Complexity sciences and Hayek's neoliberalism

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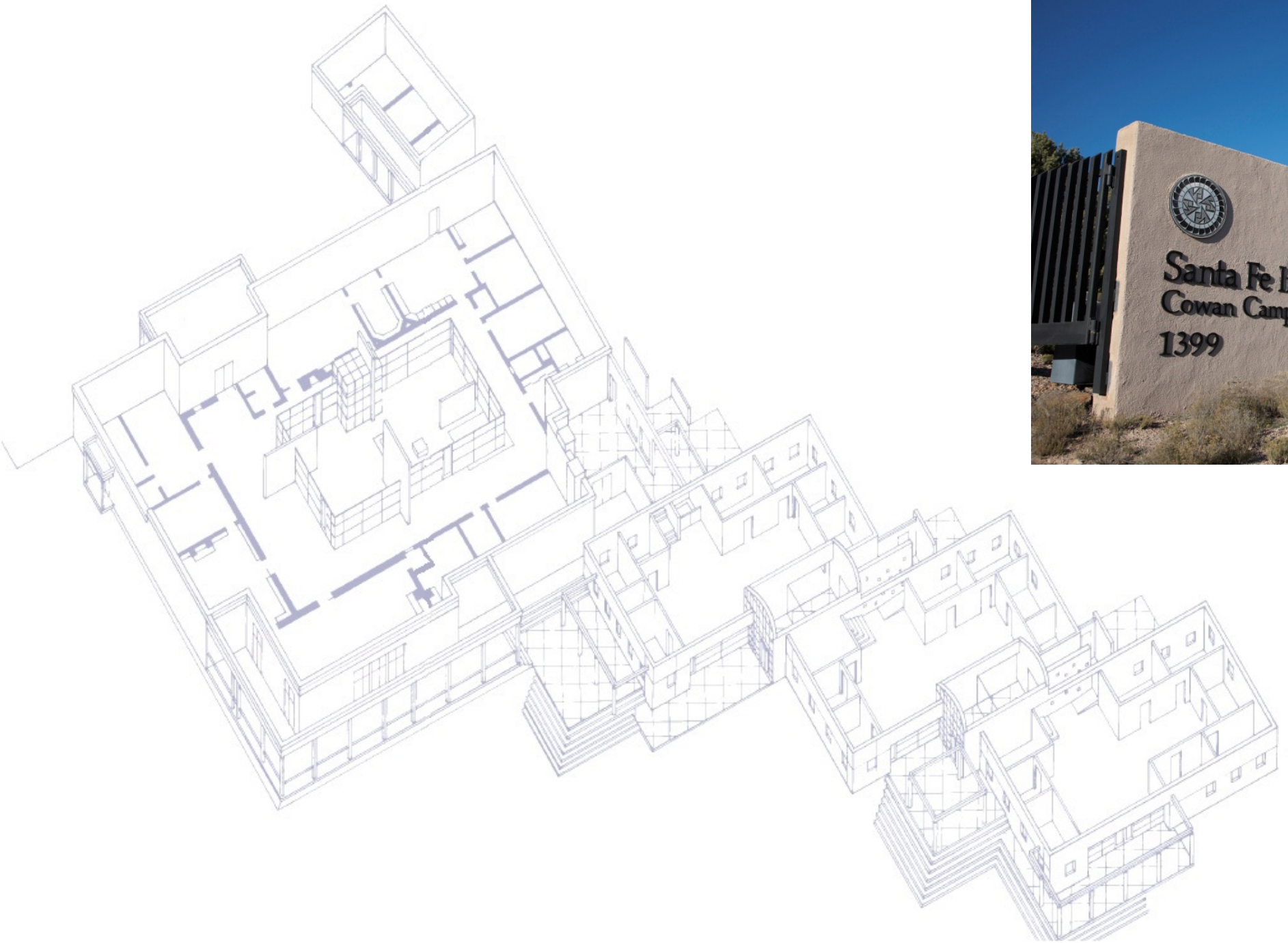
Plan

- Quick presentation of the **SFI** and of **complexity sciences**

- First thesis: at the SFI, complexity and liberalism **mutually reinforce** each other
  - On a theoretical level
  - And on a normative level

