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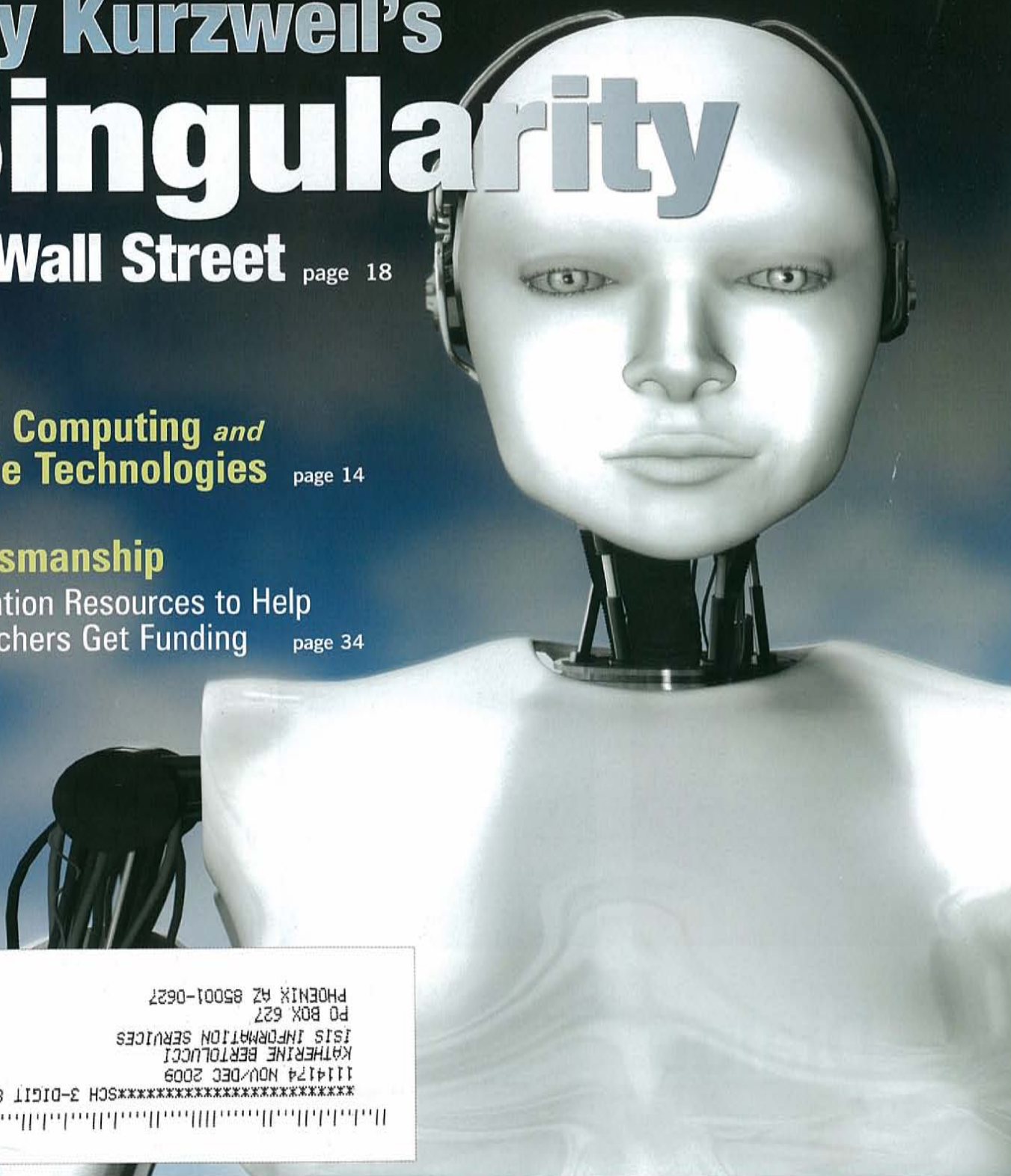
The Magazine for Database Professionals

