SANTA FE INSTITUTE

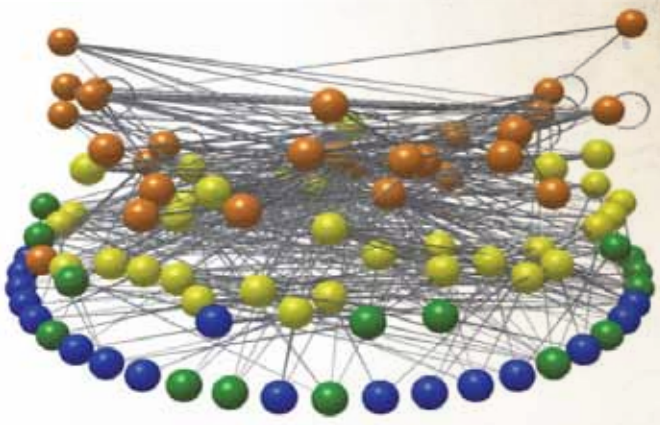
May / June 2014

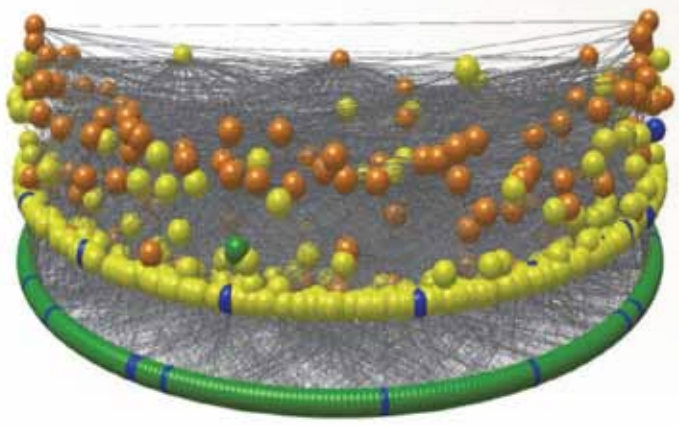
UPDATE

Ancient food webs show modern structure soon after mass extinction

A research team led by SFI Professor Jennifer Dunne has pieced together a highly detailed picture of the feeding relationships among 700 mammal, bird, reptile, fish, insect, and plant species from a 48 million year old lake and forest ecosystem.

Their analysis of fossilized remains from the Messel deposit near Frankfurt, Germany, provides the most compelling evidence to date that ancient food webs were organized much like modern food webs. Their paper describing the research appeared March 19 in *Proceedings of the Royal Society B: Biological Sciences*.





Above and below: Visualizations of the Messel lake food web (top) and forest food web (bottom). Spheres represent species and lines represent feeding links. The vertical axis corresponds to trophic level, with plants at the bottom. (Credit: Jennifer Dunne)

Above right: Among the well-preserved fossils from the Messel deposit is the small primate *Darwinius masillae*. (Credit: Franzen, Gingerich, Habersetzer, Hurum, von Koenigswald, & Smith)

The researchers first compiled data about the more than 6,500 feeding relationships among 700 species found in the deposit. Then they constructed two networks of feeding interactions – one for the lake and one for the surrounding forest. Next, they mathematically compared each food web's structural features with those of modern-day food web datasets.

"What we found is that the Messel lake food web, with 94 taxa and 517 links, looks very much like a modern food web," says Dunne.

Analysis of the Messel forest food web's structure was more challenging due to the high degree of species diversity represented in the dataset – 630 taxa and 5,534 feeding links – far more than what datasets for modern webs include. Nevertheless, the researchers were able to show that the Messel forest web is likely comparable in structure to modern webs.

The results are significant because they show that the Messel ecosystem developed a modern ecological structure, along with a modern biota, in a relatively brief 18 million year period following Earth's most recent die-off, the end-Cretaceous mass extinction, which disrupted ecosystem dynamics on a massive scale and served as a species diversity bottleneck.