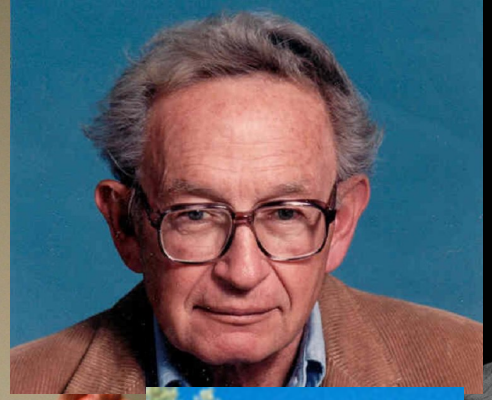
- Second thesis: the SFI as a scientific institutional **embodiment** of liberalism
  - On a practical level

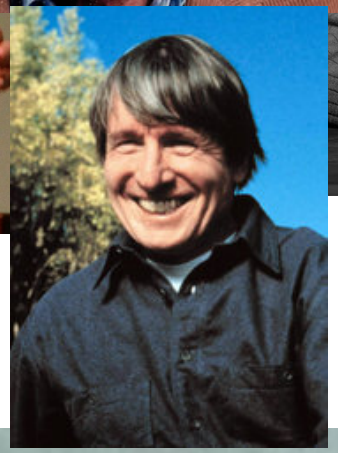


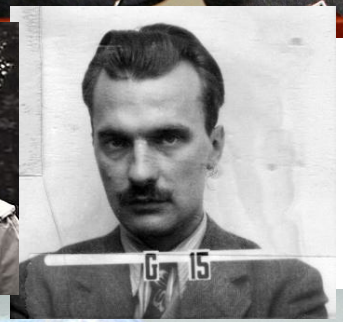

Santa Fe Institute
Cowan Campus
1399

History of CSS

1. SFI was founded in **1984** by several **physicists**
2. It rapidly integrated **biologists**, **computer scientists**, mathematicians and **economists**
3. It launched the « **science of complexity** »
4. Very effective outreach and favorable **popular press** that spread its jargon
5. Around **60 institutes** of complexity in the world, but declining fundings
6. A **few journals**, not prestigious according to my interviewees

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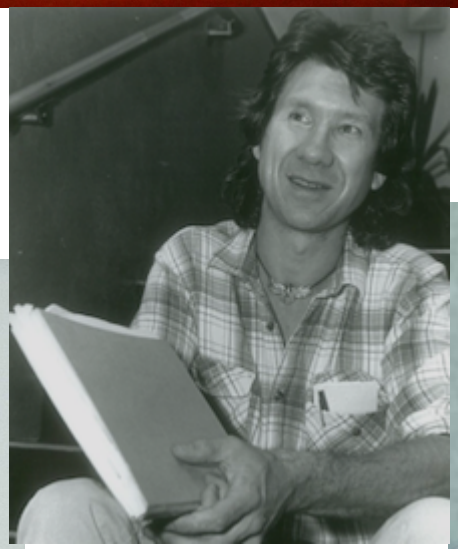

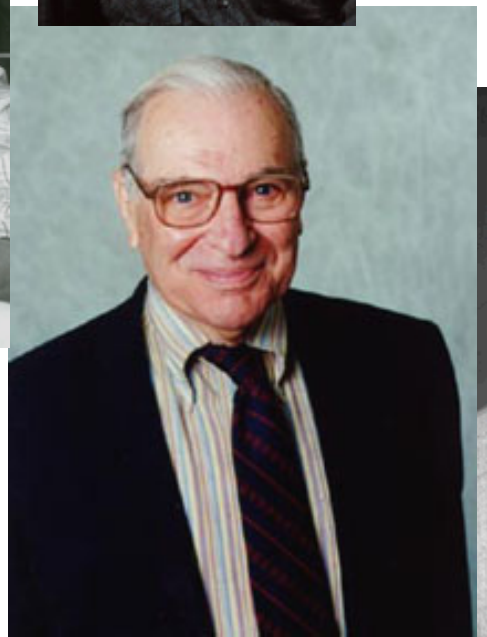
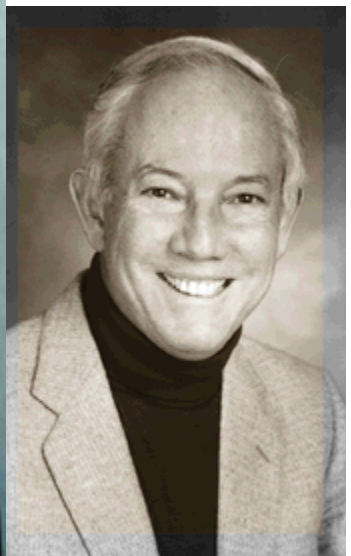

