In an age when information is more proliferic and more widely available than ever before, diagrams, maps, and visualization tools offer a means to filter and make sense of it. We live amid a deluge of data—gathered by sensors, arrayed by software, and dispersed via every-proliferating networks—and to visualize it is to understand it, or so we hope. Colin Ware, a researcher in human perception, notes that we acquire more information through vision than through all of the other senses combined: the twenty billion neurons in the brain that help us analyze visual information provide a pattern-finding mechanism that is a "fundamental component of much of our cognitive activity." Ware makes a five-point case for the advantages of visualization: it helps us comprehend huge amounts of data; it allows us to perceive emergent properties we might not have anticipated; it can reveal problems with the data itself; it facilitates our understanding of large-scale and small-scale features; and it helps us form hypotheses. Yet, at the same time, the data explosion has brought about an aestheticizing of information, to the point that it has become difficult to sort function from creative expression. Information graphics adorn advertisements, architecture, magazines, textbooks, TV shows, and political campaigns.

Cascading veils of information, as famously depicted in the binary code of the 1999 film The Matrix, have become a definitive signifier of our age. As Arthur C. Clarke observed, "If you don't know where you are, you can't go anywhere else." By extension, early maps of the Internet seem to obfuscate rather than to illuminate. Today we tend to think of the Internet as something that enhances or augments the physical world, something we encounter everywhere we go. Previous pages: Barrett Lyon, The Opte Project. Mapping the Internet. 2003. Opte software.

The Value of Visualizations: Three Views

How, then, do we gauge the value of a visualization? Some maps, graphics, and diagrams seem to obfuscate or distort information or bewilder readers, while others have a profound effect on society, changing the course of government policy, scientific research, and public opinion. This vast terrain of imagery—of network diagrams, 3-D mappings, charts, graphics, and browsers—presents something of a navigation problem in itself. Is it an art or a science? In an effort to take stock of the current state of the field, Jarke van Wijk, a math and computer science researcher at Eindhoven Technical University, identifies three prevailing views of visualization: as a technology, as a science, and as an art. As a technology, information visualization is theoretically aimed at developing new solutions and selecting the best ones, according to the criterion of usefulness. A benchmark of usefulness cited by van Wijk is one of the best-known information graphics in history, physician John Snow's 1854 map charting the location of eighty-three deaths from an outbreak of cholera in central London. Snow revealed that fatalities occurred in a cluster around the water pump at Broad Street, and argued against prevailing wisdom that cholera was an airborne disease—that the pump was contaminated and should be shut down. Both Robinson and Edward Tufte, the writer and publisher of four well-known books on information design, wax lyrical about this graphic, which arguably changed the course of epidemiology and information design. Its apparent efficiency is stunning.

Visualizations as an empirical science can be dated to the 1987 publication of an influential paper, "Visualization in Scientific Computing," and is perhaps best characterized by Ware's textbook Information Visualization: Perception for Design, which uses psychological principles of human perception to build a set of rules governing the effective presentation of information. Ware provides a foundation for this view by first tackling the arguments that the manipulation of images to represent concepts can ever be systematized, making a case for those conventions that are so ingrained in our brains that they have become hardwired. As we shall see, both the technological and scientific approaches have some limitations. The third view, visualization as an art form, is grounded in the least credibility by van Wijk, who characterizes its goals as the production of images that have "clear aesthetic value" and the pursuit of simple, elegant solutions that provide "intellectual and aesthetic satisfaction." He quickly counters that this is not a line of defense that can "help us to convince our prospective users and sponsors." Such a diminutive account of art might be expected in much of the natural sciences, but outside the world of peer-reviewed papers and industry-backed research, the art of visualization can be seen to be a living, breathing field.
as an important critical counterpoint to the technological and scientific views. As a practice, it might even open up the field.

**Technological Determinism?**

The canonization of Snow's map is a good starting point for examining the technological view, which places a great deal of emphasis on technique and the integrity, efficiency, and effectiveness of visualizations. Tufte focuses on the notion of graphic integrity, frequently rewording "deceptive" graphics to illustrate how to avoid distorting data in the representation. Revisiting Snow's map in *Visual Explanations*, he gives an intriguing lesson on how different time-series representations of Snow's data can be used to support a sensationalist version of the tale, which states that immediately following Snow's report the Broad Street pump handle was removed and the cholera outbreak subsided. As Tufte reveals with his chart of the day-to-day chronology of deaths, the decline had begun before the handle was removed, most likely because Londoners were fleeing the area. Simply reorganizing the death rates by weekly intervals shows a sudden dramatic decline in death rates immediately following the handle's removal.