Beyond the ecological and evolutionary significance of the study, Dunne says, the work resulted in the most highly resolved, detailed, and comprehensive terrestrial food web ever compiled. "We want our data to serve as a challenge to ecologists to compile more highly and evenly resolved food web data for extant systems," she says. ■

RESEARCH NEWS

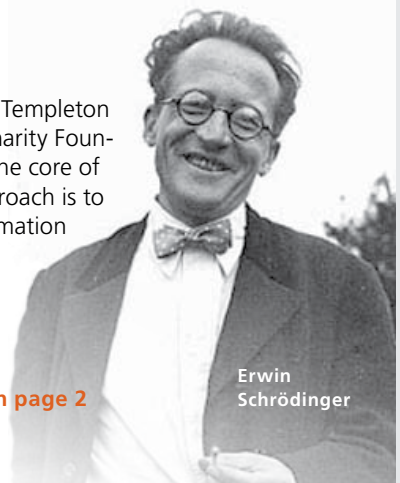
Taking a new tack on Schrödinger's Paradox

Back in 1935, Erwin Schrödinger posed a vexing thought experiment now known as Schrödinger's Paradox. It goes something like this: the Second Law of Thermodynamics posits that over time there is a general increase of entropy (disorder) in any closed system; yet, many observable living systems (everything from bacteria to ecosystems to the whole biosphere) appear to increase in complexity over many different time scales.

Do such systems actually increase in complexity, or is that an illusion arising from vague notions of "complexity"? If they do increase in complexity, is this due to random drift in the value of complexity, or does the Second Law somehow drive that increase?

SFI Professor David Wolpert and SFI Omidyar Fellow alum James O'Dwyer (now at the University of Illinois) are asking these questions in a new way as part of a three-year grant from the Templeton World Charity Foundation. The core of their approach is to use information theory to formalize both

> more on page 2



Erwin Schrödinger

IN THIS ISSUE

RESEARCH NEWS

A checkup for web disease tracking

Web-based disease trackers like Google Flu Trends are supposed to revolutionize public health response to outbreaks, many say, but how well do they actually work, and can they be made to work better? SFI Omidyar Fellows and epidemiologists Sam Scarpino and Ben Althouse hope to know more after a workshop starting May 19.

Traditional disease surveillance is a slow process: when a patient gets sick enough she visits the doctor, and the doctor reports her symptoms to the Centers for Disease Control and Prevention. Eventually the CDC puts enough reported cases together to spot an outbreak.

Google's idea was to use web searches related to symptoms as a proxy for sick patients; queries for "fever" or "muscle aches," for example, correlate with searchers actually having those symptoms, so a pattern of such searches could, in theory, signal an oncoming influenza epidemic.

> more on page 2

RESEARCH NEWS

How knowledge is transmitted

In an ambitious three-day working group organized by SFI Cowan Professor Ricardo Hausmann and Harvard collaborator Dany Bahar, experts will try to understand how individuals, organizations, and nations create and transmit knowledge across the boundaries that separate them.

Naively, it appears knowledge is easy to transmit; as soon as you write something down you can post it on the Internet, where it spreads at the speed of light, Hausmann says. "But the amazing thing is how incredibly local knowledge is," and how limited and narrow the channels can be through which knowledge flows.

> more on page 2

In the *Santa Fe New Mexican* on April 14, SFI External Professor Brian Arthur reviews the history of Complexity Economics and its contribution to the contemporary practice of economics.

On March 25 in *Prospect* magazine, philosopher and SFI External Professor Dan Dennett exchanges perspectives with philosopher Richard Swinburne on how academics should approach the study of religion.

Low-carbon technologies are getting more affordable each year, in part thanks to government support for technology development, but continued public-policy support is needed to maintain the momentum, writes SFI External Professor Jessika Trancik in a March 19 commentary in *Nature*.

In *The Huffington Post* on March 18, radio/TV host Paula Gordon cites the work of SFI's Melanie Mitchell and Murray Gell-Mann in an article on facial expressions and pattern recognition.

Physicists have made a number of lasting contributions to a deeper understanding of finance and economics, including a few researchers affiliated with SFI, writes Mark Buchanan in his blog The Physics of Finance as part of a sweeping review of "econophysics."

In the *Santa Fe New Mexican* on March 3, SFI Omidyar Fellow alum Scott Ortman summarizes his research with SFI Professor Luis Bettencourt showing that the same equations describe all human settlements, from the ancient cities of the Aztecs to today's megacities.