History of CSS

The canonical definition of Complex Adaptive Systems (CAS) explicitly contains all the epistemic project of complexity sciences and implicitly its normative tenets

- A CS is « a system in which **large networks** of components with **no central control** and **simple rules** of operation give rise to **complex collective behavior**, sophisticated **information processing**, and **adaptation** via learning or evolution. (Sometimes a differentiation is made between complex adaptive systems, in which adaptation plays a large role, and nonadaptive complex systems, such as a hurricane or a turbulent rushing river…)

Mitchell, M., *Complexity. A Guided Tour*, Oxford, New York, Oxford University Press, 2009, p. 13

Le projet épistémique des sciences des systèmes complexes

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Abstract: The present article describes the epistemic project of complex systems sciences. The Santa Fe Institute founded in 1984 (New Mexico, United States) was the first theoretical research institute to focus on complex systems sciences as a field of research for studying the network of relationships within and between systems. Described by some as post-Laplacian, holist and antireductionist, the field of complex systems sciences relies heavily on a multidisciplinary approach to fundamental theoretical questions across the domains of physical and social science. Proponents such as renowned journalists and sociologists have declared the developing domain as the advent of a new revolutionary paradigm for all fields of knowledge. The specific aim of this text is to show that the epistemic project of complexity science is less pluralist, anti-positivist and antireductionist than some would claim. Further, I will examine why the epistemological and ontological framework of these sciences have remained both analytic and reductionist in physicalist, computational, mathematical and biological manners.

History of CSS

- The epistemic project is to include all natural and social sciences through four mouvements:

1. Computational view of nature and society (computer science)

2. A unified theory of CAS with simple rules (physics)

3. Formalize life and social sciences (mathematics)

4. Everything learns and adapts (Darwin)

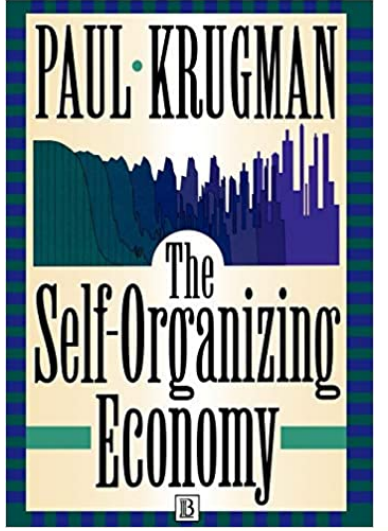
History of CSS

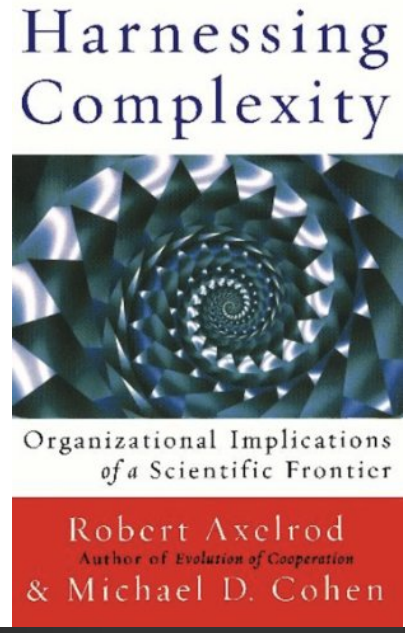
It integrated from other disciplines or developed (in two cases) a dozen of tools:

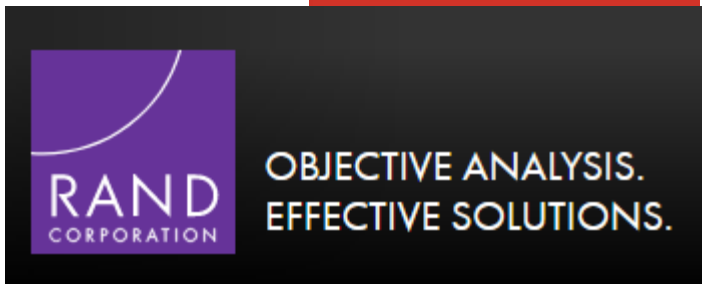
1. Dynamical systems and chaos
2. Cellular automata
3. Statistical physics
4. Spin glasses
5. Neuronal networks
6. Boolean networks
7. Network theory
8. Agent-based models (Artificial Life)
9. Self-organized criticality
10. Genetic algorithms
11. Game theory
12. Machine learning

