SANTA FE INSTITUTE

Update

May/June 2009

RESEARCH NEWS

Delays in networking yield rapid super-connection

Water can suddenly freeze into a sheet of ice similarly to how a network of points can suddenly achieve super-connectivity. (Image: Brandon Keim)

Delaying an emerging network's overall connectivity can last for only so long, and can make for a cataclysmic shift when it finally happens, according to recent research by a team of scientists that includes SFI External Professor Raissa D'Souza.

Dubbed "explosive percolation," the phenomenon challenges conventional understanding of network formation and opens a new door for studies of connectivity, from material sciences to epidemics.

The usual pattern of emerging connectivity follows what is known as the Erdös-Rényi random graph process. In it, linking randomly chosen pairs of points one at a time eventually yields a rapid but smooth transition between little and great connectivity. Every attempt to adjust the onset of connectivity has generated a continuous transition – until now.

Raissa, an associate professor in the Department of Mechanical and Aeronautical Engineering at UC Davis, and colleagues applied an algorithm that exploits the randomness of the links: They randomly generated two candidate pairs of points to join – rather than one – and chose to connect the pair that creates the smaller subgroup (the pair of points having the fewest existing connections).

As with Erdös-Rényi, the level of connectivity stays low until a critical point but then shoots up to covering more than half the network nearly instantaneously. The team's method also hastens the onset of super-connectivity when the greater subgroup option is chosen. "It's surprising that a small change could impact the fundamental nature of the process," says Raissa.

The team has shown the pattern computationally, but a mathematical proof of the behavior has yet to be worked out.

Explosive percolation offers applications both in fields that wish to build connections quickly, such as online or transportation networks, or destroy them, such as disease modeling, she says.

The work appeared in the March 13 issue of *Science* and has caught the interest of researchers in areas from basic science to counter-terrorism. ■

RESEARCH NEWS

First map of scientific curiosity reveals surprises

A Los Alamos National Laboratory research team that includes SFI External Professor Luis Bettencourt has created maps that for the first time portray the private usage behavior of consumers of scientific scholarship.

Using "clickstream" data – detailed records of the sequences of articles scientists download as they chase their curiosities on the World Wide Web – the researchers created maps that yield insights about the dynamics of scholarship and relationships among scientific fields.

The researchers believe their visualizations can help funding agencies detect emerging trends and point scientists to interdisciplinary hot spots.

The research, led by LANL's Johan Bollen, appeared recently in PLoS One (http://is.gd/mIQH). "This will be a crucial component of future efforts to study and predict scientific innovation, as well as novel methods to determine the true impact of articles and journals," Bollen says.

Previous visualizations of scientific activity typically based on citation data are, like early world navigation charts, useful but not fully representative of the terrain being mapped, the researchers say. Existing citation data-

> more on page 2

IN THIS ISSUE

RESEARCH NEWS

Constants in language change

Eight researchers spanning the linguistic disciplines met at SFI for two days in March to find common ground and address big questions about how human language changes.

The workshop, called "Models of Innovation and Propagation in Language Change," was organized by SFI Postdoctoral Fellow Dan Hruschka and External Professor Morten Christiansen (Cornell University). It builds on a related meeting held last year.

"Discovering the pressures that lead people to adopt new words and ways of saying things helps us understand the nature of social interaction and the human condition more broadly," Morten says.

Rather than the typical series of talks followed by discussions, the researchers explored

> more on page 3

INSIDE SFI

2009 public lectures offer more viewpoints

SFI's public lectures have been recast for 2009.

Fewer lectures will make way for a more provocative format featuring richer discussion around a greater diversity of viewpoints.

Each lecture includes multiple presentations by leading thinkers from various fields, moderated by an SFI faculty host who highlights agreements and differences in perspectives.

This year's lineup addresses some of the biggest challenges facing our world, says SFI Education & Outreach VP Ginger Richardson.

On April 2 SFI Faculty Chair David Krakauer hosted the first public lecture in the 2009 series. "The Post-Darwinian World" reviewed the historic insights of Charles Darwin and highlighted how his theory of evolution has revealed greater complexities – in the fields of biology, economics, and politics – that today require new and expanded sets of ideas. 2009 is the 200th anniversary of Darwin's birth.