In the March issue of *Wired*, SFI External Professor Mark Pagel writes that human invention isn't creativity so much as it is improving on and combining ideas that came earlier – and that is essentially the same process as evolution.

Digital footprints left on search engines, social media, and social networking sites can be aggregated and analyzed as health proxies, yielding anonymous and instantaneous insights, according to a February 27 commentary in the *Journal of the American Medical Association* (JAMA) co-authored by SFI Omidyar Fellow Ben Althouse.

In an Al Jazeera guest commentary on February 24, SFI External Professor Libby Wood notes that data from her own and others' research of wartime violence suggests that by understanding what factors lead to either the strategy or practice of rape, scientists might be able to offer methods for systematically avoiding wartime rape by combatants.

In *PNAS* on February 12, former SFI Chair of the Faculty Doug Erwin suggests that the similarities seen in the data on past mass extinctions may lie not with the triggering mechanisms, but in how the Earth's biota responds to environmental insults. A February 20 *New York Times* article quotes Erwin on this topic.

"Name any problem that concerns humanity and the city is the crucible where you will find it bubbling away," writes SFI Distinguished Professor Geoffrey West in a guest CNN.com article about cities on November 15.

Nonlinearities
From the editor

If you're a regular to our website or social media – or to our hallways – you've probably heard by now that SFI's beloved cat, Dr. Zen, passed away Friday afternoon, March 21, at the age of 18 following a series of worsening health problems. On the pet spectrum Zen was truly an outlier. Honest to goodness, I haven't met a more human-like animal. Kong Cheong said it well: "He would meow to be let into the Collins [Conference] room. He would then meow at you to thank you for opening the door. He then walked around the room. If he is satisfied with what is going on he would meow to be let out. He is a very respectful cat." We'll miss Zen. You can read his obituary and leave a memory at www.santafe.edu/news/item/in-memoriam-dr-zen/.

By the time you're reading this issue of the *Update*, we'll have two more publications available online and in print: SFI's *2013 Annual Report* (which I like to call SFI "soup to nuts"), and the April 2014 issue of the *SFI Bulletin*, in which SFI External Professors David Krakauer and Jessica Flack and their colleagues take us on an SFI-inspired journey through a multi-layered hypothesis about how and why life on earth might have evolved from its earliest, simplest, single-celled forms to its complex, hierarchical, diverse, and sometimes intelligent forms today. Here's a hint: Their approach involves statistical mechanics, information theory, and computation – all in the service of understanding what might be characterized as niche construction writ large. It's heady stuff, to be sure; you won't regret investing some of your time in a thoughtful read.

Dan Dennett arrives for a sojourn at SFI soon. While he's here he'll be treating us to a May 14 community lecture AND a May 18 Science On Screen presentation (see page 4 for details). I always enjoy afternoon tea just a little more when he's here. How to explain…Dennett's intellect is like a weed eater in a flower show. There's so much destruction of such well-tended thought, but it's spectacularly colorful destruction. ■

– John German, jdg@santafe.edu

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Exploring the rise and fall of early societies

Icelandic portion of the Carta Marina ("map of the sea"), a woodcut block map created by Swedish ecclesiastic Olaus Magnus in the 16th century. It is the earliest map of the Nordic countries providing details and place names. (Image: Wikimedia Commons)

When Europeans first settled on inhospitable Iceland, they struggled but eventually stabilized; on neighboring Greenland, early Norse settlements ultimately disappeared. Similarly, Zuni tribes flourished in what is now the southwestern United States while the nearby Hohokam dwindled.

Reasons for the rise or decline of societies are many and varied, and only increase in complexity with a changing climate. SFI External Professor Tim Kohler, an archaeologist at Washington State University, and Margaret Nelson at Arizona State University are co-organizing two SFI meetings the last week of May to explore ways to study these dynamics.

The first, a three-day workshop titled Social Change In the Context of Climate Challenges: Issues in Coupled Natural Human Systems, will match more than a dozen experts with SFI-style transdisciplinary tools and approaches.

Kohler cites agent-based modeling as one such tool: it can help reconstruct the basic resources of a landscape – such as water sources and prey growth rates – that influence each household (agent) in choosing the best living arrangements. Differences between the models of settlements and observations from the archaeological record often reveal other factors.