By drawing attention to the possibility that the removal of the water pump was unrelated to the decline in cholera in the area, Tufte seems to point to a problem in the very myth he is weaving around Snow's map. Is the graphic important because it is a technical paradigm of visual clarity and integrity, or because it is inextricably linked in our minds to the progress of epidemiology? Clearly, if Snow had been wrong about cholera and water, the map would not be a benchmark today. It certainly was not a technical innovation. Medical maps were common in the mid-1800s, and plotting deaths with dots was not a Snow invention.7 The backbone of the case for cholera as waterborne was Snow's detective work, as revealed in his prize-winning essay on the subject, to which the map was simply an accompaniment. To canonize the map through association is to risk invoking a kind of technological determinism, which suggests that Snow's map alone changed the way we view disease. If in the future Snow were proven to be wrong about cholera, one suspects his map would be quietly dropped from the "infoviz" canon.

A more recent example of putting undue emphasis on an information graphic can be found in the brouhaha that greeted the "hockey stick" graph showing temperature change over the last one thousand years. First published in the magazine *Nature* in 1998, the graph was included in the United Nations Intergovernmental Panel on Climate Change Third Assessment Report, in 2001, and writ large in Al Gore's 2006 film, *An Inconvenient Truth*. It earned its nickname from its shape, depicting relatively level temperatures for nine hundred years followed by a sharp upturn in the last ninety years.4 Based on proxy evidence from tree rings, ice cores, coral, historical records, and instrumental data, the graph points the finger squarely at human activity as the cause of global warming. Opponents of this argument contend, however, that the visualization was derived by using a particular statistical convention that favored production of the hockey stick form. By focusing on one decontextualized graphic, and side-stepping the overwhelming body of evidence linking human behavior with climate change, right-wing critics were able to muddy the waters of the argument. (Incidentally, this tactic effectively overshadowed other statistical conventions that achieved the same hockey stick shape. A paper published in *Nature* in 2005, to cite one example, found—using proxy evidence from stalagmites and lake sediment—the latter part of the twentieth century to be the warmest period in two thousand years.11 Effectiveness, a barometer of the technological view, is also an unreliable test of visualization. Consider a set of graphics produced by the *New York Times* to accompany a report in April 2002 on the vulnerability of New Orleans's flood-control system (pp. 126–27).12 A shaded relief map using a twenty-fold vertical exaggeration (albeit a Tufte no-no) effectively shows the changes in terrain around New Orleans, highlighting the critical role of the levees in protecting land (shaded red) at sea level or below. A cross section of the same area reveals the water levels of the Mississippi River and ocean in relation to the land. An aerial view shows the potential path of a "worst-case hurricane." And, finally, three flooding scenarios show the city in various states of submergence. Although the case for preventive measures was clearly and efficiently spelled out, the visualizations, like others published ahead of Hurricane Katrina, had little or no effect on policy. Its value is contingent on hindsight, as a vivid artifact of an institutional failure to heed well-documented warnings.

**The Science of Visualization**

For Ben Fry, who worked at MIT and Harvard University's Broad Institute developing dynamic visualization tools for genomics researchers, the chief oversight of Tufte's approach is its failure to address situations in which data is complex and undergoing continuous change—a situation that often calls for the user to interact with the data.6 Fry finds certain advantages in the scientific empirical approach laid out by Ware, specifically as a strategic counter to the current impulse to begin a visualization with the data itself. With vast data sets like the human genome, it becomes crucial for research teams to ask themselves, before the visualization stage, what they are trying to show. "Storytelling winds up being the crux of this stuff," says Fry. "Most often I work with people coming from the engineering or science side, and there's a
In an equities valuation tool he was creating in 1989 for the global finance firm Lehman Brothers, Paley adhered to general principles of perception. One of his own examples was an Asian student working on a system for visualizing a hard disk. The use of red to symbolize danger, for example, might seem for some to be hardwired, but Fry quickly realized a more flexible approach—slowly revealing little about the relations between the nodes on the networks they render. A simple comparison of TreeMap's Visual Thesaurus, which arrays synonyms in a dynamic network map, with the rich word-usage history of the Oxford English Dictionary, quickly reveals to any writer that the former is a reductive tool that closes down meaning while the latter opens up expressive possibilities within language. Fry has noted that the quality of visual design is generally neglected in the scientific approach to information visualization, perhaps because in its efforts to quantify the practice the field has come to perceive the business of making things attractive as too subjective. Yet those "cosmetic tweaks" on a simple diagram become extremely important when applied to a complex data set of thousands of elements, as Fry notes: "Minor problems in the diagram of a smaller data set are vastly magnified in a large one." Singling out by way of example the TreeMap software introduced by Ben Shneiderman's Human Computer Interaction Laboratory at the University of Maryland in 2002, Fry critiques its layout, noting the visual noise caused by frames, borders, labels, and the use of valuable screen real estate for sliders and dead space at the cost of providing more space for the data.
The Art of "Viz" as Critical Practice