> more on page 2

LIT BITS

Neutral network sizes of biological RNA molecules can be computed and are not atypically small; Jorg, T.; Martin, O.C.; **Wagner, Andreas [SFI External Professor]**; *BMC Bioinformatics* 9, October 30, 2008, pp. 1-12

Nonextensive statistical mechanics and nonlinear dynamics; **Tsallis, Constantino [SFI External Professor]**; *Interdisciplinary Aspects of Turbulence* 756, 2009, pp. 21-48

Condensate-induced transitions between topologically ordered phases; **Bais, Sander (F.A.) [SFI External Professor]**; Slingerland, J.K.; *Physical Review* B 79 (4), January 2009, pp. 577-603

Major dimensions in food-web structure properties; Vermaat, J.E.; **Dunne, Jennifer [SFI Research Professor]**; Gilbert, A.J.; *Ecology* 90 (1), January 2009, pp. 278-282

On the robustness of q-expectation values and Renyi entropy; Hanel, R.; **Thurner, Stefan [SFI External Professor]; Tsallis, Constantino [SFI External Professor]**; *EPL* 85 (2), January 2009, pp. 27-32

Protein material costs: Single atoms can make an evolutionary difference; Bragg, J.G.; **Wagner, Andreas [SFI External Professor]**; *Trends in Genetics* 25 (1), January 2009, pp. 5-8

Simple prediction of interaction strengths in complex food webs; Berlow, E.L.; **Dunne, Jennifer [SFI Research Professor]**; Martinez, N.D.; Stark, P.B.; Williams, R.J.; Brose, U.; *Proceedings of the National Academy of Sciences* 106 (1), January 6, 2009, pp. 187-191

Pruning the tree of life: k-core percolation as selection mechanism; Klimek, P.; **Thurner, Stefan [SFI External Professor]**; Hanel, R.; *Journal of Theoretical Biology* 256 (1), January 7, 2009, pp. 142-146

Evolutionary model of species body mass diversification; **Clauset, Aaron [SFI Postdoctoral Fellow]; Redner, Sidney [SFI External Professor]**; *Physical Review Letters* 102 (3), January 23, 2009, pp. 302-305

Change and stability in Permian brachiopod communities from western Texas; Olszewski, T.D.; **Erwin, Douglas [SFI Professor]**; *Palios* 24 (1-2), January-February 2009, pp. 27-40

How many species have mass M?; **Clauset, Aaron [SFI Postdoctoral Fellow];** Schwab, D.J.**; Redner, Sidney [SFI External Professor]**; *American Naturalist* 173 (2), February 2009, pp. 256-263

Cancer research meets evolutionary biology; **Pepper, John [SFI External Professor]**; Findlay, C.S.; Kassen, R.; Spencer, S.L.; Maley, C.C.; *Evolutionary Applications* 2 (1), February 2009, pp. 62-70

Evolution and self-assembly of protocells; **Solé, Ricard [SFI External Professor]**; *International Journal of Biochemistry & Cell Biology* 41 (2), February 2009, pp. 274-284

The evolution of hierarchical gene regulatory networks; **Erwin, Douglas [SFI Professor]**; Davidson, E.H.; *Nature Reviews Genetics* 10 (2), February 2009, pp. 141-148

Nonextensivity at the edge of chaos of a new universality class of one-dimensional unimodal dissipative maps; Ruiz, G.; **Tsallis, Constantino [SFI External Professor]**; *European Physical Journal* B 67 (4), February 2009, pp. 577-584

Quantifying social and opportunistic behavior in e-mail networks; Gomes, L.H.; Almeida, V.A.F.; Almeida, J.M.; Castro, F.D.O.; **Bettencourt, Luis [SFI External Professor]**; *Advances in Complex Systems* 12 (1), February 2009, pp. 99-112

> *2009 public lectures*

continued from page 1

Charles Darwin at 31

"As scientists we are always searching for better and more accurate explanations," David said. "Theories generate new questions that without the lens of the theory were invisible."

Since Darwin's time, for example, mathematical models and genetic principles have been developed to describe evolutionary mechanisms that in many ways undermine Darwin's theory as it was conceived. And yet, David says, Darwin's theory was essential for progress in those areas.

Four other SFI faculty members explored both the influence and the limitations of Darwinian thought on modern science: Professor Tanmoy Bhattacharya on disease and health, Research Professor Jennifer Dunne on ecosystems, Research Professor Jessica Flack on society, and Professor Eric Smith on economics.