During a follow-on two-day working group titled Global Human Ecodynamics Alliance Modeling: Evolvability and Robustness, many of the workshop participants will stay to consider useful means of societal comparison. For example, explains Kohler, whether people live in dark, icy weather in the North Atlantic or droughts in the American Southwest, we can quantify the severity and frequency of risks in the landscape and thus start to compare extraordinarily different societies. From there, signs of a healthy or declining society emerge, which of course hold relevance today.

"If we can retrospectively define early warning signals of catastrophic thresholds in the archaeological record, we have a chance to spot them today," he says. ■

> *Web disease tracking* continued from page 1

It looked promising at its debut in November 2008, but Google Flu Trends failed spectacularly in 2009, and again earlier this year, when it predicted about twice as many flu cases as were actually reported to the CDC. Another system, FluNearYou, relies entirely on self-reported symptoms, meaning it can only track those who decide to participate.

"It's clear there's potentially valuable information, but what does it really mean?" Scarpino asks, noting that web and Twitter-based systems face a number of methodological and statistical challenges. Of particular interest is whether the relationship between web searches and symptoms is changing, perhaps driven by the growing interest in the disease trackers themselves.

Althouse says their first goal is "getting everyone in the room," from scientists to CDC and World Health Organization officials to private-sector researchers. Then, he says, they hope to "figure out what's urgently needed and how to prepare now for the next pandemic." ■

> *Schrödinger's Paradox* continued from page 1

"complexity" and the Second Law. In doing so, they want to create a bridge between biosystem complexity and this key tenet of modern physics.

A focus of their project will be the flow of information across the scales in a biosystem. Their aim, working with SFI Professor Jennifer Dunne and External Professor Seth Lloyd of MIT, is to achieve a deeper understanding of how a flux of "negative entropy" (food) through a biosystem (ultimately arising from sunlight) can drive the evolution of information flow across the scales of that system – and might drive an associated increase in its complexity.

Their approach builds on Wolpert's recently introduced concept of information width as a measure for information theoretic complexity. The hope is to go beyond this, to develop new measures of complexity, information processing, information flow, and information storage in physical systems – measures specifically tailored for analyzing Schrödinger's Paradox.

Using biological models (ranging from minimal, abstract models of living systems to highly detailed ecological network models), the project will identify whether and when complexity increases at multiple scales, and whether there are basic principles allowing for prediction of when changes will occur.

"Ultimately," says Wolpert, "understanding such principles might allow scientists to look at the physical laws governing the surface of the sun, or the deep atmosphere of Jupiter, or some other 'non-biological' system and say, 'Aha! Complexity must be increasing in that system, just as though it were a biosphere.'" ■

> *Knowledge* continued from page 1

Hausmann cites sports as an example. Tennis players must react quickly to serves. The ball leaves the racquet, and a good player knows where to be, how to hit the ball, and where to place it. Passing that knowledge on is another story. "They know how to do it, but they don't know how it is that they know how to do it," says Hausmann, and without that, transmitting know-how is impossible.

Similar thinking "explains part of the puzzle about why poor countries have so much trouble catching up to rich countries," he says. "It's because know-how travels through these extremely narrow channels that we're just starting to understand.

"There are many areas in which people in their fields are saying that knowledge is the key variable, but they're analyzing it at very different scales, at very different levels, and with very different paradigms," Hausmann says. The early June working group, will bring those people together to move toward a more comprehensive understanding of knowledge. ■

BOOKS BY SFI AUTHORS

Spin Glasses and Complexity (January 2013), by SFI Science Board member Daniel Stein and co-author Charles Newman, offers an accessible introduction to spin glasses, why they are important, and how they are suggesting new ways of thinking about complexity. The book is the latest in the "Primers in Complex Systems" series, a collaboration between SFI and Princeton University Press.

Entrepreneurial Capitalism and Innovation: A History of Computer Communications, 1968-1988 by former SFI Trustee James Pelkey is now available as a hypertext online book. Pelkey's historical reconstruction views the evolution of computer communications from 1968 to 1988 as the emergence of data communications, networking, and internetworking.