Perhaps fallow ground and incremental progress are indicators that a discipline has argued itself into a corner. An expansive science would surely allow for alternative theoretical approaches, just as a technological approach benefits from a meta-perspective. Here, van Wijk's characterization of art as the production of self-rationalized aesthetic objects that bring intellectual delight merits a little rethinking. If instead we align the art of visualization with the art of urban planning and architecture, we open up a potentially fruitful comparison. Both urban planners and architects aim at the production of spaces with clear aesthetic value, yet this is only part of the reason that their users and sponsors are convinced, to use van Wijk's wording. Their services are enlisted in order to take part in a process, to "reformulate what already exists," as landscape architect James Corner argues in his essay “The Agency of Mapping”: "What already exists is more than just the physical attributes of a terrain (topography, rivers, roads, buildings) but includes also the various hidden forces that underlie the workings of a given place." Among these, Corner lists several forces indicated in the exploration of the canonic visualizations above: historical events, local stories, economic and legislative conditions, and political interests.

If we follow Corner's lead and imagine the art of visualization as a creative process concerned with not just the finished artifact but the framing, gathering, connecting, and arraying of data, then we can also imagine it as a critical practice--sizing up and reformulating a terrain of knowledge as well as experimenting with new and alternative forms.

Drawing from Gilles Deleuze and Felix Guattari, Corner uses the motifs of the rhizome and the burrow for their nonhierarchical and expansive way of connecting points from the middle rather than the beginning or end. Corner finds a paradigm of such "rhizomatic" mapping in a project also lauded by Tufte: Charles Joseph Minard's narrative diagram of Napoleon's ill-fated march on Russia during the winter of 1812–13. The map elegantly brings together facts such as the diminishing size of the French army, its movement, the terrain, locations and times of battles, weather, and the passage of time in one predigital "datascape," printed in 1885. "More than telling a story," writes Corner, "the map conditions how places on the land have come to exist in new relationships precisely through the vector of an event."

But he qualifies his praise by noting that the Minard map is a "closed system" that invites only a linear read. According to Corner, a rhizomatic map would be more multivariate and open: "Indeed such a map might not ‘represent’ an event but rather it might simply array a complex combination of things that provides a framework for many different uses."

Such rhetoric risks encouraging data-driven rather than story-driven visualizations. But it also provides for radical experimentation of the sort practiced by Natalie Jeremijenko, a design engineer and "techno-artist." Jeremijenko's OneTrees project, for example, reimagines cloned trees as environmental sensors. In 2003 she and two San Francisco–based nonprofit groups planted cloned pairs of Paradox trees around the Bay Area in order to register the different social and environmental conditions in the various locations. A map of OneTrees locations, produced with experimental architectural practice Terraswarm, juxtaposes a U.S. Geological Survey Landsat 7 aerial image of the Bay Area with "lay knowledge," such as the locations of bike trails, common hawk flight paths, and the habitat of the endemic song sparrow. The implicit critique is of culturally entrenched hierarchies of information, which, for example, prioritize satellite views and expert, institutional knowledge over the knowledge of ordinary people.