SFI's upcoming public lectures include:

"**The Computer, the Brain, and the Internet,**" May 27 – The Internet, not the computer, may now be our best current model for understanding how the brain works. Thought may be nothing more than a search in the space of ideas. These talks will explore a new hybrid world where the brain, the computer, and the Internet are progressively merging and the implications for the intellectual future of our species.

"**What will it cost the Earth to save the planet?**" July 16

"**Stanislaus Ulam Memorial Lecture Series: Adventures in the simple and the complex: A tribute to Murray Gell-Mann**," September 15, 16, and 17

Watch the *Update* for more about SFI's upcoming public lectures. To receive email notification about lectures, subscribe to lecture-subscribe@santafe.edu. ■

> *Map of science*

continued from page 1

bases tend to over-represent the natural sciences at the expense of the social sciences and humanities, and citation data can be dated because of the significant delays in publishing, so any map created from it represents the world as it was years earlier and not as it is today.

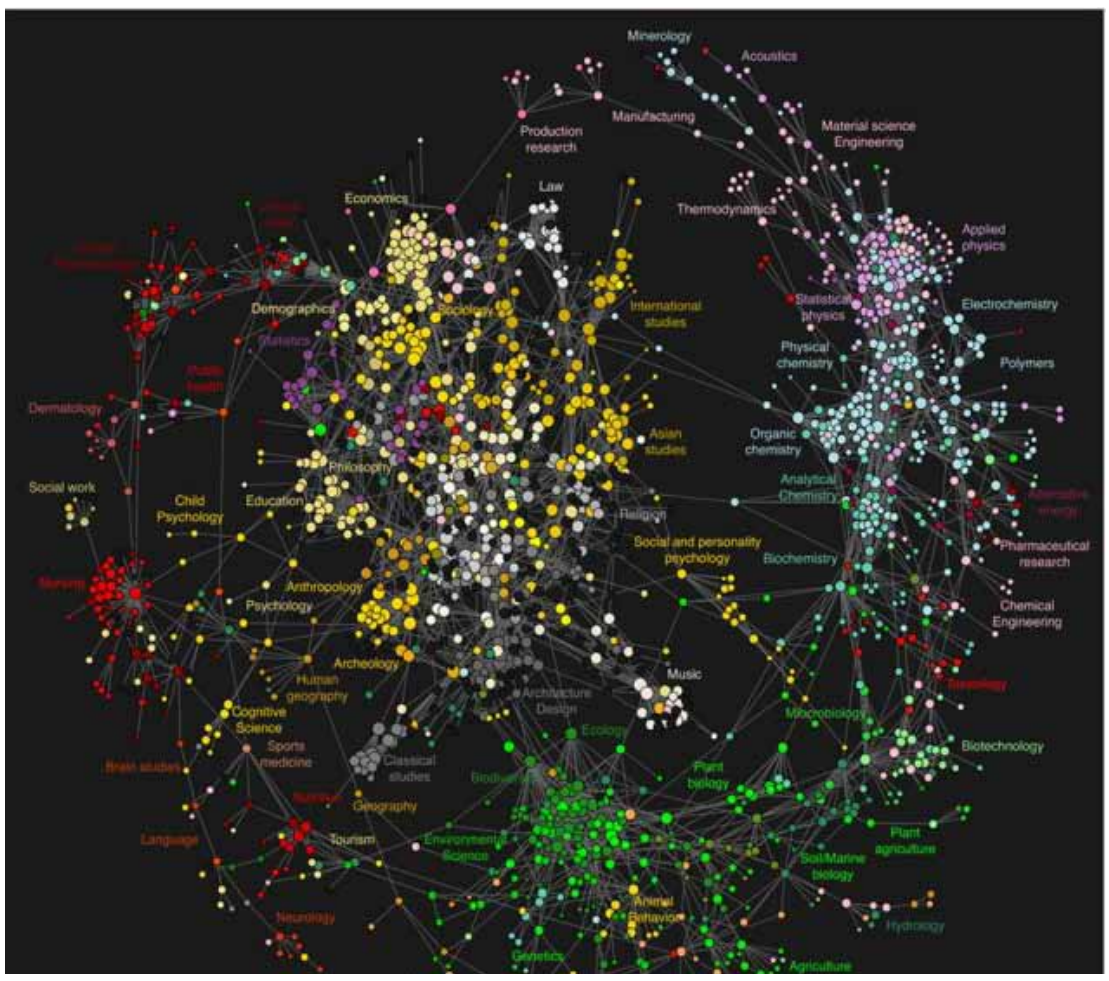
Finally, they say, a scientist can be motivated to include a formal citation in a journal article for a number of reasons that bias the data – to impress colleagues or flatter a potential reviewer, for example.