Ray Kurzweil's Singularity on Wall Street

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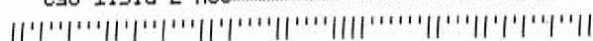
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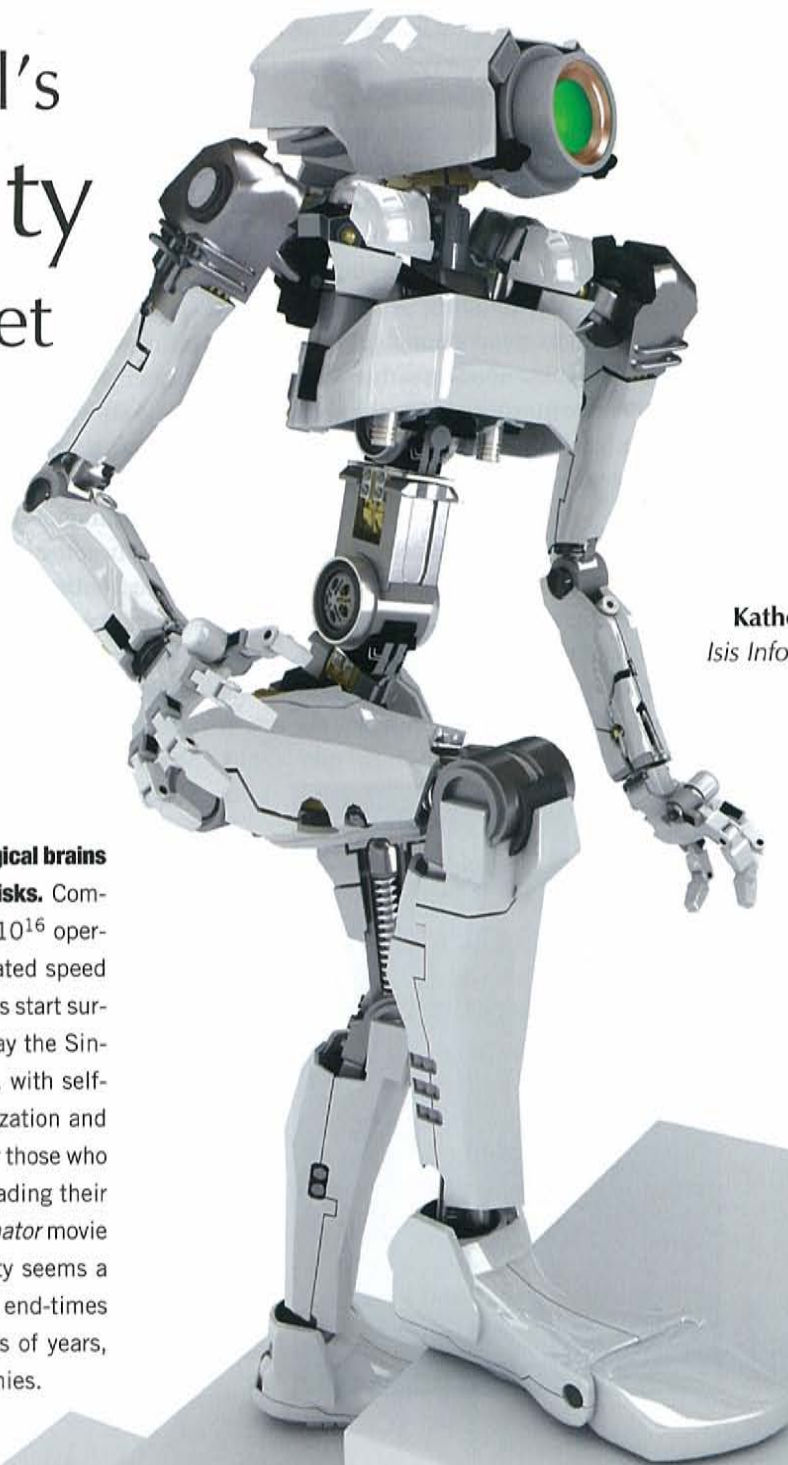


The Future Still

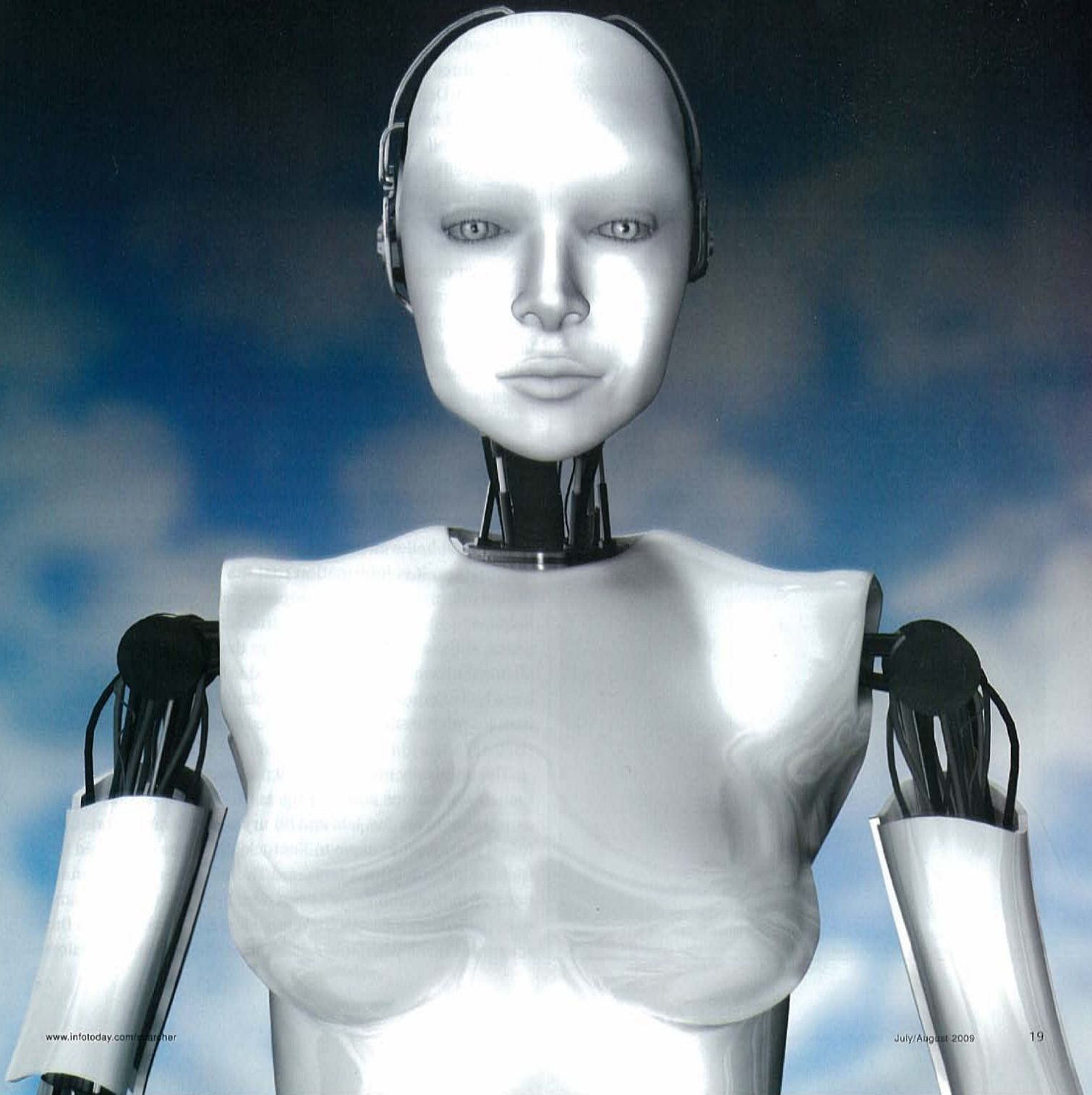
Ray Kurzweil's Singularity on Wall Street