First thesis

- Within SFI complexity sciences, **liberal theories** are used to reinterpret **natural theories** and at the same time natural theories enrich and fortify theoretical liberalism.
- This is visible – explicitly and implicitly – on **three levels** at one and the same time (**coproduction**: multiple elements coevolving and no simple causality, funds from the private world and percolation of CAS jargon to management – e.g. Axelrod & Cohen –, economics – e.g. Krugman – and think tanks – e.g. RAND):
  - Theoretical
  - Normative
  - Practical (second thesis)







First thesis: theoretical

- Let me give you some examples of the theoretical level:
- Cosma Shalizi – former post-doctoral fellow at the SFI, where he worked on a program about adaptive computation – has claimed that:
  - Joseph Schumpeter and Friedrich Hayek […] wrote their great works more than half a century ago, and yet echoes of their words could be heard throughout the discussion [at the adaptive computing workshop held that year at the SFI]. Schumpeter's explains how capitalism requires (and supports) a larger society, many of whose institutions are run on quite antithetical lines. Hayek's explains how markets work as distributed computing mechanisms, adaptively optimizing the allocation of scarce resources […] **Today we have a much better body of abstract theory about emergence, and a wonderful assortment of models, and they make very nice analogies to what Hayek and Schumpeter talked about**; Hayek even lived long enough to appreciate some of them. (SFI 1999a: 10)

First thesis: theoretical

- **Robert Axtell** finds in Hayek a possibility to push further the complexity approach to economics:
  - Not only does Hayek deserve credit for beating the physicists and other complexity scientists to the punch in articulating a coherent view of complex systems, **his radically distributed and decentralized view of the world is a wellspring for renewal of the complexity program** as the methodology continues its colonization of new scientific fields.
- In the following, **John Holland** describes his classifier systems, a machine learning technique that can be combined to **genetic algorithms** (also invented by him), in order to break up complex solution spaces into smaller parts:
  - **Competition** allows rules to be treated as hypotheses, more or less confirmed, rather than as incontrovertible facts. […] stronger rules are more likely to win the competition when their conditions are satisfied. […] the classifier system's reliance upon a rule is based upon the rule's average usefulness in the contexts in which it has been tried previously.

SFI Bulletin, 1988, vol. 3, n. 1

The Institute's Visiting Fellows Program brings to Santa Fe scientists currently pursuing advanced research in complex systems. During 1987 SFI hosted six fellowships. As project directors, the residencies of three Visiting Fellows—Philip Anderson, Kenneth Arrow and David Pines—centered mainly on activities in connection with the Global Economy workshop. During their stays Brian Arthur, John Holland and Stuart Kauffman participated in SFI's September workshops, collaborated with one another and with other colleagues at the Institute and Los Alamos National Laboratory, and pursued individual research.

Brian Arthur, SFI Visiting Fellow

W. Brian Arthur is Morrison Professor of Population Studies and Economics at Stanford University. A 1987 Guggenheim Fellow, he is a Member of the International

other offers. The two are bid into an equilibrium; and given information on people's tastes and possibilities, the equilibrium market shares are determinable and predictable in advance.

Economic theory built upon positive feedbacks or increasing returns on the margin is different. For example, in the video technology field Sony Betamax possesses increasing returns in the sense that increased prevalence on the market encourages more films to be produced in that technology and so returns to purchasing Betamax increase with its market share. If Betamax and its rival, VHS, compete, a small lead in market share gained by one of the two technologies may enhance its