They believe clickstream data are a more genuine indicator of scientific discovery and cross-fertilization among disciplines, are more contemporary because most scientific papers are available online months or years before they are published, and offer a fuller view of scientific activity in the social sciences and humanities as well as the natural sciences.

"Our map of science derived from clickstream data may thus run counter to accepted wisdom and offers a first-ever glimpse of this scholarly terra incognita," the paper says.

To create the maps, the team first examined online usage logs from leading scientific publishers, aggregators, and institutions generated in 2007 and 2008. Their collection totaled more than a billion retrievals of scientific information.

They then calculated the probability that an article or journal accessed by a user would be followed by a subsequent article or journal. The resulting model was visualized as a network of connected articles and journals that outlines the relationships between various scientific domains.



Online behavior of scientists, with colors representing the scientific discipline of each journal and lines reflecting the navigation tendencies of users. Colors: physics, light purple; chemistry, blue; biology, green; medicine, red; social sciences, yellow; humanities, white; mathematics, purple; and engineering, pink.
(Image: Los Alamos National Laboratory)

"Whereas maps based on citations favor the natural sciences, our maps showed a prominent and central position for the humanities and social sciences, which, in many places, acted like interdisciplinary bridges connecting various other scientific domains," says Luis. "In this sense the creation of scientific knowledge is a fundamentally interdisciplinary activity, though certain connections appear as a multitude of weak links that were hard to observe before by the more stringent criteria involved in citations."

Future work will focus on developing models of scholar searches. The researchers also will continue to develop real time data-management systems and models that allow emerging trends in scientific innovation to be identified and encouraged.

The research team includes Bollen, Herbert Van de Sompel, Ryan Chute, and Lyudmila Balakireva of LANL's Digital Library Research and Prototyping Team and Aric Hagberg, Luis, and Marko Rodriguez of LANL's Mathematical Modeling and Analysis Group and LANL's Center for Nonlinear Studies.

Recent news coverage of the work appeared in *Nature* (March 9), the *New York Times* (March 16), *Seed* magazine (March 20 and April 14), and *Wired* (March 11). ■

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The SFI *Update* is published bi-monthly by the Institute to keep our community informed about current work and activities. Please send comments to Ginger Richardson at *grr@santafe.edu.*

RESEARCH NEWS

Seminar series to explore dynamics of construction

Descriptions of how high-level, often unexpected structures arise from small-scale properties or individual behaviors (in ant colonies, for example) recently have been applied in fields far from their origin fields of physics and biology. Less well understood are the processes by which such structures are built from the ground up.

A series of seminars at SFI this summer will begin to share ideas from a variety of SFI research threads, and may prompt work toward a common theoretical framework for the building of structure across many scales, from viruses to societies.

The "Construction Dynamics Seminar Series" organized by SFI Research Professor Jessica Flack will explore, among other topics, the computational processes underlying construction, how structural feedback influences lower-level behaviors, and how principles and rules governing construction evolve.

"Of particular interest is whether cells or organisms, or individuals in social groups, by building their ecological and social environments, reduce uncertainty about the cost of social interactions or the availability of resources, and are therefore better able to develop appropriate strategies for competing," she says.

The seminar series is broad enough to include much ongoing research within the Institute's community: the major transitions in evolution, levels of selection, evolution of development, evolution of signaling systems, animal behavior, cognitive science, niche construction, the origins of individuality, robustness and innovation, scaling, information theory, and theories of computation and emergence, to name a few.

The series kicks off May 7 with a presentation by SFI Sabbatical Visitor John Odling-Smee (University of Oxford), a leading researcher in animal learning, its role in evolution, and niche construction.

For more information, **www.santafe.edu/events/** ■

LIT BITS (cont.)

