You Know How You Are

Some Circumstances in Which Social Behavior is Predictable (and Why)

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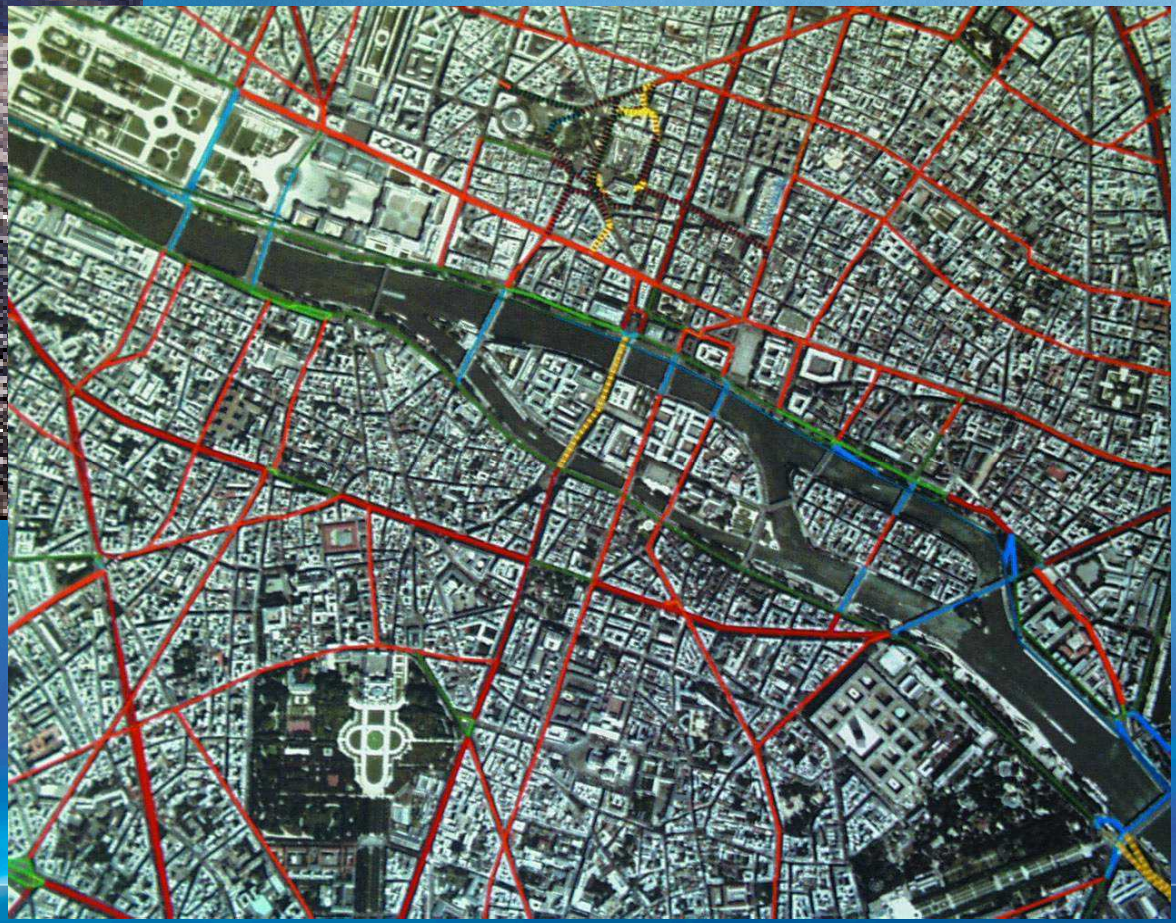
How does this…

end up like this?

Or this…

Sacramento

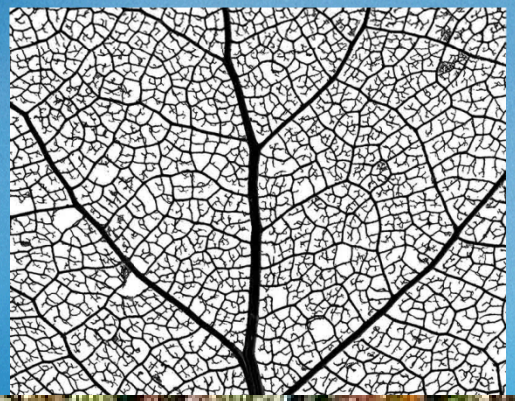
become this?



