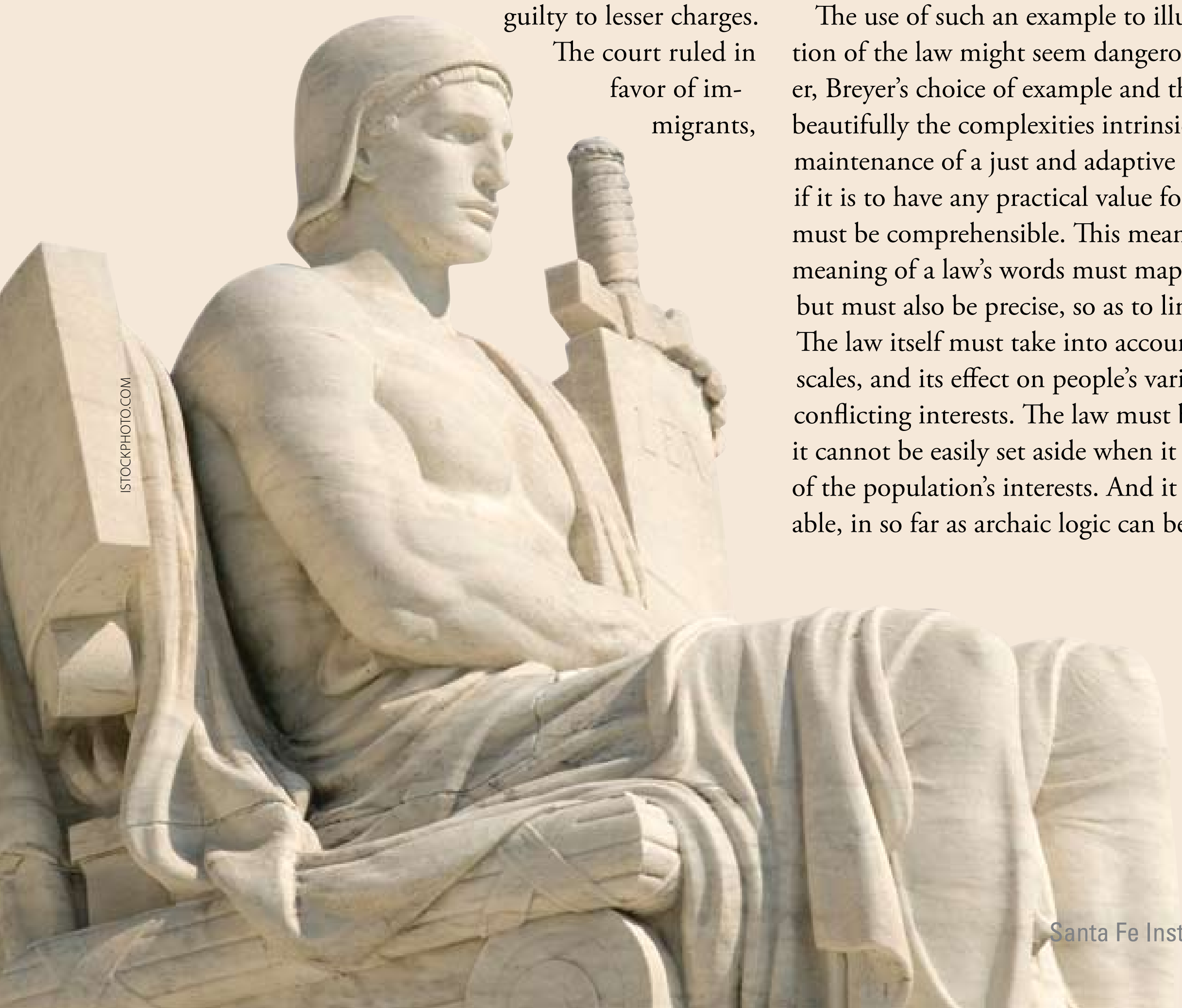
Engineering Better Legal Systems

BY JESSICA FLACK

In April of this year the Supreme Court of the United States had to decide whether it was constitutional to prosecute illegal immigrants for using falsified social security numbers. The primary issue in Flores-Figueroa v. United States, No. 08-108 was whether an individual could be charged with identity theft even if he or she had not known that the number belonged to someone else. A second issue concerned prosecutors using the threat of these more serious charges as a means of coercing illegal immigrants into pleading guilty to lesser charges. The court ruled in favor of immigrants, stating that the law only applies when an offender has knowingly transferred, possessed, or used, without lawful authority, another person's means of identification. The court argued that the "knowing" requirement meant that the presumed offender understood that the number he was adopting belonged to someone else. Justice Stephen G. Breyer made this point in everyday terms: "If we say that someone knowingly ate a sandwich with cheese, we normally assume that the person knew both that he was eating a sandwich and that it contained cheese."