Socio-economical dynamics as a solvable spin system on co-evolving networks; Biely, C.; Hanel, R.; **Thurner, Stefan [SFI External Professor]**; *European Physical Journal* B 67 (3), February 2009, pp. 285-289

Topological signatures of species interactions in metabolic networks; **Borenstein, Elhanan [SFI Postdoctoral Fellow]; Feldman, Marcus [SFI External Professor]**; *Journal of Computational Biology* 16 (2), February 2009, pp. 191-200

Complexity measures from interaction structures; Kahle, T.; Olbrich, E.; **Jost, Jüergen [SFI External Professor]; Ay, Nihat [SFI External Professor]**; *Physical Review* E 79 (2 PT 2), February 2009, pp. 169-177

Toward a systems biology framework for understanding aging and health span; **West, Geoffrey [SFI President and Distinguished Professor]**; Bergman, A.; *Journals of Gerontology Series A - Biological Sciences and Medical Sciences* 64 (2), February 2009, pp. 205-208

Structural profiles of human miRNA families from pairwise clustering; Kaczkowski, B.; Torarinsson, E.; Reiche, K.; Havgaard, J.H.; **Stadler, Peter [SFI External Professor]**; Gorodkin, J.; *Bioinformatics* 25 (3), February 1, 2009, pp. 291-294

Inferring malaria parasite population structure from serological networks; **Buckee, Caroline [SFI Postdoctoral Fellow]**; Bull, P.C.; Gupta, S.; *Proceedings of the Royal Society B-Biological Sciences* 276 (1656), February 7, 2009, pp. 477-485

Genetic influences on social network characteristics; **Jackson, Matthew [SFI External Professor]**; *Proceedings of the National Academy of Sciences* 106 (6), February 10, 2009, pp. 1687-1688

Natural selection 150 years on; **Pagel, Mark [SFI External Professor]**; *Nature 457* (7231), February 12, 2008, pp. 808-811

Recession watch: End the obsession with interest; **Geanakoplos, John [SFI External Professor]**; *Nature 457* (7232), February 19, 2009, p. 963

Adaptationism and the adaptive landscape; **Wilkins, Jon [SFI Professor]**; Godfrey-Smith, P.; *Biology & Philosophy 24* (2), March 2009, pp. 199-214

Algorithmic guided screening of drug combinations of arbitrary size for activity against cancer cells; Zinner, R.G.; Barrett, B.L.; Popova, E.; Damien, P.; Volgin, A.Y.; Gelovani, J.G.; Lotan, R.; Tran, H.T.; Pisano, C.; Mills, G.B.; Mao, L.; Hong, W.K.; Lippman, S.M.; **Miller, John [SFI Professor]**; *Molecular Cancer Therapeutics* 8 (3), March 2009, pp. 521-532

Armed groups and sexual violence: When is wartime rape rare?; **Wood, Libby [SFI Professor]**; *Politics & Society* 37 (1), March 2009, pp. 131-161

Rare HLA drive additional HIV evolution compared to more frequent alleles; Rousseau, C.M.; Lockhart, D.W.; Listgarten, J.; Maley, S.N.; Kadie, C.; Learn, G.H.; Nickle, D.C.; Heckerman, D.E.; Deng, W.; Brander, C.; Ndung'u, T.; Coovadia, H.; Goulder, P.J.R.; **Korber, Bette [SFI Research Professor]**; Walker, B.D.; Mullins, J.I.; *AIDS Research and Human Retroviruses* 25 (3), March 2009, pp. 297-303

When economic incentives backfire; **Bowles, Sam [SFI Professor]**; *Harvard Business Review* 87 (3), March 2009, pp. 22-23

Expanded breadth of the T-cell response to mosaic human immunodeficiency virus type 1 envelope DNA vaccination; Kong, W.P.; Wu, L.; Wallstrom, T.C.; Fischer, W.; Yang, Z.Y.; Ko, S.Y.; Letvin, N.L.; Haynes, B.F.; Hahn, B.H.; **Korber, Bette [SFI Research Professor]**; Nabel, G.J.; *Journal of Virology* 83 (5), March 1, 2009, pp. 2201-2215

INSIDE SFI

iTunes U to make SFI events available for download

Podcasting of digital audio and video files over the Internet, not long ago mainly an entertainment phenomenon, has ushered in an era of mobile learning.

This spring SFI is making digital media available for download from the Institute's website via Apple's iTunes U system. SFI will join Stanford, Harvard, MIT, and many other major universities in making educational materials available to the public via iTunes U.

According to SFI project manager Atty Mullins, the new SFI iTunes U site will allow public access to select Institute public lectures, colloquia, seminars, and workshops. He expects the project to go live in May.

Conceived and executed with the help of content developer Luke Washburn, iTunes U will allow both Mac and Windows users to view videos via the iTunes application or download them to video iPods or iPhones.