Katherine Bertolucci
Isis Information Services

It's just a matter of time before our biological brains become as obsolete as 8-inch floppy disks. Computers are forecast to reach speeds of 10^{16} operations per second by 2029, one estimated speed for the human brain. When the machines start surpassing us, some prominent thinkers say the Singularity will be right around the corner, with self-replicating computers taking over civilization and rendering humans redundant, except for those who have merged with machines by downloading their brains. (Have you seen the latest *Terminator* movie yet?) On the other hand, the Singularity seems a lot like the Apocalypse or Armageddon, end-times that have been predicted for thousands of years, only this one is a Rapture myth for techies.



Awaits Us



So what's a Singularity, you may ask. In astronomy, a Singularity occurs when a star dies and becomes a black hole. At that point, the laws of physics no longer apply. Anything that falls in is destroyed, but that destruction may be the beginning of a new universe. Verner Vinge, science-fiction author and retired San Diego State University math professor, popularized the idea of a technological Singularity in a 1993 *Whole Earth Review* essay, originally presented at a NASA symposium. Vinge admirably lays it all out in the first sentences of the abstract, "Within thirty years, we will have the technological means to create superhuman intelligence. Shortly after, the human era will be ended" [1]. He also predicted that "as time passes, we should see more symptoms." Consider as one symptom the 2008 economic meltdown, which was influenced by computers developing new financial instruments, trolling the international digital markets for money-making opportunities, and enacting their own trades, supervised only by algorithms.

Depending on how machines feel about money, the Singularity may or may not become the end of the financial system, but it is definitely forecast as the end of biological humans, brought about by our own digital inventions. The primary cheerleader for the ultimate rise of the machines is inventor Ray Kurzweil, who sees the Singularity as a thrilling event. At age 61, he follows an austere health regimen so he can live long enough to merge with a machine and attain immortality.

Kurzweil predicts symptoms of the Singularity, using his Law of Accelerating Returns, based on Moore's Law, which forecast the doubling of semiconductor capacity approximately every 2

years. Kurzweil amplifies this to include the exponential growth of most technological advances, with slow doublings until suddenly each double becomes a massive breakthrough.

To promote his vision of exponential growth, Kurzweil has written three books about the Singularity: *The Age of Intelligent Machines*, *The Age of Spiritual Machines: When Computers Exceed Human Intelligence*, and *The Singularity Is Near: When Humans Transcend Biology*, which was on *The New York Times* best-seller list. To help everyone stay alive for the few years remaining until the mind-machine merger, he has also written three health books, *The 10% Solution for a Healthy Life* and, with Dr. Terry Grossman, *Fantastic Voyage: Live Long Enough to Live Forever* and this year's *TRANSCEND: Nine Steps to Living Well Forever*.

Kurzweil's intellectual credentials could explain his success in promoting the Singularity. He is an honored inventor, included in the Patent Office's National Inventor's Hall of Fame. According to his website biography, Kurzweil "was the principal developer of the first CCD flat-bed scanner, the first omni-font optical character recognition, the first print-to-speech reading machine for the blind, the first text-to-speech synthesizer, the first music synthesizer capable of recreating the grand piano and other orchestral instruments, and the first commercially marketed large-vocabulary speech recognition" [2]. Stevie Wonder was Kurzweil's first customer for the print-to-speech reading machine. Then they collaborated on the electric piano. Kurzweil has had a big influence on the information industry. The Lexis-Nexis databases were originally developed using his character-recognition methodology.

Kurzweil believes that "order is even more profound than information. It is information that fits a purpose. It is a step toward information that is more profound, more beautiful, more inspiring . . . It moves towards indescribable beauty, intelligence, and creativity — all the things that God has been called" [3]. Ray Kurzweil has been compared to Thomas Edison, but he has a lot in common with English scientist and dissenting minister, Joseph Priestley, who discovered oxygen and photosynthesis in 1774.

The politically active Priestley promoted the American and French revolutions and civil rights for dissenters (non-Anglicans). After his home, lab, and library were burned in a riot, he found it prudent to move to Kentucky. There he continued his friendships with John Adams and Thomas Jefferson, whom he had met in England. Twenty years after Priestley's death, Adams wrote to Jefferson describing a breakfast conversation with the scientist. Priestley had told Adams about his millenarian vision



A star being torn apart by the tidal forces of a black hole.
Photo Credit: Chandra X-Ray Observatory

based on evidence from Revelations and revolutions. He believed the signs of the time revealed the coming Rapture (i.e., the return of Christ posited in the Bible as the world ends). Like most Rapture enthusiasts, he anticipated it would occur within a couple of decades. Unlike Kurzweil, he wasn't expecting immortality, but he did plan to be resurrected when the great event happened.

Priestley based his version of the Rapture on the major upheavals of his era — political revolutions. Kurzweil's Singularity is based on the major upheaval of *our* time — technology. They both expect(ed) the great event within a few decades and they both expect(ed) to experience it even after death. Should he miss the Singularity by a few years, Kurzweil will be cryogenically frozen and resurrected when the fireworks start. Priestley didn't have that option.

I don't want to worry you, but Kurzweil does have a track record of accurate futurist predictions.