SFI Online

Multimedia content available at ***www.santafe.edu***

Video: Ross Hammond of the Brookings Institution reviews the data and trends on obesity and looks to complex systems science for promising new approaches to obesity prevention. SFI 2014 Community Lecture

Video: Conservation biology pioneer Thomas Lovejoy explores how we might manage both biological and human economic systems to reduce the long-term effects of climate change. SFI 2014 Community Lecture

Video: Evolutionary psychologist Robin Dunbar explains why our brains are hard-wired to maintain meaningful relationships with no more than around 150 people – and this includes Internet relationships. SFI 2014 Community Lecture

Video: SFI journalism fellow Julie Rehmeyer explores society's poor handling of illnesses without clear causal mechanisms or sharply-defined symptoms, including her firsthand experience with chronic fatigue syndrome. SFI lunchtime seminar

Video: Colleagues of SFI Distinguished Professor Murray Gell-Mann honor him during a special event celebrating "50 years of the quark." Caltech event

SFI@30

1984-2014

New Science. New Horizons.

SFI@30 continues…

The SFI@30 history series continues online with "1987-1995 – Transcendence: A place to call home." Watch for the article in May at www.santafe.edu/support/the-history.

INSIDE SFI

Six new Omidyar Fellows to join SFI

Starting this summer, six early career researchers will join SFI as 2014 Omidyar Fellows.

The Fellowship, supported by Pierre and Pam Omidyar, offers postdocs the opportunity to spend up to three years at the Institute working on research projects of their own design while collaborating within SFI's transdisciplinary community of scholars.

Fellows typically go on to accept positions in university science departments as well as in the private sector.

This year's fellows hold doctoral degrees in ecology and evolutionary biology, neurobiology and behavior, linguistics, physics, and computer science.

Says SFI Chair of the Faculty Jennifer Dunne: "We had our strongest pool of candidates ever, and were fortunate that all six offers we made were accepted, which will result in an outstanding and diverse cohort."

The six selectees are:

Andrew Berdahl, a physicist and ecologist from Princeton University, seeks to understand the patterns and processes of collective group behaviors such as navigation.

Justin Yeakel, also an ecologist, studies how food web interactions and the flow of biomass shape ecosystems over evolutionary time. He joins SFI from Simon Fraser University.

Vanessa Ferdinand, from the University of Edinburgh, examines the intersection of linguistics and cultural evolution. She seeks to understand how patterns in cultural behaviors, such as language, reflect on human cognition.

Caitlin Stern, a biologist from the University of North Carolina, researches the effects of cooperation and competition on societal complexity.

Josh Grochow, a computer scientist and mathematician, comes to SFI from the University of Toronto. He is interested in applying theories and methods from computation to a richer understanding of complex systems in general, and vice versa.

Yoav Kallus, a physicist from Princeton University, explores how physical processes bring simple building blocks together in complex structures.

In addition to the six new Omidyar Fellows, one postdoctoral fellow, **Laurent Hébert-Dufresne**, will join SFI in 2014, funded through the James S. McDonnell Foundation's Postdoctoral Fellowship in Complex Systems. Hébert-Dufresne is a physicist from the Université Laval, Québec, whose interests are in network theory, particularly as applied to epidemiological and social systems. ■

ACHIEVEMENTS

Simon Levin, a member of SFI's Science Board, has been awarded the 2014 Tyler Prize for Environmental Achievement for bridging ecological research and environmental policy, economics, and social science. The award was established in 1973 and is bestowed by the international Tyler Prize Executive Committee and the University of Southern California. Levin, whose research has revealed the multifaceted relationships between species and ecosystems, has played a foundational role in shaping environmental policy and advancing the study of complex ecosystems.

The Penn Museum awarded its prestigious Lucy Wharton Drexel Medal to SFI President Jerry Sabloff during a special dinner in Philadelphia on April 25. The award recognizes his work on some of the key themes that have advanced the field of Maya archaeology since the 1960s. Sabloff was the Williams Director of the Penn Museum from 1994–2004 and its Interim Director from 2006–2007, as well as the Christopher H. Browne Distinguished Professor of Anthropology at the University of Pennsylvania. (On the same evening, Sabloff received the Society for American Archaeology Lifetime Achievement Award for 2014, given in Austin in his absence.)

