY Hall of Science playing an educational science game developed by NYU Computer Science Graduate Students.

"Our goal is to show high quality scientific results while working with middle school teachers and students in the New York area, and ultimately to show that something really works and what really works. And that will be the foundation for other funding," Perlin said.

Although those involved with the new institute are very grateful for Microsoft's seed money, they acknowledge that the project needs long term investment. "We're actively looking for other people who are interested in funding, participating, and sustaining the Games for Learning Institute, above and beyond the initial funding period," Perlin explains. "From the beginning, we're going to be working with other corporations, education game publishers, and foundations who are interested in jumping on board."

According to Perlin, "We will initially be working with middle schools but the general principles we're discovering can also be used by computer clubs or in museum settings, for example. We're learning the paradigms of how to engage a child in the process of learning, because there are different kinds of learning. More than absorbing facts, there's the process of how to learn (metacognitive knowledge), as well as how a particular learning process can help you feel better about yourself and give you confidence in learning.

"If kids think you're tricking them into learning, that's not good. You really need to be engaging them as participants. Ultimately we're not trying to replace teachers – we're trying to give teachers a better tool that's more active and more interesting to kids than just textbooks. We're offering something that's not only actively engaging and that allows kids to help facilitate their own learning, but that can also help monitor the right level for them to be learning at, the level that keeps them engaged and neither bored nor frustrated. Individual learners will be able to learn in different ways."

In step with how kids listen, play, and chat, the institute's educational games will go beyond computers and classrooms. Since today's kids spend just as much time, if not more, with PDAs, game boys, and iPhones than with desktops, these handheld devices can now be learning devices. "That's a platform that's potentially applicable to kids around the world – in inner cities or third world countries where kids can't afford to have their own computer," Perlin said.

As well as directing the Games for Learning Institute, Perlin was also founding director of Courant's Media Research Lab. "We founded it a long time ago with just a couple of faculty," he explained, "and now it's part of a group of several labs with about half a dozen faculty who work in vision, machine learning, geometric modeling, mobile robotics and motion capture. We get along great and have fantastic students. We've developed a critical mass of great faculty just in the last few years; that's allowing us to get some really top Ph.D. students who are coming here instead of the equivalent labs in say Berkeley or Stanford or MIT. That's great fun when you know you're getting the best students. When students are looking at vision, machine learning and graphics, they look at us very seriously and apply to Courant."

Prolifically designing computer graphics games is also one of Perlin's strengths. One such game that he designed, "Face" has had an unexpected but very positive application. As Perlin described it, "A researcher at North Carolina State University named Dorothy Strickland came up to me when I was showing this game publicly and said this could be used to help children with autism or Asberger's syndrome. One of the common conditions associated with autism is a diminished innate capacity to look at someone's face and know what the emotion is. But many of these kids are very intelligent and very good general learners; given the right tools, they can teach themselves what isn't already built in brain-wise. My "Face" game is a tool that is very good for them. For example, to learn what anger looks like, you don't want to go up to someone and get them angry – that's not a very safe way to learn. But now they have a safe environment to understand people's emotions."

Thanks to Ken Perlin and his team at the Games for Learning Institute, students around the country and hopefully around the world soon will be zooming through virtual tunnels and zapping formidable foes, all the while learning valuable algebra and science. Nothing could please Professor Perlin more. "We're excited!" he explained. "We're doing good in the world and having a good time."

Masters Association in Computer Science (MACS)

A new Association has been formed at the Courant Institute – the "Masters Association in Computer Science." According to Chee Yap, the Director of Graduate Studies for M.S. programs in Computer Science, and the Association's President, M.S. student Trishank Karthik, "The charter of this organization is to develop and foster a community for masters students in Computer Science."

Professor Yap further noted that "In most universities, including NYU, the undergraduates and doctoral students get all the attention. This club, which is officially registered as an NYU student organization, will cater to the special needs of masters students." On the average, the Courant Institute has about 350 students in its M.S. programs in Computer Science each year.

The Association plans to "foster a community" for these 350 individuals by "for example, organizing professionally-oriented talks by industry leaders or by creating networking opportunities with our many alumni in the field."

MACS had its kick-off party this October 30th, and a career panel is planned for the Spring.

More information can be found on the web at http://cs.nyu.edu/~macsweb/ or by contacting macs@cs.nyu.edu.

Courant Institute of Mathematical Sciences

NEW YORK UNIVERSITY

FALL/WINTER 2008
Volume 6 - Number 1

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