Wall Street on Machines

A few months after the 1987 stock-market crash, Lester Thurow, then dean of MIT's Sloan School of Management, wrote an article absolving computers of responsibility for the crash. Program trading, the automated trading of a portfolio of stocks, had kicked in when the market started dropping. Computers, following instructions, automatically started selling at predetermined price drops. This was widely assumed to have caused the crash. Thurow hastened to set his readers at ease. He explained that humans had programmed the computers. The only advantage of computers is "they can monitor more information faster and give the appropriate buy or sell orders long before a human could figure out what to do" [4]. The computers were only "automatically executing decisions that brokers would have made anyway." He goes on to say the precipitous market drop "was the product of herd panic, not so different from the sudden panic that occurs among herds of antelope on the plains of Africa."

In other words, automated program trading made the herd reaction happen faster. That is a step toward the Singularity. After the 1987 crash, the stock exchanges imposed circuit-breakers that stop trading at defined percentage changes, but Wall Street physicists and mathematicians, known as quants, have had 22 years to devise new ways to speed up transactions. Machines now enact trades in milliseconds. Investment companies locate their buildings and servers as close to the market data server as possible just to shave a few thousandths of a second off the time required to enact a trade. They are practicing algorithmic trading. Quants design computer instructions to

Is Your Company Ready for the Singularity?

Information Pros as Futurists

You can help your company prepare for future events, including even the Singularity, by doing what comes naturally — research.

Studying the future is an obvious role for information professionals because it is research-intensive. You have to know what happened before and what is happening now before you can forecast what will happen in the future. This futures research process is often called environmental or horizon scanning. It is basically a matter of paying attention.

The best approach to environmental scanning is an ongoing project including multiple members of your company. The leader is the information pro, but the team can include anyone who likes research. Many of your colleagues are already conducting formal or informal studies in their own areas of interest. It's just a matter of getting them to view their research with a futurist mind-set and to share their materials.

Then set up the topics to be scanned. The team will decide what areas need to be included, but you must cast a wide net. Curiosity is your best friend here. For example, even if your business has nothing to do with real estate, it might have been valuable to have noticed early that the subprime loan market was in trouble. You don't have to predict a stock market crash, but you do want to consider the ability of people in foreclosure to buy your company's services. Or will foreclosed homeowners be able to buy your customers' services?

Keep your company informed about what you find. Futurist research has to be in the open so everyone can consider the implications. You might start a newsletter that delivers your resource discoveries. Ray Kurzweil does this with his *KurzweilAI.net Newsletter*, a wide-ranging daily or weekly report of the latest articles about technology, the future, and health. You can also write reports about specific scanned topics. You don't have to make forecasts, just report on what you are finding in the scan.

Have a futurist workshop every so often. You might actually want to start your project with one of these. They're fun and tend to get people excited about futures research. Activities might include a STEEP (Social, Technological, Ecological, Economic, and Political) analysis of identified or expected trends. Basically, you look at a trend and analyze it in terms of its social effects, its technological effects, etc. The STEEP analysis can lead to scenario planning in which the group writes several stories about how the trend might play out in the future. Consider hiring a consultant for the first event, but after that, you, the information pro, will be the logical leader for this activity.

Further Resources

The Singularity

Edge

The Singularity: A Talk with Ray Kurzweil

http://www.edge.org/3rd_culture/kurzweil_Singularity/kurzweil_Singularity_index.html

IEEE Spectrum

Special Report: The Singularity

<http://www.spectrum.ieee.org/Singularity>

KurzweilAI.net

<http://www.kurzweilai.net>

- *The Age of Spiritual Machines*, Chapter 9
<http://www.kurzweilai.net/meme/frame.html?main=/articles/art0275.html>
- *The Age of Spiritual Machines*, Timeline
<http://www.kurzweilai.net/meme/frame.html?main=/articles/art0274.html>

The Singularity Institute for Artificial Intelligence

<http://www.singinst.org>

Wikipedia

Predictions Made by Raymond Kurzweil

http://en.wikipedia.org/wiki/Predictions_made_by_Raymond_Kurzweil

Wall Street

Dow Jones Elementized News Feed

<http://www.djnewswires.com/us/djenf.htm>

Shaping Tomorrow

Getting the Best Out of Financial Catastrophe: Expert Views on Global Recovery and Beyond

http://www.shapingtomorrow.com/nav-frameset.cfm?hl=_link-srvfile.cfm%3F%3Dforesightpaper1.doc

Recovery solutions suggested by futurists. Free registration required.

Subprime Mortgage Crisis, Two Clear Explanations

- This American Life: The Giant Pool of Money
http://www.thisamericanlife.org/extras/radio/355_transcript.pdf
- The Crisis of Credit Visualized
<http://www.crisisofcredit.com>

Thomson Reuters NewsScope

http://thomsonreuters.com/products_services/financial/NewsScope_Real_time

■ The Reuters NewsScope Event Indices

http://online.thomsonreuters.com/newsscoperereports/update/reuters_final2.pdf

■ A white paper about this service

Timelines:

•Wikipedia

Subprime Crisis Impact Timeline (1968–2008)
http://en.wikipedia.org/wiki/Subprime_crisis_impact_timeline

• University of Iowa Center for International Finance and Development

Financial Crisis Timeline (2003–2009)
<http://www.uiowa.edu/ifdebook/timeline/timeline1.shtml>

The Future

Futurist Organizations

The author has been associated with these futurist organizations:

Information Futurists Caucus, Special Libraries Association

<http://units.sla.org/caucus/kinf>

The author is a former convener of this group. Membership is open to SLA members.

Shaping Tomorrow

<http://www.shapingtomorrow.com>

Shaping Tomorrow Foresight Network

<http://shapingtomorrowmain.ning.com>

Social networking site for futurists.