SFI Science Board member Peter Littlewood has been selected as the next director of Argonne National Laboratory. Littlewood, an associate director of the lab since 2011, succeeds Eric Isaacs, who became provost at the University of Chicago on March 31. ■

RESEARCH NEWS

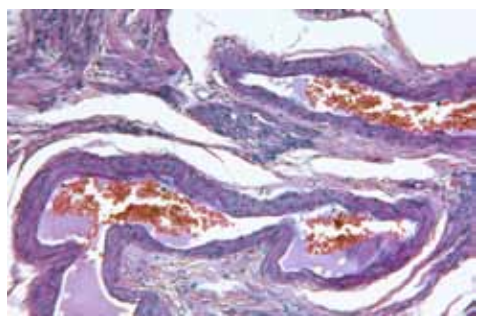
Is instability the key to cancer treatment?

Cancerous tumors may be poised at the edge of their own destruction, an insight that could help researchers find new, more effective treatments, argue SFI External Professor Ricard Solé and colleagues in an April 9 paper in the journal *Bioessays*.

Despite decades of work, cancer researchers still aren't sure what makes the disease tick, but Solé says a key observation is that cancer thrives on genetic instability. Mistakes are common when cells replicate, and they're usually corrected. But if errors arise in genes responsible for correcting those mistakes, the genome can become unstable. Then, increasing instability can drive the growth of a mass of cancerous cells, each with its own, slightly different DNA.

Still, there's a point where cancer starts choking on its largesse. "In a normal cell, instability is not good news, but in a cancer cell it's kind of the driving engine, except that you have a limit," says Solé. "You cannot be infinitely unstable."

That suggests a threshold beyond which cancer cells start dying, having lost their most basic functions to rapid mutations. If so, researchers might be able to identify those functions and target them, or simply dial up the mutation rate – a strategy experiments show prevents RNA viruses from infecting people.



The time is right for a new approach, he says. Recent studies suggest that the usual treatments – surgery followed by chemotherapy – leave behind the strongest cancer cells, which can grow into new, deadlier tumors.

"The strategy should probably shift in some direction, and that's why I think it's very important to figure out what the architecture is for these unstable cells, because we really don't understand that yet," Solé says. ■

RESEARCH NEWS

Indigenous societies' 'first contact'

A new study of Brazil's indigenous societies led by SFI's Marcus Hamilton paints a grim picture of their experiences following "first contact" by Western societies, but also offers a glimmer of hope to those seeking ways to preserve remaining indigenous societies.

Brazil is "a tragic natural experiment," Hamilton says. For the majority of its indigenous societies, first contact was disastrous – it soon brought collapse, with disease and violence responsible in most cases, and with lasting detrimental effects.

Several hundred native tribes contacted by outsiders remain, according to Instituto Socioambiental, a non-governmental organization that reports census data on 238 of those societies going back a half-century or more. That volume of data makes possible a detailed analysis of the health and prospects of the surviving contacted – and uncontacted – societies, an analysis that wouldn't be possible anywhere else in the world.

Using a method called population viability analysis, the researchers found that contact by outsiders is typically catastrophic, yet survivable. While first contacts in Brazil led to population declines of 43 percent on average, that decline bottomed out an average of eight or nine years after contact, following which population numbers grew as much as four percent a year. Projecting those results into the future suggests that contacted and as-yet uncontacted populations could recover from a low of just 100 individuals.

Hamilton and co-authors Robert Walker and Dylan Kesler of the University of Missouri described their analysis in a paper published April 1 in *Scientific Reports*.

While their findings are hopeful, Hamilton notes that deforestation, the breakdown of interactions between tribes, and assimilation with the outside world pose ongoing threats to indigenous societies.

"Demographically they're healthy," Hamilton says, but as for their long-term survival, "it's very much up in the air." ■

'Introduction to Complexity' has begun

Our free online course "Introduction to Complexity" is now in session! You can enroll any time before June 15 at www.complexityexplorer.org.