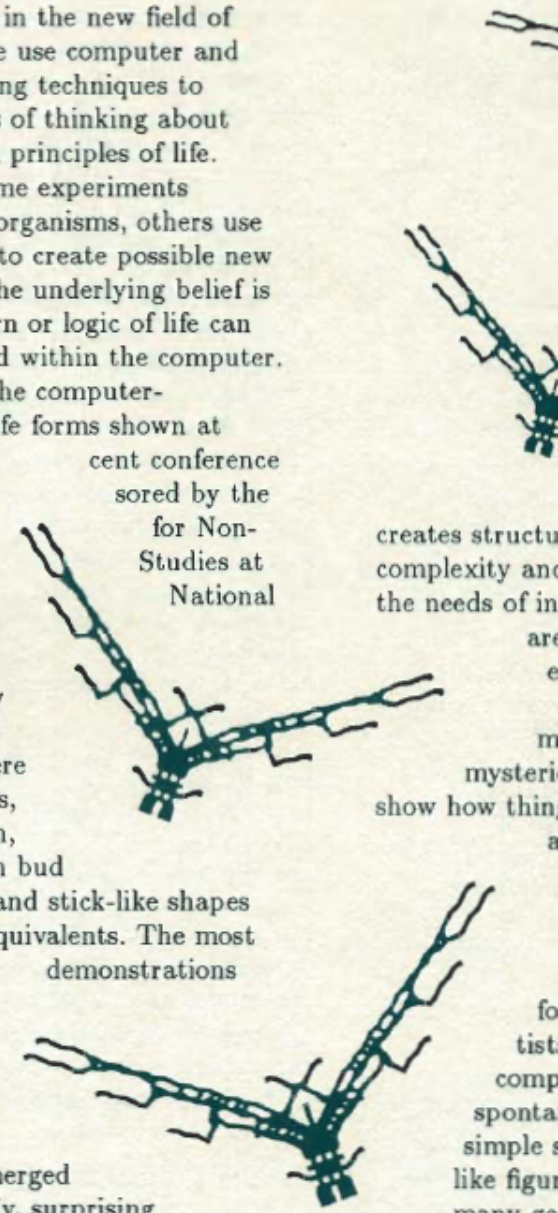
These properties appear to have counterparts in physical and biological systems. Physicists talk about nonlinear mode-locking rather than lock-in, about non-ergodicity rather than path-dependence, and about potential levels rather than efficiency. There are other correspondences. In the video example the market starts out even and symmetric, yet it ends up asymmetric; and so there is "symmetry breaking." An "order" or pattern in market-shares "emerges" through initial market "fluctuations." Biologically we might say that the two video technologies compete to occupy one "niche" and the one that gets ahead exercises "competitive exclusion" on its rival. And if one technology isn't innately superior, it has more chance of taking the market: it possesses "selectional advantage."

What is important here is not just that positive-feedback systems show much the same properties whether they occur in economics or in physics. More interesting are the methods and insights that can be traded from one field to another. In economics we have developed powerful non-linear probabilistic Strong Laws that may become

Artificial Life: Computation and Biology Mixed

Scientists in the new field of Artificial Life use computer and other modeling techniques to provide ways of thinking about the universal principles of life. Although some experiments imitate real organisms, others use sets of rules to create possible new life forms. The underlying belief is that a pattern or logic of life can be abstracted within the computer.

Some of the computer-automated life forms shown at the re- cent conference spon- sored by the Center for Non- linear Studies at Los Alamos National Laboratory (and co- sponsored by the Santa Fe Institute) were ocking birds, schooling fish, flowers which bud and unfold, and stick-like shapes given gene equivalents. The most intriguing demonstrations have been those in which lifelike qual- ities have emerged spontaneously, surprising even the programmers. One pro-



creates structu complexity an the needs of in ar e m mysteri show how thin a fo tist comp sponta simple s like figu many ge increasin

Genetic Algorithms

A genetic algorithm is an idealized computational model of evolution based on the principles of genetic variation and natural selection, pioneered by SFI External Professor John Holland. The goal of a genetic algorithm is to find a good solution to a problem by evolving a population of solutions. Individuals in the population are represented as bit strings, collections of ones and zeros, corresponding to the chromosomes of biological organisms. During each generation the fitness of all individuals is evaluated; the best individuals tend to survive and produce new bit strings, while the less-fit individuals tend to be eliminated from the population. Through time the average fitness of the population increases, resulting in better solutions.

At each generation new bit strings may be produced either by mutation (changing a bit value) or through the crossover operator which combines two individuals to produce two new, mix-and-match offspring. Crossover allows two bit strings to combine and, in a single step, occasionally produce a much better offspring with the best features of both parent bit strings. For this ability to leap across to better solutions, the crossover operator is often credited for genetic algorithm's successful results.