Paris

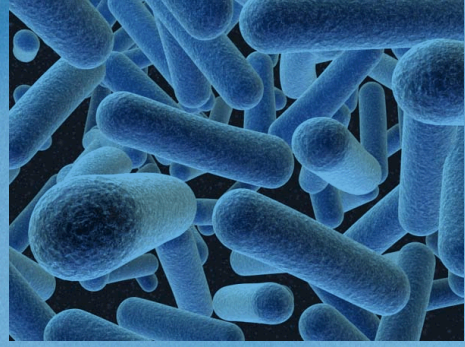
Why does this…

resemble this…

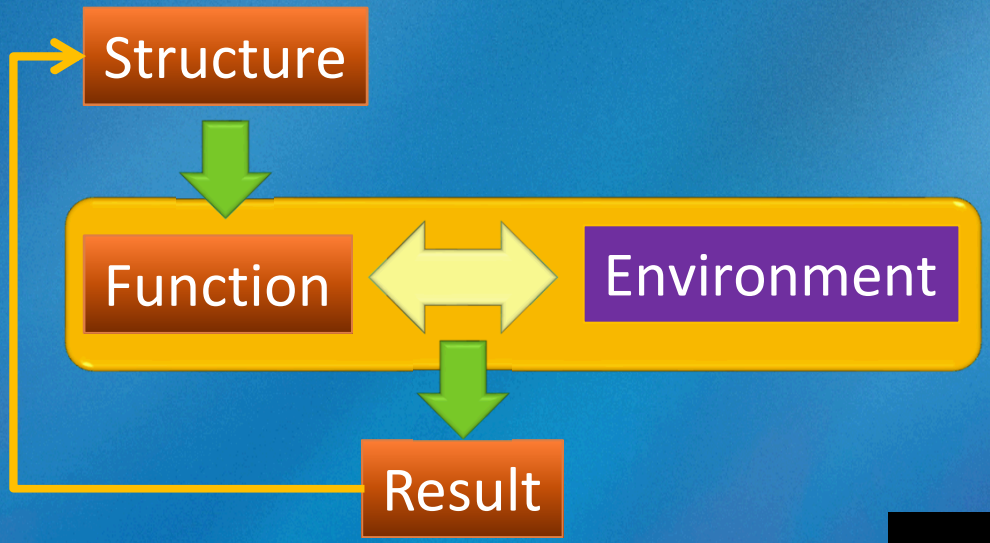


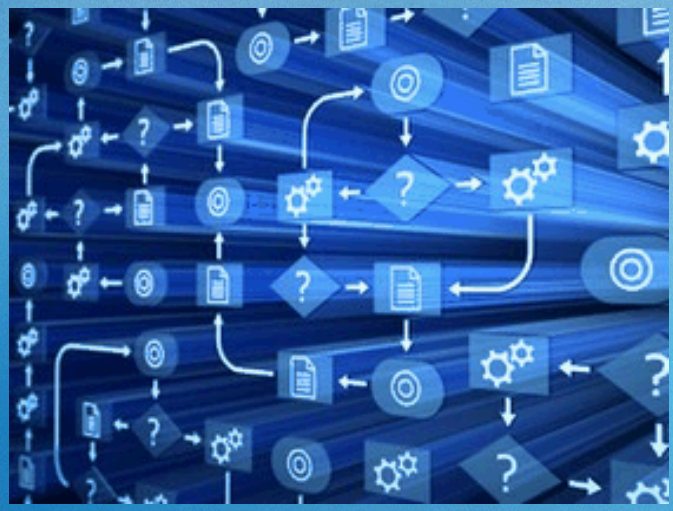
and this?

Complex Adaptive System:



A system that modifies its structure to enable success in its environment





Does not require:

- Intelligence
- Foresight
- Conscious purpose
- Irrationality or emotion
- Chaos or randomness

Where’s the line between adaptive and not?