"We believe iTunes U will further SFI's education and outreach goals by making the Institute's unique content available to a much larger audience than ever before," Atty says. ■

INSIDE SFI

Busy season approaches for SFI education programs

This summer young scientists from the secondary through the graduate level are converging on the Institute to better understand complex systems.

The Institute's educational programs have several broad impacts, says SFI Education & Outreach VP Ginger Richardson. "First, we're training the upcoming generation of complexity science scholars who will become practitioners within this new paradigm here at SFI and elsewhere," she says. "Second, our students become very real ambassadors for SFI and complexity science as they move forward in their careers. Finally, good science education simply benefits society at large."

2008 CSSS students collaborate on a project.

The Institute is one of the sites for the annual Research Experiences for Undergraduates program funded by the National Science Foundation. Undergraduate students work with faculty mentors on individual research projects focused on some aspect of complex systems. Each project may be based on a suggestion from the SFI mentor, an idea from the student, or a combination of the two. This summer nine outstanding undergraduate scholars from the U.S. and Latin America are participating; the students live at nearby St. John's College and spend their days at SFI.

The 15th annual Graduate Workshop on Computational Social Science Modeling and Complexity takes place June 21 through July 4. Co-directed by SFI Professor John Miller (Carnegie Mellon University) and External Professor Scott Page (University of Michigan, Ann Arbor), the workshop includes faculty lectures, special topic seminars by SFI researchers, and presentations of work in progress by the advanced graduate student participants.

"Our vision is to create an idyllic two-week graduate experience – an environment in which students can do good science, explore ideas without feeling shackled by disciplinary constraints, and pursue those ideas to their logical ends," Scott says. "The intellectual interplay between computer scientists, economists, and sociologists is always fun."

The two programs are part of a wide variety of year-round educational outreach offerings from SFI. Annual schools provide students with an intensive introduction to and collaborative research experience in different complexity science topics.

The Institute also supports residential and international internships and fellowships through the postdoctoral level. And Project GUTS ("Growing Up Thinking Scientifically"), supported by SFI, is a free, one-year after school program for motivated New Mexico-area middle schoolers who share an interest in scientific inquiry, problem solving, and investigating topics of interest to their local communities. ■

> *Language change*

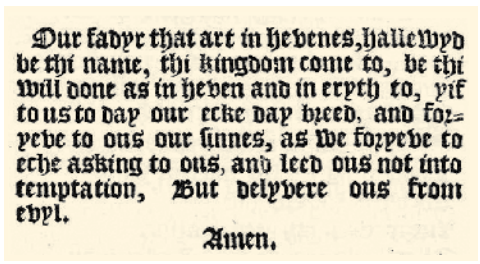
continued from page 1

themes based on five position papers written by participants and circulated before they met. Issues of interest included models of random and constrained change in language, conditions of creating change, and how social forces like population structure and context act as mechanisms for changes to spread and stay in languages. First, though, they had to decide how each discipline, from cognitive linguistics to historical linguistics, defines ideas like variance and innovation.

"Every time we say a new sentence, that's probably a new way of saying something," says Dan. "Is that entire utterance an innovation? What counts as an innovation?"

Morten called the workshop a success. "We were able to put together a number of ways of looking at language change across the different perspectives of participants."

They outlined a paper that covers their findings, tentatively titled "Toward a cognitive science approach to language change," and plan to submit it to a journal later this year. ■


Our fadyr that art in hevenes, hallewyd be thi name, thi kingdom come to, be thi will done as in heven and in erpth to, yif to us to day our ecke day bred, and forgeve to ous our sinnes, as we forgeve to eche asking to ous, and leed ous not into temptation, But delyvere ous from evyl.
Amen.

14th century version of the Lord's Prayer, showing how much a familiar Western text has changed over the centuries.