World Future Society

<http://www.wfs.org>

Wikipedia, Futurology

■ Research Centers

http://en.wikipedia.org/wiki/Futurology#Research_centers

■ Organizations

<http://en.wikipedia.org/wiki/Futurology#Organizations>

Information Pros as Futurists

Bryson, John M. *Strategic Planning for Public and Nonprofit Organizations*. San Francisco: Jossey-Bass, 1995.

Environmental scanning methods as part of a strategic plan.

KurzweilAI.Net Newsletter

<http://www.kurzweilai.net>

Newsletter about technology, the future, and health.

Murray, Art. "What Life Will Be Like, Starting Today." *KMWorld*, October, 2008, 22, <http://www.kmworld.com/Articles/Column/Future-of-the-Future/The-Future-of-the-The-Future-What-life-will-be-like,-starting-today-50886.aspx> (accessed May 21, 2009).

An imaginative look at today's technologies presented in scenario form.

Wendy L. Schultz. "The Cultural Contradictions of Managing Change: Using Horizon Scanning in an Evidence-Based Policy Context." *Foresight*, 8 (4) (2006): 3-12.

Thoughtful article about environmental scanning.

Schwartz, Peter. *The Art of the Long View*. New York: Doubleday Currency, 1996.

A classic resource for scenario planning.

find trading opportunities, develop new trading instruments, and fool the markets, the ratings agencies, and each other. The algorithms even write new algorithms.

Take one simple example — a technique in which a computer trolls international markets looking for price discrepancies. The computer may find that shares of a company are selling for \$1.00 in London and for \$1.05 in New York. The computer buys the London shares and instantly sells them in New York, generating a \$50 profit, less trading fees, on 1,000 shares. Computers in competition with each other all seek such price discrepancies, which explains why milliseconds count. The discrepancies tend to be short-lived. One trader bragged, "My software can automatically execute a trade within 20 milliseconds — five times faster than it would take for my finger to hit the buy button" [5]. This trader estimated a volume of 1,500 to 2,000 trades per day. If each trade garnered our imaginary \$50, the trader's algorithm would gross \$75,000–\$100,000 in a day of trading, a small sum in our time of billion-dollar bailouts.

A slightly more complex example also involves trading shares. Let's say an algorithm reviews the price of 123 a company's stock in 1-minute increments. The review indicates that a profit will be made 80% of the time if the stock is bought within 30 seconds of a specified trading event and then sold within 10 minutes [6]. Quants then write algorithms to do just that, but they have to be careful. Other algorithms are trolling the markets looking for patterns that represent trading strategies worth stealing.

Here's another one, read by Steve Kroft on *60 Minutes*, "a derivative that links 10.8% of the sum of the German mark, Swedish krona, and Italian lira swap rate plus the Swiss franc and the German pound value as determined by the London Interbank Offered Rate divided by 5" [7]. That instrument was offered 14 years ago.

Algorithmic trading continues to get faster and more complex. As of June 2007, one-third of all American share trades were algorithm-generated [8].

Like Lester Thurow, the major players in the 2008 financial crisis are positioning themselves to place blame elsewhere. Foreclosed home owners are a popular villain. They succumbed to the constant barrage of mortgage advertisements offering almost free money. When the low-interest come-ons morphed into high-interest adjusted rates, a lot of homes foreclosed, thus starting a cascade toward the near collapse of the global economy. Yet, former trader and economics professor Frank Partnoy in a new "Afterward" to his 1997 best selling *F.I.A.S.C.O.: Blood in the Water on Wall Street*, claims mortgage losses represent "less

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than 1 percent of the actual market declines during 2008" [9].

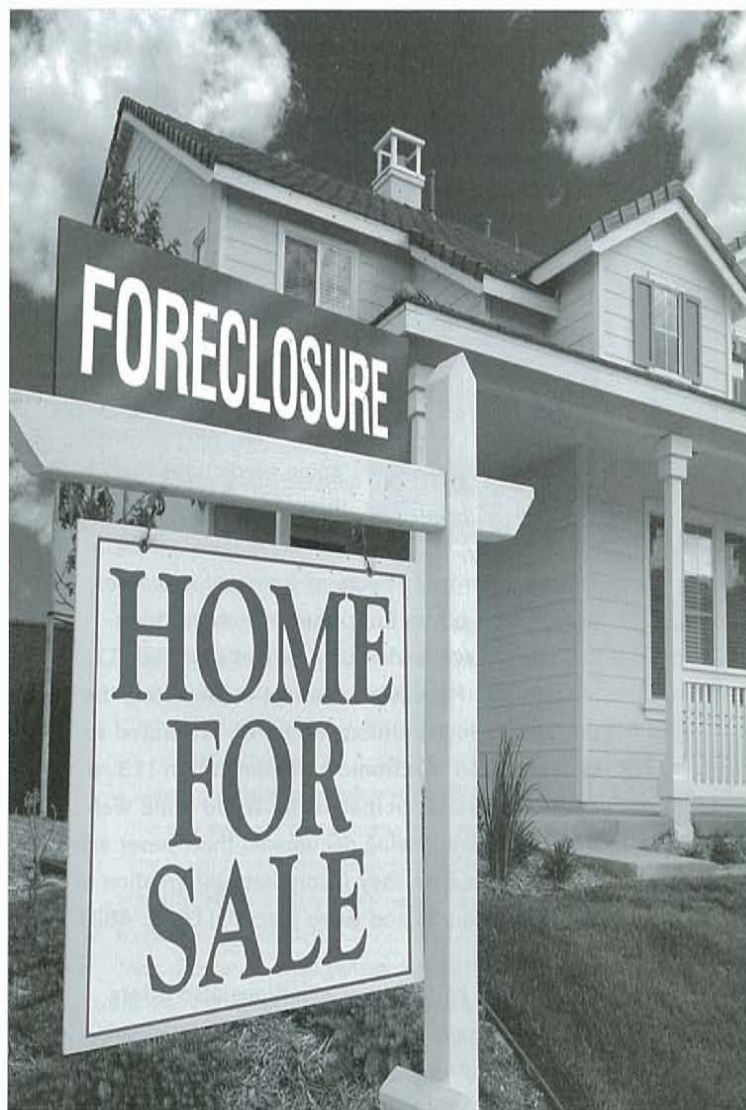
Instead of causing the crisis, foreclosed home owners were pawns in a giant gambling racket known as credit default swaps, an unregulated insurance technique that, according to Partnoy, accounted for \$60 trillion in 2008 [9]. Compare that to the total world's savings, which between 2000 and 2006 increased from \$36 trillion to \$70 trillion [10]. In perhaps another step toward the Singularity, it almost doubled exponentially. Because global wealth increased so fast, there were not enough investment opportunities. That's where subprime mortgages come in.