Jeremijenko's provocations attempt to call into question the legitimacy of the entire barrage of scientific procedures, presenting disruptive juxtapositions and very unscientific instruments (such as trees or toy robotic dogs). A more conventional project—though a potentially more disruptive one—was begun by architect and artist Laura Kurgan at the Columbia University Spatial Information Design Lab in 2006. Working with the Justice Mapping Center, Kurgan and Columbia graduate students have been mapping data from the criminal justice system. They have been looking not at where crimes were committed, as is common, but at the home addresses of the people incarcerated as a result of the crimes. Coining the term "million dollar blocks," the research collaborative revealed in their maps how a disproportionate number of prisoners come from a very few neighborhoods in the country's largest cities, to the extent that some states are spending in excess of a million dollars a year to incarcerate the residents of single city blocks. A description of the project, named Architecture and Justice, concludes with a discussion of its implications: "Guided by the maps of Million Dollar Blocks, urban planners, designers, and policy makers can identify those areas in our cities where, without acknowledging it, we have allowed the criminal justice system to replace and displace a whole host of other public institutions and civic infrastructures...What if we sought to undo this shift, to refocus public spending on community infrastructures that are the real foundation of everyday safety, rather than criminal justice institutions of prison migration?"

Potentially, Architecture and Justice does offer a new kind of benchmark for critical visualization.
There is no such thing as raw data. And presented for specific purposes. In other words, neutral; it is collected for a reason, and processed. Justice project reminds us, the data itself is never civic infrastructure that necessitates the inclusion of a distant exostructure—prisons and jails.

In his first book, Tufte introduced a guideline with which to judge statistical representations, that the “lie factor”: the ratio of the size of an effect shown in the visualization to the size of the effect in the data. Tufte utilized many of the principles espoused by Tufte and Ware, efficiently and effectively conveying a clear, succinct story. As a critical mapping, it challenges current thinking by reformulating what already exists. It uses the master’s tools—the aerial view, with which to judge statistical representations, that the “lie factor”: the ratio of the size of an effect shown in the visualization to the size of the effect in the data. But as the Architecture and Justice project reminds us, the data itself is never neutral; it is collected for a reason, and processed.

Laura Kurgan, Eric Cadora, David Reinfurt, and Sarah Williams. Spatial Information Design Lab, Graduate School of Architecture, Planning and Preservation, Columbia University. Architecture and Justice from the Million Dollar Blocks project. 2006. ESRI ArcGIS (Geographic Information System) software.

Notes
1. Colin Ware, Information Visualization Perceptions for Design and Analysis (San Francisco: Morgan Kaufmann, 2004), pp. 2–3.
4. Ware, Information Visualization, p. 17.
7. Ibid., p. 214.
8. Ibid., p. 245.
9. Ibid., p. 246.
13. Ibid., p. 214.
17. Ibid., p. 214.
18. Ibid., p. 245.
19. Ibid., p. 246.
22. Ibid., p. 245.
23. Ibid., p. 246.
When it comes to visualizing great amounts of data, the Internet is an irresistible subject of study. As it has grown, so has the challenge of accurate measurement and modeling of its topology. Numerous Internet maps exist, some strictly functional and diagnostic (such as the Internet Mapping Project initiated by Bell Labs in 1998), others more “atmospheric,” meant as dynamic snapshots of a universe in continuous expansion.

**Walrus**

Walrus graph visualization tool 2001–02
Java and Java3D software

In mathematics and computer science, a graph is a set of points or nodes connected by lines that can be considered equivalent in either direction (from A to B equals from B to A). In a directed graph, or digraph, each direction is instead considered distinct and called a direct arc or link. Digraph analysis has a wide set of applications as a deductive tool, especially in the social sciences, where points often stand for individuals and arcs as relationships between them. Walrus clearly illustrates the results of a digraph analysis for particularly large amounts of data, optimally with a few hundred thousand nodes.

Applied to the Internet, these visualizations allow us to appreciate the complex world of Internet connectivity. By sending probes to several hundred thousand IP addresses every day, researchers can actively measure both topology and average round-trip time (RTT)—the time interval between the moment a probe is sent and the moment a response is received—across a wide cross-section of the Internet. The graph shown here depicts a single cycle of measurements originating on February 2, 2002. Different colors identify each link’s RTT, with cyan being the fastest and red being the slowest. (And likely showing poor or problematic connectivity.)