PEOPLE

Mitchell book offers accessible, guided tour of complexity science

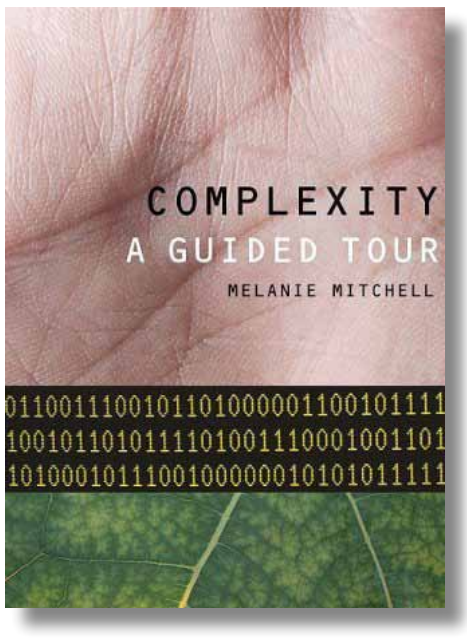
A new book by SFI External Professor Melanie Mitchell (Portland State University) offers an accessible, illustrated overview of the foundations of complexity research and a survey of recent developments in the field.


Melanie Mitchell

Complexity: A Guided Tour (Oxford University Press, 2009) reviews the historical roots and visionaries of complexity science and its underlying concepts, in particular emergence – how large-scale complex, organized, and adaptive behaviors arise from myriad individuals or processes. Melanie illustrates emergence at work in complex systems as diverse as neurobiology, ant colonies, and the Internet.

Her book then outlines approaches, from a variety of disciplines, used by complexity scientists to comprehend complex adaptive systems and to identify general principles or laws that apply to all of them.

It also surveys promising developments in complex network theory, biological scaling, and cellular automata and suggests several major practical applications the field could potentially tackle, such as a better understanding of financial markets.



A recent review of the book in *Nature* said: "It has become fashionable in recent years to criticize complex systems science for generating too much hype and not offering enough practical insight. But insights into truly complex problems do not come easy. Mitchell's welcome book makes it clear that this field is making steady, if slow, progress." ■

PEOPLE

Crutchfield lives

SFI External Professor Jim Crutchfield might sometimes be late, but he is alive and well, according to his colleagues.

A review of SFI External Professor Melanie Mitchell's new book, *Complexity: A Guided Tour*, in the March 26 issue of *Nature*, referred to Jim as "Mitchell's former colleague, the late Jim Crutchfield."

"I (and even more so, Jim) have received numerous worried e-mails about Jim," Melanie says. "Please rest assured Jim is OK."

In a letter to *Nature's* editors, Melanie thanked the journal for the positive comments about her book, but wrote: "Happily, Jim is alive and well, still my colleague, and doing important work on complex systems at the University of California at Davis and the Santa Fe Institute."

Says Jim: "Many thanks to all of my far-flung colleagues for their expressions of concern and their condolences. I can assure them that my demise, as unexpected as exaggerated, was painless. Looking back, the main regret is not to be able to publish posthumously now. That's something I'll just have to look forward to." ■

RESEARCH NEWS

Forrest paper selected for two awards

A paper co-authored by SFI External Professor Stephanie Forrest (University of New Mexico) was one of five selected as a 2009 International Conference on Software Engineering (ICSE) ACM SIGSOFT (Special Interest Group on Software Engineering) Distinguished Paper. ACM is the Association for Computing Machinery.

The paper, titled "Automatically finding patches using genetic programming," was co-authored by Westley Weimer (University of Virginia), ThanhVu Nguyen (University of New Mexico), Claire Le Goues (University of Virginia), and Stephanie. It presents a fully automated technique for repairing bugs in off-the-shelf legacy software using a form of genetic programming – a machine learning approach inspired by biological evolution.

The study also was selected for the International Federation of Information Processing's Manfred Paul Award for Excellence in Software: Theory and Practice. (**www.cs.up.ac.za/cs/jbishop/TC2Award.html**)

The team's work was supported in part by the National Science Foundation, the Air Force Office of Scientific Research, and Microsoft Research. ■

PEOPLE

Former CSSS students publish joint paper

Two participants in SFI's Complex Systems Summer School (CSSS) are publishing collaborative work they began during the 2007 CSSS session. Their paper, accepted by the *Journal of Theoretical Biology*, is available online at doi:10.1016/j.jtbi.2008.11.008.


Ryan Chisholm

For their 2007 CSSS collaborative project, biologist Ryan Chisholm and physicist Elise Filotas examined "critical slowing down" (CSD), a phenomenon whereby a disturbed ecosystem takes increasingly longer to recover from small perturbations as it nears a transition to another stable state.

The pair took an analytical approach to two two-species models. They found that CSD gives greater advance warning of a transition in a predator-prey model when predation is high or the prey population grows slowly. In a competition model, it works when the rare species' population grows slowly.