Beginning in the 1970s, as Wall Street was getting computerized, home mortgages stopped being individual agreements between a home buyer and a bank and became collateralized debt obligations (CDO). Almost anything with a revenue stream can become a CDO. David Bowie turned himself into a CDO when he sold bonds on the royalties from his record sales for \$55 million. Investment houses needed lots of mortgages to fuel the CDO market, so, in order to create more of them, unqualified home buyers were encouraged to take out subprime loans.

The process began when a mortgage broker made a deal with a home buyer, often with an automated system that algorithmically approved the loan. The broker, who represented a lender, got a fee. The lender gathered together a lot of these loans and sold them on the secondary market to an investment company. Note that the broker and the lender are now absolved of any risk in the loan, which may encourage them to take greater risks.

The investment company bought lots of these subprime loan packages, pooled them together, and algorithmically divided them into slices known as tranches for an AAA rating, a medium rating, and a risky rating. Now a group of subprime mortgages with high-risk home owners has an AAA rating. Another investment company might then buy the riskiest rated tranches, retransch them into new slices, and transform what was the greatest risk in the original tranche into an AAA security. These instruments strayed so far from the initial mortgage that some foreclosures are being challenged because no one can find the original contract, a minimum requirement for initiating foreclosure [11].

It was felt there was little risk in subprime loans because real estate values always rise and the wide geographic disparity insured against any local economic downturns. But to be on the safe side, investment companies issued a sort of insurance called a credit default swap (CDS). It was not called insurance because insurance companies have to follow certain regulations that



require, for example, enough assets to pay claims. If mortgage CDO buyers also buy CDS, they pay premiums to the CDS issuer who agrees to pay them if the monthly mortgage payments default. Anyone can purchase a CDS; you do not have to own the CDO being insured. So issuers can collect lots of premiums on the same CDO. They did not plan for defaults since their quant-generated models said the risk of default was almost zero. When lots of people started defaulting on their mortgages, firms such as AIG were not prepared to pay for the deals they had made. Their customers, often other financial institutions, demanded

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Kurzweil Predictions for



In *The Age of Intelligent Machines*, Kurzweil made some predictions that have famously come to pass. He revisited them

9 years later in *The Age of Spiritual Machines*, noting that a machine beat a human chess champion a year earlier than he had expected [13, pp. 74–75]. He was also correct in predicting the fall of the Soviet Union, which he attributed to decentralized electronic communication [13, p. 172–173]. He anticipated the World Wide Web with its accompanying documents that “never exist on paper because they incorporate information in the form of audio and video pieces” [16, p. 483].

The Age of Spiritual Machines also offers new predictions presented in 10-year increments. While he didn’t predict a financial crisis, his 2009 chapter is filled with technological achievements that we should be experiencing right now. Conveniently, he included a selection of predictions in a “Time Line” [13, pp. 277–280]. Unless otherwise noted, the quotations below come from the Time Line. Let’s see what he got right.

Photo: Ray Kurzweil

Computer Power

- 2009** “\$1000 personal computer can perform about a trillion calculations per second.” In a June 2008 interview, Kurzweil commented on his predictions for 2009. The interviewer later republished some of the comments in a New Year’s Eve blog post [17]. Kurzweil mentioned machines that were almost a teraflop for \$1,000. Flop(s) is an acronym for Floating point Operations Per (Second). He expected a trillion flops for \$1,000 later in the summer of 2008. Actually it was achieved in the same month he spoke, when AMD announced its FireStream 9250, a teraflop stream processor, priced at \$999.
- 2019** “A \$1,000 computing device (in 1999 dollars) is now approximately equal to the computational ability of the human brain.”
- 2029** “A \$1,000 (in 1999 dollars) unit of computation has the computing capacity of approximately 1,000 human brains.”
- 2099** “There is a strong trend toward a merger of human thinking with the world of machine intelligence that the human species initially created.”

Computer Size

- 2009** “Personal computers with high-resolution visual displays come in a range of sizes, from those small enough to be embedded in clothing and jewelry up to the size of a thin book.” Handheld computers are now common. The controversy here is in computers as adornment. In a recent address to the TED Conference (Technology, Entertainment, Design), MIT professor Pattie Maes presented her Sixth Sense device that can shine “relevant information about whatever is in front of you,” including explanatory information about objects or humans. It can even shine a usable keyboard onto a hand. Maes wore the device around her neck and described her invention as stylish. Perhaps in a nod to Kurzweil’s marketing of the Singularity, Maes closed her presentation by suggesting, “Maybe in another 10 years, we’ll be here with the ultimate Sixth Sense brain implant” [18].
- 2019** “Computers are now largely invisible and are embedded everywhere — in walls, tables, chairs, desks, clothing, jewelry, and bodies.”
- 2029** “Permanent or removable implants (similar to contact lenses) for the eyes as well as cochlear implants are now used to provide input and output between the human user and the worldwide computing network.”