**Median RTT**

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<th>RTT (ms)</th>
<th>Color</th>
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<tr>
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<td>Red</td>
</tr>
<tr>
<td>150–300</td>
<td>Orange</td>
</tr>
<tr>
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<td>Yellow</td>
</tr>
<tr>
<td>&lt;50</td>
<td>Green</td>
</tr>
</tbody>
</table>

Edward Marcotte (American, born 1967) and Alex Adai (American, born 1976)
Center for Systems and Synthetic Biology (est. 2003), The University of Texas at Austin (USA, est. 1883)
**Protein Homology Graph**
2004
bioinformatics.icmb.utexas.edu/lgl/#gallery
Large Graph Layout (LGL) software

The sequencing of a genome is central to molecular biologists’ understanding of the basic makeup of every living organism. The goal is to appreciate how this information comes together to constitute a uniquely characteristic being, whether a human, a plant, an animal, a bacterium, or a virus. The calculus necessary to compile and interpret this enormous quantity of data can be supported only by ever-increasing computer capabilities, which become more effective when coupled with good visualization design. The Protein Homology Graph is one example of this. To measure homology—the similarities between genes in different organisms that are so strong they point to a common evolutionary ancestor—Edward Marcotte and Alex Adai compared the sequences of 140,000 known genes; after nearly 21 billion comparisons were performed, 1.9 million homologies were established. Marcotte and Adai then used software to present this data as an immense web of relationships in which each point represents a single gene, and genes in the same family are connected by lines. Genes that share homologies are placed near each other, creating constellations of points. Larger groupings designate larger family groupings and often point to fundamental building blocks of life (such as organelles) or even entire organisms. Establishing such blueprints of genetic information provides important clues as to how genes affect what one being stands or which can lead to important medical and pharmaceutical understanding and disease treatment.

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Design and the Elastic Mind

Portfolio 4


Lisa Strausfeld (American, born 1964) and James Nick Sears (American, born 1980)
Pentagram (UK and USA, est. 1972)

Illustrator, Acrobat, and Processing software

Understanding connections in the vast landscape of information often requires a new way of looking. On December 3, 2006, the lead story for the New York Times Magazine, penned by Clive Thompson, discussed the challenge of analyzing and interpreting information about terrorism and coordinating its exchange among various intelligence organizations. For the article, information designers Lisa Strausfeld and James Nick Sears programmed an applet in which keywords—in this case names of terrorists or terrorist events—are connected by springlike links, which become stronger and more animated with the frequency of the words’ interconnection in a database. The resulting visualizations can be rotated in three dimensions to reveal new viewpoints, while for the purpose of the story the designers used the Internet as the source database; the model could also be adapted by government agencies using their own classified databases.

Aaron Koblin (American, born 1982)
Department of Design | Media Arts (est. 1994), School of the Arts and Architecture, University of California, Los Angeles (USA, est. 1966)

Illustrator, Acrobat, and Processing software

Celestial Mechanics, a project launched in 2005, visualizes the arresting patterns of the myriad flying objects—satellites, aircraft, balloons—that are at any time hovering around the earth. The work, which combines science, statistics, and art, was meant to be shown in a planetarium. Flight Patterns is a “flat” corollary to the project, one which also shows the informative and aesthetic potential of this type of visualization. As Aaron Koblin explains it, “Aircraft data collected by the Federal Aviation Administration was parsed and plotted to create animations of North American travel paths. Through visual traces of airplanes, one gets at any moment a sense of the changing dynamics of traffic in the skies above, as well as insight into the geographies and superstructures guiding the network.”

GustavoG (anonymous)
The FlickrVerse: A Graph Depicting the Social Network of the Flickr Community, April 2005

The FlickrVerse, a now inactive blog, explored the social landscape of Flickr. One day in 2005, one Flickr user, the elusive GustavoG, designed an image showing the social landscape of Flickr. The graph depicts a snapshot of the Flickr community at a particular moment.
Design and the Elastic Mind

Portfolio 4

Harvesting the Internet

W. Bradford Paley (American, born 1958)
Digital Image Design Incorporated (USA, est. 1982)
TextArc
2001
www.textarc.org
Java software

One of the main characteristics of visualization design is its capacity to use beauty and elegance as a path to clarity and analysis. W. Bradford Paley is one of the foremost experts in the communication of great amounts of data, and his renowned tool, TextArc, is used to conduct structural analyses of text. The pain of a relationship ending mixed with the anguish of adolescence is requisite material for pop songs, movies, and magazines. Building on the idea that the Web holds an amazing repository of humanity, The Dumpster, an interactive visualization Web site, uses real-life examples from the lives of American teenagers drawn from the Internet to provide a snapshot into the romantic lives of teens in 2005. The site—launched on Valentine’s Day, 2006—uses postings extracted from millions of blogs in which the phrases “broke up” or “dumped me” appeared.