The genetic algorithm, like evolution, exhibits the parallel and distributed behavior of emergent computation systems. The fitness of individuals, for example, can be evaluated in parallel during each generation. Responsibility for crossover and mutation is distributed among all individuals, rather than being given to a central authority. Each individual performs these operations autonomously. The behavior of the genetic algorithm is emergent because, while each bit string may mutate and crossover independently, it is the combined action of the entire population that produces results.

First thesis: normative

- Let me give you some examples of the normative level: (econophysicists, geographers, Alifers and economists)

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Five anticipation communities in complex systems sciences Complexity science and its visions of the future

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	High-frequency prediction	Open-ended evolution	Decentralized prediction	Future co-construction	Centralized anticipation
Approaches and devices	Chaos theory, economics, psychology, times series, genetic algorithms, neuronal networks, statistical arbitrage	Evolution, Artificial Life, Artificial Intelligence, economics, entomology, agent-based modeling, genetic algorithms	Geography, physics, statistics, agent-based modeling, power laws, network theory	Geography, computer science, ecology, social sciences, agent-based modeling	Public health, network theory, physics, computer science, meteorology, agent-based modeling
Performativity	Detecting order within chaos permits short-term predictions	Artificial life simulations are alive and can evolve to solve problems	Homology between target and simulated systems allows prediction	Simulation can only provide simplified insights for pedagogy	Homology between target and simulated systems allows anticipation

Extra-academic activities	Speculating in the stock markets	Robotics, drugs, software for industrial optimization	Consulting for administrations and enterprises	Participatory forums with different stakeholders	Consulting for governments and agencies
Future regimes	High-frequency prediction	Optimization	Prediction (but also prospective and anticipation)	Prospective	Anticipation (but also prospective and urgency)
Anticipation policy	Making money, make the market more efficient, compete, bet	Make industry and management more efficient, increase gains, adapt	Help policy and enterprise in planning, innovation and competition are the motors of history	Democratize, pacify, and make more sustainable the management of environmental commons	Limit human and animal casualties, maintain political and economic status quo

First thesis: normative

- A scientist from the SFI illustrates the supposedly **apolitical approach** of the institute:
  - **Science is supposed to tell me how things work** whereas policy is […] about making a specific thing that does something specific in a given context. […] So I'm not going to tell [policy makers] exactly what to do because that's their problem, but I'm going to tell them what can be done, what data they could collect, how maybe it was done somewhere else, why this is important from a scientific and empirical perspective.
- STS have shown in several domains with multiple examples that as soon as scientists "frame" the world, they consciously or unconsciously, implicitly or explicitly foster certain normative views instead of others:
  - [My activity as a consultant is devoted to] **liberalism with a big L**, not the political liberalism, but the idea that we should create societies which have a lot of choice and agency […] You can say that that's political but I think it's also quite consensual in terms of that being a good thing and that science can tell you a little bit about the conditions that generate more of that.
- While this is perfectly political, it is **depoliticizing** – but that's another question…

First thesis: normative

- SFI **idiosyncrasy** for any form of **State bureaucracy**. Governmental agencies are described as too **directive**, **old-fashioned**, **short-sighted** and **rigid** – unfit characteristics to thrive in a liberal agonistic world
- As one of the institute's treasurers explained in a 1991 bulletin, private gifts are generally accompanied by a letter which specifies to the institute how and when the money shall be spent – but according to her, **governmental scholarships are much more restrictive**: **"The tracking of funds is endless"**, she declares. It is because federal agencies ask frequent reports and states-of-the-art to the scholarship recipients. They also impose them a certain number of regulations and audits. Such constraints are perceived by the New Mexican institute as invading and uselessly bureaucratical. If the SFI has never renounced to search for public resources, it has mainly been for symbolic reasons: **"Competitive peer-reviewed grant funding provides credibility for the Institute's science, while the availability of unrestricted funds from contributions allows investment in cutting-edge, high-risk ideas."**

Second thesis

- On the **institutional and organizational** level, the SFI can be seen as a scientific **embodiment** of the (neo)liberal political project

Some remarks about (neo)liberalism

- For me it is at the same time a general concept for

    1. An **intellectual movement** within what Dupuy calls the **political economics**, with authors like Hayek, Friedman (who is also a neoclassical in scientific economics), etc.