2009 and Beyond

2099 "Most conscious entities do not have a permanent physical presence."

Connectivity

2009 "Cables are disappearing. Communications between components uses short-distance wireless technology. High-speed wireless communication provides access to the Web." We have Wi-Fi networks at home and often on every corner — at least those with Starbucks cafes.

2019 "Three-dimensional virtual reality displays, embedded in glasses and contact lenses, as well as auditory 'lenses,' are used routinely as primary interfaces for communication with other persons, computers, the Web, and virtual reality."

2029 "Direct neural pathways have been perfected for high-bandwidth connection to the human brain. A range of neural implants is becoming available to enhance visual and auditory perception and interpretation, memory, and reasoning."

2099 "Most [machine-based] intelligences are not tied to a specific computational processing unit."

Language

2009 "The majority of text is created using continuous speech recognition. Also ubiquitous are language user interfaces (LUIs)." In June 2008, Kurzweil felt that continuous speech recognition was needed because handheld computers are too small for keyboards, but he revised general adoption to several years in the future [17]. In the amplified Chapter 9, Kurzweil says that LUIs will be "narrowly focused . . . on specific types of tasks" [13, p. 190]. Perhaps automated conversant systems for telephone customer service qualify as ubiquitous LUIs. While customers can generally only use a predefined set of words, the automated voice is becoming more and more lifelike, annoyingly lifelike as it pretends deep, sensitive concern with our human failure to ask only the questions it expects us to ask.

2019 "Most interaction with computing is through gestures and two-way natural-language spoken communication."

2029 "Similar to virtual reality, much of what is seen and heard in 'real' reality also has no physical counterpart. Thus family members can be sitting around the living room enjoying one another's company without being physically proximate" [13, p. 222].

2099 "Even among those human intelligences still using carbon-based neurons, there is ubiquitous use of neural-implant technology, which provides enormous augmentation of human perceptual and cognitive abilities."

Business

2009 "Most routine business transactions (purchases, travel, reservations) take place between a human and a virtual personality. Often, the virtual personality includes an animated visual presence that looks like a human face." Certainly a great many routine business transactions are conducted online, but most do not involve interacting with a virtual personality, other than the telephone conversant systems mentioned above. But then millions of users belong to Second Life where virtual personalities conduct business transactions in the virtual world. A recent article estimated that avatars in simulated environments conducted a billion dollars of commerce in 2005 [19].

2019 "The vast majority of transactions include a simulated person."

2029 "The majority of communication does not involve a human. The majority of communication involving a human is between a human and a machine."

2099 "Machine-based intelligences derived from extended models of human intelligence claim to be human, although their brains are not based on carbon-based cellular processes, but rather electronic and photonic equivalents."

Education

2009 "Although traditional classroom organization is still common, intelligent courseware has emerged as a common means of learning." Kurzweil seems to target 2009 as a transition stage for education. He says that both traditional classrooms and intelligent courseware will become common. He definitely got the first part right. We have fully online education in distance learning, especially at the college or continuing education levels. Commonly used intelligent courseware is another matter, although there are examples in curricula. Carnegie Learning sells a product called Math Solutions in which "software lessons are based upon an intelligent software program that adapts the learning path to each student's understanding of mathematical concepts" [20].

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Kurzweil Predictions for 2009 and Beyond

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- 2019 "Paper books or documents are rarely used and most learning is conducted through intelligent, simulated software-based teachers."
- 2029 "Human learning is primarily accomplished using virtual teachers and is enhanced by the widely available neural implants" [13, p. 221].
- 2099 "The goal of education, and of intelligent beings, is discovering new knowledge to learn."

Disabilities

- 2009 "Pocket-sized reading machines for the blind and visually impaired 'listening machines' (speech-to-text conversion) for the deaf, and computer-controlled orthotic devices for paraplegic individuals result in a growing perception that primary disabilities do not necessarily impart handicaps." In Chapter 9, Kurzweil adds, "These reading systems are equally adept at reading the trillions of electronic documents that are instantly available from the ubiquitous wireless worldwide network" [13, p. 192]. Last year, Kurzweil Technologies and the National Federation for the Blind introduced a pocket-sized combination reading machine and cell phone. It reads paper documents and can import/export text files, but the phone is not web-enabled. An odd error, since this is the prediction over which Kurzweil has the most control. The reading machine is his invention and his company develops the new versions.
- 2019 "Blind persons routinely use eyeglass-mounted reading-navigation systems. Deaf persons read what other people are saying through their lens displays. Paraplegic and some quadriplegic persons routinely walk and climb stairs through a combination of computer-controlled nerve stimulation and exoskeletal robotic devices."
- 2029 "The prevalence of highly intelligent visual navigation devices for the blind, speech-to-print display services for the deaf, nerve stimulation, intelligent orthotic prosthetics for the physically disabled, and a variety of neural implant technologies has essentially eliminated the handicaps associated with most disabilities" [13, p. 221].
- 2099 "Humans who do not utilize [neural-implant technology] are unable to meaningfully participate in dialogues with those who do."

Translation

- 2009 "Translating telephones (speech-to-speech language translation) are commonly used for many language pairs." As of June 2008, Kurzweil expected the translating telephone within 1-2 years. He said his company had "a prototype of this technology that can capture speech with speaker-independent large vocabulary speech recognition and then translate to another language with voice output" [17]. He also described current cell phone technology offered by his company "that can capture print documents in seven languages and then translate the documents into any of the seven languages."
- 2019 "Routinely available communication technology includes high-quality speech-to-speech language translation for most common language pairs" [13, p. 205].
- 2029 "There is widespread use of all-encompassing visual, auditory, and tactile communication using direct neural connections, allowing virtual reality to take place without having to be in a 'total touch enclosure.'"
- 2099 "Because most information is published using standard assimilated knowledge protocols, information can be instantly understood."