Jonathan Harris (American, born 1979) of Number 27 (USA, est. 2002)
Sep Kamvar (American, born 1977)
We Feel Fine: An Exploration of Human Emotion in Six Movements 2005
wefeelfine.org
Perl, MySQL, Java, PHP, and Processing software

People often use the Internet to express and share emotions and to connect with others. The Web site we feel fine has been harvesting human feelings from blogs since 2005. Every few minutes, the system searches the world’s newly posted blog entries for occurrences of the phrases “I feel” and “I am feeling.” When it finds such a phrase, it records the full sentence and tags the feeling expressed in that sentence. In addition to the age, gender, and geographical location of the author, as well as the local weather conditions at the time the sentence was written, resulting in a database of several million feelings (increasing by about fifteen to twenty thousand new feelings each day). The site’s designers have experimented in six visualization systems, which they call “movements,” each one with its own efficacy and beauty.

Golan Levin (American, born 1972) of Carnegie Mellon University (USA, est. 1900)
Kamal Nigam (American, born 1972) of Google (USA, est. 1998)
Jonathan Feinberg (American, born 1972) of IBM Research (USA, est. 1914)
The Dumpster (Valentine’s Day) 2006
artport.whitney.org/commissions/thedumpster
Java software

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History Flow presents visualizations of the flow of editing that takes place on all Wikipedia entries, taking advantage of Wikipedia's free access to the complex layers of every entry's contributing history, providing a chronicle of a not always harmonious collaborative process. The examples shown here refer to the history of a highly controversial entry—abortion—on top, and of a very popular one—chocolate—below, as of 2003. Each color corresponds to a different contributor. Each vertical line, called a “revision line,” corresponds to the beginning of changed or updated text, while a line’s length indicates the length of the text. The immediate visual reading of this flow can render with relative precision the level of debate and controversy surrounding a topic. A deeper reading using various parameters, such as time, can push the analysis further into surprising detail.

Designed by Casey Reas and Ben Fry, formerly of the Aesthetics + Computation Group at the MIT Media Lab, Processing is an open source “programming language and integrated development environment (IDE) built for the electronic arts and visual design communities” based on Java language. Simple enough to be picked up by nonprogrammers and yet sophisticated enough to be used for high-level design, architecture, visualization, and animation projects, Processing has already had a significant impact as a powerful and inspiring design tool. Presented here are only a few of the many new experiments that Processing has sparked.

Demetrie Tyler (American, born 1973), Interactive Telecommunications Program (est. 1979), Tisch School of the Arts, New York University (USA, est. 1965)

Hypothetical Drawings about the End of the World 2006
www.demetrietyler.com/hypotheticaldrawings
Processing software

Demetrie Tyler's Hypothetical Drawings about the End of the World are large-format social landscapes inspired by online conversations that contain argumentative and divisive language. These exchanges were found all over the Web by using a Bayesian filter similar to that employed to identify spam e-mail. The images were created using a set of algorithms based on the designer’s drawings. The purpose of the work, in the designer's words, is to investigate “the idea that as communities continue to become defined more by common ideologies than common geographies and as ideological contrasts become further exaggerated as a result, we become less able to identify with each other....In other words, the more we choose to spend our time conversing with people who are interested (or worried) about exactly the same things that we are, in relatively tiny but globally dispersed communities, the more we feel like the rest of the world is just plain crazy.”
Ben Fry (American, born 1975)
Distellamap (Pac-Man) 2004
benfry.com/distellamap
Processing software
Ben Fry’s Distellamap is a visualization of the code and data found in a Pac-Man Atari 2600 cartridge. Fry began “showing” code with his Dismap project of 2003, in which he rendered graphically both the executable code of some early computer games and the data sections that are used to store images or game scenarios, highlighting not only the mathematical instructions, but also the commands that would direct jumps to different locations in the program. In Distellamap, Fry explains, the code is listed as “columns of assembly language, most of it either math or conditional statements (if x is true, go to y). Each time there is a ‘go to’ instruction, a curve is drawn from that point to its destination. When a byte of data (as opposed to code) is found in the cartridge, it is shown as an orange row: a solid block for a ‘1’ or a dot for a ‘0.’” With both Dismap and Distellamap, Fry’s intent is not to analyze the software but rather to celebrate its elegance with an equally graceful portrait of it.