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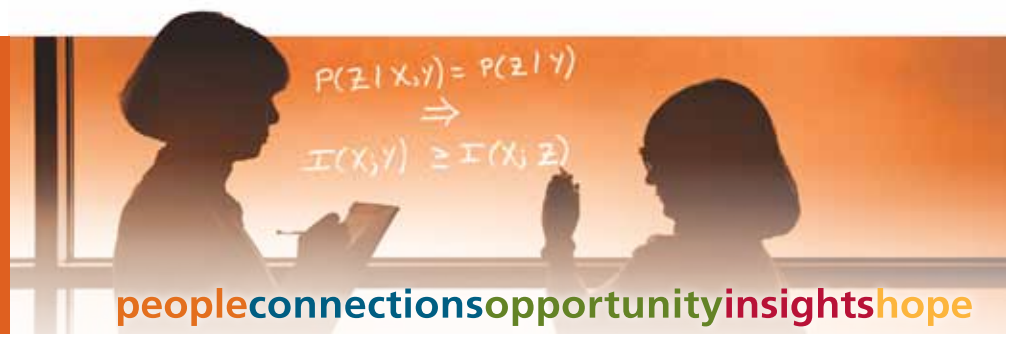
New Science. New Horizons.
1984-2014



Above: Data Processing Inequality

Thirty years of making connections

As we observe our three-decade milestone this year, we not only celebrate the connectivity inherent in our transdisciplinary approach, but also the fundamental connections that created and continue to guide SFI. When a small group of scientists affiliated with Los Alamos National Lab joined forces in 1984, their deep intellectual – and, in many cases, personal – connections promised to turn traditional science on its head.

Such connections continue to drive the Institute's day-to-day work and bring together the distinctive ideas, people, and approaches to understanding complex systems that keep SFI at the frontiers of new science. As George Cowen once noted, the Institute should find "the common ground between the relatively simple world of natural science and the daily, messy world of human affairs." In other words, social progress through science.

Consider our 2012 workshop on Power Grids as Complex Networks. This breakthrough event used network science to show just how vulnerable our power grid is. It connected engineers, network theorists, and the optimization community to share expertise and seek viable solutions.

Or consider our ongoing research on Cities, Scaling, and Sustainability, which connects urban planners, economists, sociologists, social psychologists, anthropologists, and complex systems theorists to understand some of the toughest challenges related to human development in our rapidly urbanizing world.

Such connections are deeply ingrained in SFI's character. Even the very first *SFI Bulletin*, published in 1986, included a report titled "Connection between Biological Evolution and Computer Adaptation."

None of this would be possible without one more critical connection – one that brings private funding together with science. The Institute was conceived and created as a privately funded scientific research center 30 years ago – long before this was common practice. Today, more than 70 percent of the support that drives SFI science comes from private sources.

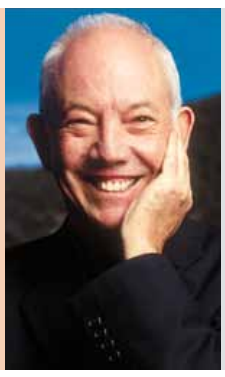
Why does this model work so well? Because SFI supporters believe that seeking connections in unexpected places is the best way to understand our complex world. As you think about how to best connect your own scientific passions to meaningful outcomes, please think about the many connections SFI has made in our first three decades. These connections – along with the important bond between science and private investment – not only enrich our lives, but have the potential to change the world.

Warm regards,

Nancy Deutsch,
Vice President for Advancement

SFI@30
MY STORY

W. Brian Arthur
External Professor,
Santa Fe Institute
Visiting Researcher,
Palo Alto Research Center



"At the now-famous SFI physics-economics conference in 1987 I heard John Holland describing his work on adaptive classifier systems. John's idea was little 'agents' that were sets of condition-action rules so each of these could 'recognize' the state of the system and react appropriately. Over time the agents would explore and find rules that worked better. John, I realized, was describing a method whereby intelligent action could emerge within systems, and this was something we could use in economics. A feeling grew in me that John Holland was the answer. All we had to do was find the question."

New Science. New Horizons.

Campaign news

As part of SFI's 30th anniversary, the Institute has launched a comprehensive fundraising campaign: New Science. New Horizons. To date, we've raised more than $22 million toward our $30 million campaign goal.