    2. A **political project** with its theoreticians, supporters, executors and embodiments (think tanks, lobbys, politicians and institutions)

    3. And a **historical period** and **geopolitical analysis** of the period going from the 1970-1980s to today on a planetary level (globalization)

Some remarks about (neo)liberalism

- Other social scientists refuse the term and simply employ « **liberalism** »;
- others following Polanyi talks about « **unembedded liberalism** »;
- others remain attached to the term « **capitalism** »;
- others yet refuse the term because too **simplistic and contradictory**:
  - They invite to be more precise: Hayek is an ultraliberal, libertarian or anarchocapitalist more than a neoliberal
  - (**Yes, but** at the same time we can say that his ideas have influenced, in a complex manner, the neoliberal project and the current historical period [see Chamayou]. If they refuse « neoliberalism », they should also refuse the concepts of Renaissance or Baroque?)

Second thesis

- So how does the SFI concretely work? Let me give you some examples for the institute's porosity with finance and industry:

- The first important workshop organized in 1987 by the SFI featured physicists and economists, and dealt with the tentative modeling of market chaotic patterns. **Citigroup** bank CEO **John Reed** famously funded the workshop. As a later bulletin recalled, "It's ironic that with all the physicists in the founding group, the first big money that came in was for economics. The funding came from Citibank: **$250,000** to study the global economy". **Reed was indeed keen for new mathematical models in order to predict the global finance and avoid loss from economic crises and stock exchange crashes**. Furthermore, the 1987 workshop had related projects and led to two follow-ups. Overall, some of the most recurrent questions on the bulletins are: "Why do [stock markets] crashes happen? And how can we design and regulate markets to reduce the risk of them happening in the future?"

Second thesis

- Several examples can be given of genetic algorithms and ABMs applications into industrial **production chains (Eli Lilly)** and **management organization (John Deere's)**.
- Importantly, the economic modeling tools developed in SFI's research did not remain confined within academia. For example, at the time of a meeting in 1991, a group of bankers and financiers from Salomon Brothers, Goldman Sachs and other hedge funds indeed claimed to use some of SFI's tools in their activities. Even more significantly, **in 1991 chaos physicists Doyne Farmer and Norman Packard detached from the SFI and the academia for some years in order to launch a start-up to "beat the market."** They founded the **"Prediction Company"** in Santa Fe. A year after its inception, the company was partially bought by a Chicago based derivatives trading house, which was later acquired in its turn by the Swiss Bank Corporation. In 2013 the enterprise passed into the hands of the Millennium Management hedge fund and was finally dissolved in 2018

Second thesis

- *Business Network (1992)* then *Applied Complexity Network (2015):* As a counterpart of a **25.000 dollars** annual inscription, the first five BusNet members used to **receive scientific material about the ongoing SFI's research**, as well as **the possibility to exchange with the institute's scientists**.

- By means of marketing languages, SFI proceeds to a **commodification of scientists**. Particularly, ACtioN promotional material puts forward the fact that enterprises may find interesting to **hire young scientists** from the institute. They can also **solicit researchers for educational support** or for **consulting about specific issues**. All SFI's research is published. Hence the "companies that want to get involved with [SFI] just want **early access** to the kinds of theories [it is] working on." An ex-postdoctoral resident from the institute moreover explains that "There is **no formal obligation** […] for us researchers in order to participate to ACtioN. **We are nevertheless encouraged to do it**

- The SFI rejects developmental contracts, but it is "totally open to the possibility that the researcher take a greater interest for the specific problem of a given company and go further in developing models that overcome the particular application into that company." The collaboration is described as a **win-win game** where the firm gets what it needs, while the researcher can exploit data to produce a new model and a new publication. According to the above mentioned researcher, scientists are more "counselors" than "consultants"

Conclusion

- In this sense, **SFI's complexity** can be seen as

1. A **movement** wich combines and mutually reinforce natural theories and neoliberal theories

2. An **embodiment** of the neoliberal political project where concepts of competition, innovation and creative destruction are openly theoretized as a normative model to follow

3. Also, even if its way of functioning does not invent anything fundamentally new, **the SFI reflects the historical period** in which it has appeared (1984) by combining a series of models both from American academia and business world