Martin Wattenberg (American, born 1970) and Marek Walczak (British, born 1957)
MW2MW (USA, est. 2001)
Thinking Machine 4 2003–04
turbulence.org/spotlight/thinking/Eclipse and Processing software
For those who have dreamt of being able to see other people’s thoughts, Martin Wattenberg and Marek Walczak’s MW2MW—a “thinking machine” against which you can play a game of chess—is a gold start. During a game against MW2MW, “the machine’s evolving thought process becomes visible on the board before your eyes: all of the computer’s possible future moves are sketched on screen as it plays,” Wattenberg and Walczak explain. “A map is created from the traces of literally thousands of potential futures as the program tries to decide its best move.” These traces reveal the “invisible lines of force”—the power of thought—that emerge when the very act of thinking is made visible.
When comparing the genomes—and thus the exact order of the three billion adenine (A), cytosine (C), guanine (G), and thymine (T) letters—of two different organisms, single letter changes can be found every few thousand letters and are at times very significant. These variations are called single nucleotide polymorphisms, or SNPs, and are often found in consecutive sets that are easily rendered in blocks. Ben Fry's isometricblocks image represents blocks in the genetic profile of three different populations: the top row shows a group of Yorubans from Africa; the middle row depicts groups with Western European ancestry; and the bottom row represents a group of Japanese and Han Chinese individuals. "The vertical height of each column is proportional to the number of people in each group that has one set of changes or another," Fry explains, "and the colors in each row depict one of (only) two variations possible for each single letter change, the most common in dark red and the less common in a paler color." As in many of Fry's other visualization experiments, diagrams are used to provide both an instinctive gauge and a progressive in-depth analysis of a given statistical topic.

Humans vs. Chimps

Just how closely related are humans and chimpanzees? It is widely known that humans and chimpanzees have a common ancestor, but when the first analytical comparison of human and chimpanzee genomes was released in 2005, it became official: Humans are 98.77 percent chimpanzee. Ben Fry's image Humans vs. Chimps accompanied an article about these findings in Seed magazine in 2005. In his visualization, Fry shows specifically how the gene FOXP2 differs in humans and chimps. The gene, a part of that 1.23 percent difference and believed to be one of the primary distinctions between humans and chimpanzees, has been linked to language. All of the nearly seventy-five thousand letters of the gene are depicted; nine letters—shown with red dots—indicate the only significant differences.

Cinema Redux: Serpico

Cinema Redux explores the idea of distilling an entire film down to a single image. Processing software is employed to sample every second of a film and generate an eight-by-six-pixel image of the frame at that moment. The process is continued for the whole film, with each row in the visualization representing one minute of film time. The result is a unique fingerprint for that film—a visual DNA showing the film's colors and pacing, as well as the rhythm of the editing process.
Design and the Elastic Mind

Portfolio 4

Mapping and Tagging

Michiko Nitta (Japanese, born 1978)
Design Interactions Department (est. 1989),
Royal College of Art (UK, est. 1837)
Animal Messaging Service from the Extreme
Green Guerrillas project. Concept. 2006–07
Paper, ink, and acrylic, 27 x 19 5/8" (68.6 x 49.4 cm)

As the environment becomes a worldwide concern, there is a lot of pressure on individuals to initiate change. Extreme Green Guerrillas, Michiko Nitta’s fictional project, is a community that proposes radical solutions to these preoccupations. It acts against both the Internet and wireless communication—tied as they are to big corporations—and against conventional postal systems, which leave an immense carbon footprint. Instead, Extreme Green Guerrillas proposes to send digital messages by “hacking” into the radio-frequency identification tags placed by environmental protection agencies on migrating animals, and turning them into an animal postal service.

Matt Pyke (British, born 1975) of Universal Everything (UK, est. 2004)
Karsten Schmidt (German, born 1975) of toxi (UK, est. 2000)
Lovebytes 2007 identity generator 2007
festival2007.lovebytes.org.uk/monsters.php
processing software

The 2007 edition of Lovebytes, an annual international digital arts festival in Sheffield, England, was devoted to the idea of process. This theme inspired the Lovebytes identity—a population of unique characters, which appeared across all festival literature. Using a rule-based design system, Matt Pyke and Karsten Schmidt created “an automated process with the potential to output an infinite number of designs: A self-contained ‘seed’ grows into a multitude of design solutions automatically, within an environment defined by ranges of parameters such as hair color, hair length, head shape, eye shape, and name.”