As a place where researchers from different backgrounds, different disciplines, and different foci connect, SFI has always served as a reactor for great ideas and new approaches to our most pressing problems. We would like everyone to have the opportunity to support this collaborative process at SFI.

Each year, we host dozens of workshops and smaller working groups that spend from a few days to a month seeking new approaches. Your gift of $250 or more will help pay for visiting scientists' transportation, housing, and activities costs.

Other campaign giving opportunities include:

President's Circle Member: $1,000 per year – Annual giving club with special programming for members.

Visiting Sabbatical Scientist Fund: $10,000 – Funds scientific visits to the Institute.

Name a Faculty Office: $25,000 and up – Yes, we will introduce you to the great mind in the office you select!

There also are opportunities to establish a permanent legacy, from named buildings and open spaces on SFI's campuses to endowed funds supporting science, education, and outreach. We welcome multi-year commitments and gifts of appreciated assets to fund your chosen program. Contact the Office of Advancement at 505.946.3678 to discuss how you can help us attain new horizons.

May / June 2014

UPDATE

SANTA FE INSTITUTE

Upcoming community events

SFI Community Lecture

Is free will an illusion? What can cognitive science tell us? Wednesday, May 14, 7:30 p.m., James A. Little Theater (1060 Cerrillos Road). Serious thinkers contend that free will cannot exist in a deterministic universe – one in which events are the singular outcomes of the conditions in which they occur. The alternative view, that free will is prerequisite for personal responsibility and morality, is the basis of our legal and religious institutions. SFI External Professor Daniel Dennett unravels this conundrum and asks whether we must jettison one of these notions, or whether they can co-exist. He then asks: if free will is an illusion, as many scientists say, should we conclude that we don't need real free will to be responsible for our actions?

SFI-CCA Science On Screen

***Her*, presented by Daniel Dennett, Sunday, May 18, 7:30 p.m., Center for Contemporary Arts (1050 Old Pecos Trail).** The popular Science On Screen series continues with SFI External Professor Daniel Dennett presenting the science fiction love story *Her.* Artificial respiration is real respiration and an artificial ear could allow a person to really hear, but would artificial emotions be real emotions? Is *Her's* Samantha, an artificially intelligent operating system, capable of love – real love generated by an artificial mind – or is Samantha just a very intelligent thinker, faking real emotions? How might artificial intelligence diverge from today's computers? Dennett will explore these questions and more in a discussion of Spike Jonze's 2013 film, which won an Oscar for best original screenplay. The show begins at 7:30 p.m. at the Center for Contemporary Arts in Santa Fe. Advance tickets are recommended. For tickets and prices, call the CCA Box Office at 505-982-1338.

SFI-MoCNA event

Chaos to complexity: Where do art and science meet? Saturday, May 31, 2:00-4:00 p.m., Allan Houser Art Park (108 Cathedral Place). SFI and the Museum of Contemporary Native Arts (MoCNA) present the third annual discussion in the Chaos to Complexity series. SFI Professor and VP for Science Jennifer Dunne and Eastern Band of Cherokee artist Shan Goshorn will explore the creative process in both art and science, in a discussion moderated by SFI's Valerie Plame. The opening reception for Goshorn's current exhibition, *We Hold These Truths*, will be held immediately following this program at 4:00 p.m. Free with paid museum admission.

SFI Community Lecture

The fabric of our lives: Cities, slums, neighborhoods, people, Wednesday, June 18, 7:30 p.m., James A. Little Theater (1060 Cerrillos Road). What is a city, and what makes Chicago so different from Los Angeles? SFI Professor Luis Bettencourt peers inside the city, down to the data describing its neighborhoods and its people. He shows how a city is less a place than a fabric, woven from the threads of the individual lives interacting within it – it is, in fact, connections that define a city. He then suggests that, from a perspective of human development, the world's slums can be thought of not necessarily as problems, but rather as gateways for millions of people transitioning from largely self-sufficient rural lives to highly connected urban lives.

SFI's 2014 Community Lectures are made possible through the generous support of Thornburg Investment Management. Lectures are free and open to the public, but seating is limited. To watch a lecture as it happens, visit SFI's YouTube page; participate in the discussion live on Twitter at #sfi_live. Other SFI events require admission fees. ■

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