The Economy

- 2009 "Accelerating returns from the advance of computer technology have resulted in continued economic expansion. Price deflation, which had been a reality in the computer field during the twentieth century, is now occurring outside the computer field. The reason for this is that virtually all economic sectors are deeply affected by the accelerating improvement in the price performance of computing." Readers can decide for themselves on the question of continued economic expansion, but Kurzweil sees any economic disruption, including the Great Depression, as a minor bump on the always improving road to prosperity.
- 2019 "Rapid economic expansion and prosperity has continued [13, p. 206].
- 2029 "Human and nonhuman intelligences are primarily focused on the creation of knowledge in its myriad forms, and there is sig-

continued

nificant struggle over intellectual property rights, including ever increasing levels of litigation" [13, p. 222].

- 2009 "Femtoengineering (engineering [within a quark] at the scale of femtometers or one thousandth of a trillionth of a meter) proposals are controversial."

Art and Music

- 2009 **"Human musicians routinely jam with cybernetic musicians."** In his 2008 interview, Kurzweil said, "There are many software packages that will accompany you with rhythm tracks that adjust to your playing, walking bass lines, and other accompaniments. Such software is also built into home digital keyboards" [17].
- 2019 "Virtual artists, with their own reputations, are emerging in all of the arts."
- 2029 "Many of the leading artists are machines" [13, p. 223].
- 2009 "There is no longer any clear distinction between humans and computers."

Health

- 2009 **"Bioengineered treatments for cancer and heart disease have greatly reduced the mortality from these diseases."** The U.S. cancer morbidity rate in 1991 was 215 per 100,000. The rate steadily decreased through 2005 with 184 per 100,000 [21]. There are also investigations of bioengineered treatments for cancer, such as "Nanomedicine Targets Cancer" [22]. Whether these two facts are related could be the subject for a well-funded research initiative.
- 2019 "Computerized health monitors built into watches, jewelry, and clothing which diagnose both acute and chronic health conditions are widely used" [13, p. 208].
- 2029 "The life expectancy of humans continues to increase and is now around 120 years" [13, p. 223].
- 2009 "Life expectancy is no longer a viable term in relation to intelligent beings."

"Hell, No! I Won't Go!"

- 2009 **"The neo-Luddite movement is growing."** Luddites appeared in the latter 18th century around the time of Joseph Priestley. They were concerned about losing their jobs to the first automated looms and actually smashed the new machines in factories. The leader was a mythical character named Ned Ludd. We don't see many laptops being smashed these days, and even anti-technology groups have websites. However, today's neo-Luddites do not share Kurzweil's unabated enthusiasm for a future with downloaded brains existing in machines. Bill Joy, a cofounder and former chief scientist of Sun Microsystems, responded in 2000 to Kurzweil's vision with a famous *Wired* article, "Why the Future Doesn't Need Us" [23]. He is especially concerned about self-replicating nanobots, molecular-sized robots that, if accidentally released, could double exponentially until all biologic life is drowned in electronic gray goo.
- 2019 "An undercurrent of concern is developing with regard to the influence of machine intelligence. There continue to be differences between human and machine intelligence, but the advantages of human intelligence are becoming more difficult to identify and articulate" [13, p. 206].
- 2029 "Machines claim to be conscious. These claims are largely accepted."
- 2009 "The number of software-based humans vastly exceeds those still using native neuron-cell-based computation."

If we think about Kurzweil's 2009 predictions in terms of technology trends, he seems to have mostly gotten it right.

In his enthusiasm, he is less accurate about current capabilities and levels of adoption, "ubiquitous" being one of his favorite words. Computer scientist Bill Joy had one explanation: "My personal experience suggests we tend to overestimate our design abilities" [23, p. 4]. Yes, but we usually get it right with a little trial and error, although as small mistakes increasingly have big consequences, it's the error part that worries Joy.

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payment. When the firms couldn't pay, the government stepped in with the bailout.

An experienced investor with David E. Shaw's early quant fund, commented in 1996, "With most of the investments I have, I understand exactly what's going on. I don't with David . . . It does bother me in a way. But it's something I can live with" [12]. Apparently the highest-paid employees of our largest investment firms decided they could live with it also.

Algorithmic trading will continue to become more complex and more difficult to understand. Financial neural networks now build self-learning systems in which the machine learns from its own mistakes and modifies its trading strategy based on new information. Some of that new information is supplied by automated news services that feed articles directly into computers to be acted upon algorithmically. This would seem to be a step toward Kurzweil's 2029 prediction that "the majority of communication does not involve a human" [13, p. 279].

Despite the feeling that quant trading may have contributed to the financial crisis, two of these news services, Thomson Reuters NewsScope and Dow Jones Elementized News Feed, have both added services since the beginning of the year. Dow Jones now feeds Standard & Poor's ratings directly into machines. Reuters has built "categories that correlate closely to the behavior of financial instruments" [14]. They also added a 20-year archive of machine-readable news stories. A Reuters manager said, "There is real interest in moving the process of interpreting news from the humans to the machines" [15].

With that, we are well on our way to 2029 and the beginning of the Singularity. Ray Kurzweil, who owns a quant fund by the way, predicted for that year, "Automated agents are now learning on their own, and significant knowledge is being created by machines with little or no human intervention" [13, p. 279]. It looks like we're already there, at least on Wall Street. ■

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