Animal Messaging Service (A.M.S.) : FROM U.K. to New York

Example of messaging routes: U.K. to New York

Festival List

2007

145 144
Anab Jain (Indian, born 1976) and Alex Taylor (British, born 1969)
Microsoft Research Cambridge (UK, est. 1997)
Objects Incognito: RFID and Body Readers
Concept. 2007–ongoing

Anab Jain and Alex Taylor imagine a future in which radio-frequency identification (RFID) tagging will be found everywhere—objects, plants, animals, people, organs—and in which people will carry around sensors to explore the RFID-enriched landscape. In this fictional project, people will be able to scan the barcode and obtain such information as product ratings, promotions, and pricing.

Miquel Mora (Spanish, born 1974)
Design Interactions Department (est. 1989), Royal College of Art (UK, est. 1837)
Flat Futures: Exploring Digital Paper
Models. 2007

Smart Tapes
Paper and adhesive tape, 2 x 3 7/8" (5 x 10 cm)

Memory Envelope
Paper and adhesive tape, 8 5/8 x 4 3/8" (22 x 11 cm)

Relying on the latest developments in organic electronics—which studies conductive polymers as opposed to the traditional, non-carbon-based copper and silicon—and on methods of using nanotechnology to print dynamic electronics, Miquel Mora explores ways to create processors, displays, and batteries on surfaces as flat and flexible as paper. "Objects will wear technology instead of carrying it inside," explains Mora. "The technology will become their skin." In Smart Tapes, a range of electronic components (such as processors, batteries, speakers, and displays) are printed on adhesive tapes, allowing a user to "enhance an existing product making it smart, or create a new one." Memory Envelopes and Memory Probes are mailing envelopes and add-ons that record and display their journey, offering their own narrative memory.

Gavin Jancke (British, born 1970)
Microsoft Research (USA, est. 1991)
Microsoft High Capacity Color Barcode
Prototype. 2004–ongoing

The mapping and tagging of information rely on the increasing capacity and decreasing size of computer chips and other data reservoirs. The High Capacity Color Barcode, developed by Microsoft Research engineering director Gavin Jancke, is a new barcode system capable of holding much more retrievable information than current UPC codes. It is composed of triangles of eight different colors arranged from left to right. The new barcode will be useful not only to vendors but also to consumers, who will be able to scan the barcode and obtain such information as product ratings, promotions, and pricing.
Raúl Cárdenas-Osuna (Mexican, born 1969)
Torolab (Mexico, est. 1995)
LRPT (La Región de los Pantalones Transfronterizos)
Prototype. 2005–06
Global positioning system, MaxScript, and 3d MAX software

"LRPT is a document of urban ethnography that proposes a new form of cartography for the transborder region between Mexico and the United States," explain the members of Torolab, an architecture and art collective based in Tijuana, Mexico. The designer chose five people settled on either side of the border and developed different "transborder clothes" for each of them. A GPS tracking system was integrated into the garments, which stem from Torolab's Toro Vestimente clothing line that addresses transborder identity and interaction. For five days, as the participants moved through the Tijuana–San Diego region, Torolab tracked their locations, velocities, and fuel consumption. The results from the collected data trace the participants' migration on a topographic urban/natural structure where the geographic and political boundaries are left unmarked.

SENSEable City Laboratory (est. 2003), Massachusetts Institute of Technology (USA, est. 1861)
Carlo Ratti (Italian, born 1971) and Andres Sevtsuk (Estonian, born 1981)
Visual software: Burak Arıkan (Turkish, born 1976) and Francesco Calabrese (Italian, born 1982)
Real Time Rome 2006
senseable.mit.edu
Processing software and cell-phone triangulated tracking system

Real Time Rome synthesizes data from communications and transportation networks—for instance GPS information from mobile phones and from public transportation and taxi triangulation diagrams—that help decipher patterns of daily life in Rome. By overlaying mobility information on the geographic references of a city, Real Time Rome unveils the relationships between fixed and fluid urban elements. According to the designers, "These real-time maps expose the dynamics of the contemporary city as urban systems coalesce: traces of information and communication networks, movement patterns of people and transportation systems, and spatial and social usage of streets and neighborhoods." Such maps also demonstrate how neighborhoods are used in the course of a day, how the distribution of buses and taxis correlates with densities of people, how different social groups, such as tourists and residents, inhabit the city, and how urban dynamics are affected by special events. The first map combines different datasets—real-time cell phone data, GIS data, and raster images—in a single interface. The second image shows the movements of mobile phone users during Madonna's concert in Rome on August 6, 2006.