The use of such an example to illustrate an interpretation of the law might seem dangerously flippant. However, Breyer's choice of example and the case itself illustrate beautifully the complexities intrinsic to the building and maintenance of a just and adaptive legal system. The law, if it is to have any practical value for ordering society, must be comprehensible. This means that the intended meaning of a law's words must map onto everyday usage, but must also be precise, so as to limit manipulation. The law itself must take into account short and long timescales, and its effect on people's varied and sometimes conflicting interests. The law must be robust, in so far as it cannot be easily set aside when it conflicts with a subset of the population's interests. And it must also be overturnable, in so far as archaic logic can be recognized and



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The statue *Authority of Law* sits at the entrance to the U.S. Supreme Court building in Washington D.C., which was constructed in 1935.

CAMERAPHOTO ARTE, VENICE / ART RESOURCE, NY

The Doge Thanking the Great Council During the First Meeting by Gabriele Bella, (18th C./Italian)

abandoned for a more appropriate set of rules.

In more general terms, a good legal system, and well-written laws, must take into account information-theoretic considerations, timescale effects, scaling, heterogeneity of agents and interactions, correlated and hidden variables, contextual effects, and trade-offs between robustness and evolvability—topics that fall under the general remit of "complexity science." Yet none of these issues is considered in a formal quantitative framework when penning legislation or when building structures such as judiciary systems.

The question is whether a better legal system might be engineered using design principles from complexity science. This is a particularly difficult task because the solution must come from individuals within the system, using largely local information. There is no external engineer with access to global information and the ability to experiment on large scales. The question of how to better incorporate insights and methods from complexity science into the study and construction of legal systems served as the basis for a meeting organized at the Santa Fe Institute by SFI Professor David Krakauer, Jenna Bednar from the University of Michigan, and me in March on "Evolution, Complexity and the Law." The meeting, which was funded by the Kauffman Foundation, was attended by an interdisciplinary group of scholars and scientists, including legal scholars and attorneys, political scientists, anthropologists, mathematicians, physicists, and biologists.

Although the problems are formidable, there is reason to be optimistic. The traditional justification for penning legislation and the methods for evaluating its effects have been largely based on argument. Argument is based on informal logic and the use of qualitative precedent, rather than on quantitative data. Partly this is because quantitative data on the scale required have been lacking. Until recently, collecting such data made little sense, as the tools and conceptual frameworks required to analyze such data were not available.

Within the last 15 years, however, researchers have developed methods for the coding and analysis of large, noisy data sets permeated with network effects, largely for the study of genomic and molecular problems. In particular, these methods allow us to empirically address issues related to the correlated activity of many variables. For example, in biological systems it is now understood that many proteins function differently depending on their connectivity in the cell's network of protein interactions. Highly connected proteins in scale-free networks are more essential to cellular function than weakly connected ones. Although this might seem obvious in retrospect, until computational methods for analyzing the structure of large networks became available, it was assumed that a particular protein was responsible for catalyzing a specific cellular reaction much as it was (and often still is) assumed that there is a gene for X. My own work, in collaboration with SFI researchers Nihat Ay, Simon DeDeo, and David Krakauer, has generated a mathematically rigorous, systematic means for determining in biological systems the types of solutions—such as scale-free wiring versus exponential wiring of networks—that contribute to robustness, as well as when system components are likely to cause problems.

These approaches for disentangling causality and studying robustness and adaptability in complex systems are general enough to be used to study social questions, such as the origins and dynamics of legal systems. This includes isolating the factors that cause laws to succeed or fail, determining the architectures and construction rules that make legal systems robust yet adaptable, and determining the conditions under which it pays to write legislation that is lengthy and operationally precise versus legislation that is concise and colloquially comprehensible.

Progress in engineering better social systems is already being made in a closely related discipline—economics—in work by SFI Science Board member and Nobel Prize Winner Eric Maskin, among others, on "Mechanism Design Theory." The research has shown that game theoretic arenas can be designed around problems to increase the probability of competing participants converging on an a priori-defined desired outcome. The design of the Vickrey auction, for example, gives bidders an incentive to bid the true value of the good being sold. In this auction, bidders submit sealed bids without knowing the bids of others. The highest bidder wins but pays the value of the bid submitted by the second highest bidder. These two rules increase the probability that in an auction for a single, indivisible good, bidders will not intentionally under- or overbid.

Our recent meeting was the first step toward engineering legal systems from the bottom up to produce just outcomes at multiple scales for a diverse set of participants. The second step is to identify a few candidate data sets, and areas for data collection and coding that offer the prospect of complementing traditional styles of legal reasoning and intervention with complexity tools and concepts. One such data set is the distribution of case citations. A group of researchers from the meeting, led by Daniel Katz, a graduate student at the University of Michigan, has been studying why these citations follow a power law—that is, why some cases are heavily cited and others rarely or never. This work will help researchers identify the factors contributing to the origins and evolution of legislation. Another group of researchers, led by David Krakauer, SFI External Professor Dan Rockmore, and Robert Cooter of the University of California at Berkeley, is focusing on the analysis of constitutions, using new statistical methods to track patterns of shifting ideas in the cultural evolution of documents. Armed with the kinds of insights generated by these projects, we can begin to develop a "mechanism design theory" for law. ◀

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