Elise Filotas

Their findings add support to earlier numerical work and suggest factors to consider when investigating transitions in disturbed systems, from eutrophic lakes to rangeland.

Since the school, Chisholm has been pursuing a PhD in ecology and evolutionary biology at Princeton University. Filotas is finishing her multi-disciplinary PhD thesis in physics and ecology at the University of Montreal.

CSSS, an annual month-long program for graduate students and postdocs, combines lectures on techniques and applications of complex adaptive systems with interdisciplinary collaboration. The 2009 Santa Fe CSSS starts in June. ■

SFI IN THE NEWS

SFI Postdoctoral Fellow Nathan Eagle's launch of "txteagle," which uses cell phones to distribute assignments for simple tasks to people around the world, is being widely covered in the news media. Such "crowd-sourcing" makes certain tasks more economical, such as improving the performance of speech-recognition software for local dialects or manually transcribing speech into text. It also provides needed income to people in some of the poorest parts of the world, says Nathan. A February 11 article in *New Scientist* described one way txteagle is already being used: "Nokia, for example, wants to provide cell phone interfaces in the 60 or so languages spoken in Kenya, but lacks the linguistic know-how to do so. So the company has begun using txteagle to recruit Kenyans to translate English words into local dialects. Contributors are sent text messages with the English words that need translation. The same word or phrase is sent to multiple users, and if a high percentage of people return the same answer, it is accepted by the system."

Other coverage:

BBC (http://news.bbc.co.uk/1/hi/technology/7881931.stm)

CBC Radio (www.cbc.ca/spark/blog/2008/09/full_interview_nathan_eagle_on_mobile_phones_in_af.html)

O'Reilly Keynote (http://blip.tv/file/1868958)

MIT's Technology Review (http://www.technologyreview.com/business/21983/?a=f)

An April 1 *PhysicsWorld.com* article asks whether today's careful, results-driven approach to scientific investment is encouraging incremental progress at the expense of the kind of revolutionary thinking that historically has led to mankind's most significant innovations. SFI President Geoffrey West weighs in: "In recent years, tightening business practices and efforts to improve efficiency have also driven corporations in a similar direction. 'That may be fine in the accounting department,' says West, 'but it's squeezing the life out of innovation'…In the short run, what the mavericks do will almost always seem less successful, perhaps even like wasting their time, and it is easy to think that this is the kind of research we should not pursue, even if this is actually very much mistaken. This is a trap, West suggests, into which modern science planning has fallen. 'My fear,' he says, 'is that by eliminating the mavericks we end up hobbling our ability to discover the big, new ideas – the next transistor. That's a serious and tragic error.'"
http://physicsworld.com/cws/article/print/38468

An April 2 post in *OpEd News* notes that "a small but growing cadre of scientists are arguing that our current [economic] crisis was in fact predictable and that the technology exists to make sure that it won't happen again. The problem may be that we've used only economists to try to solve our economic predicaments. Instead, the solution may be found by physicists and other scientists accustomed to studying complex systems… At the Santa Fe Institute, Yale economist John Geanakoplos has teamed up with two physicists to look at the natural competition that emerged among hedge funds as they competed to attract investors. The group is examining how hedge funds took on additional leverage during that process – and how the state of the market changed fundamentally as a result of the added debt…This way of thinking is foreign to mainstream economic theory, which assumes that people, firms, and other economic agents act rationally."
www.opednews.com/populum/diarypage.php?did=12753

An April 13 *New York Times* piece, "Taxing: A ritual to save the species," discusses recent research describing how, in both animal populations and in human societies, individuals often turn over hard-won resources to others for the good of the whole. "It turns out that giving up a portion of one's income for the sake of the tribe is such a ubiquitous feature of the human race that some researchers see it as crucial to our species' success. Without ritualized taxation, there would be precious little hominid representation," it said. SFI Professor Sam Bowles is quoted: "'There's not a human society in the world that doesn't redistribute food to nonrelatives,' said Samuel Bowles, director of the behavioral sciences program at the Santa Fe Institute. 'Whether it's through the state, or the chief, or a rural collective, or some other mechanism, food sharing of large nutritional packages is quite extensive and has been going on for at least 100,000 years of human history.' In hunting and foraging cultures, the proportional tax rate is so high, said Dr. Bowles, that 'even the Swedes would be impressed.'"
www.nytimes.com/2009/04/14/science/14angi.html

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