Widen the aperture to get a CAS

Higher Goal

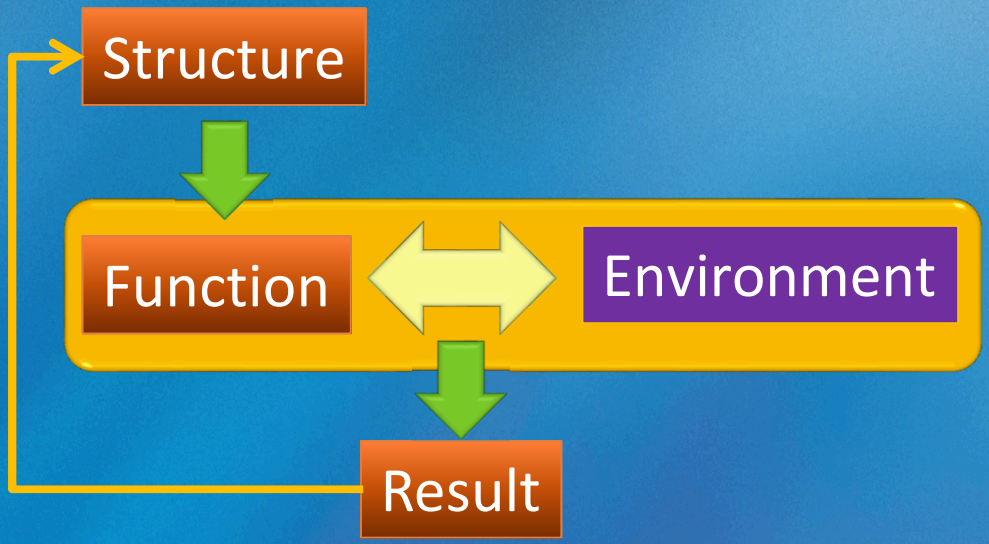
Supply Chain

Wear & Mods Thru Time

Co-Evolution

"In the wild"

How deep do the similarities among complex adaptive systems go?



Mutual adaptedness of structure, function and environment (past-present)

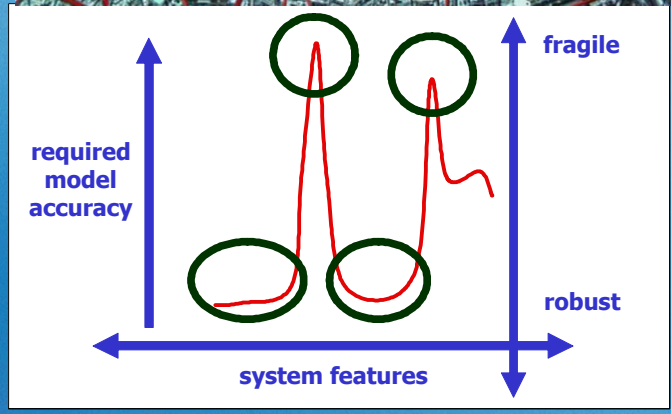
- Systems have adapted over time to perform their function in the environment
  - E.g., controlled variables reveal function

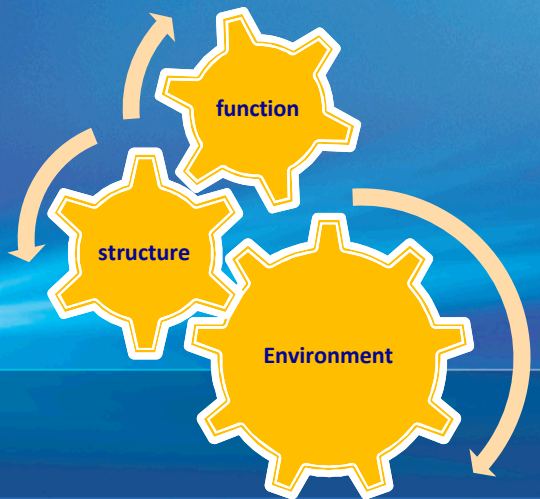
Sample exploitation of adaptedness: Robust-Yet-Fragile

Networks that evolve to improve their performance typically become *robust yet fragile* (RYF) [Carlson/Doyle 2000, 2002; Colbaugh/Glass 2003].

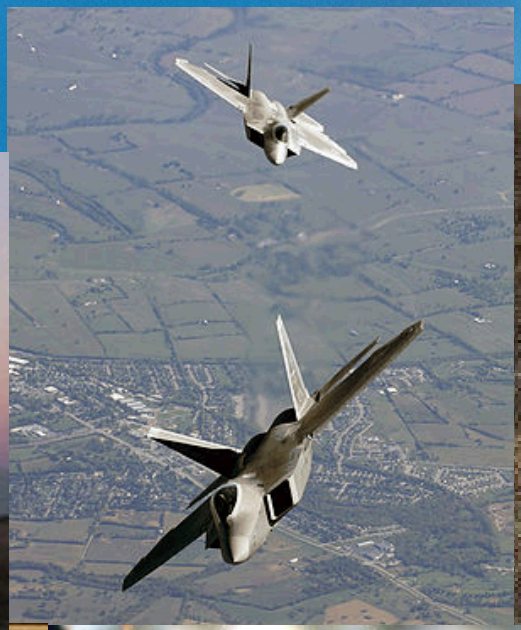
RYF has important implications:

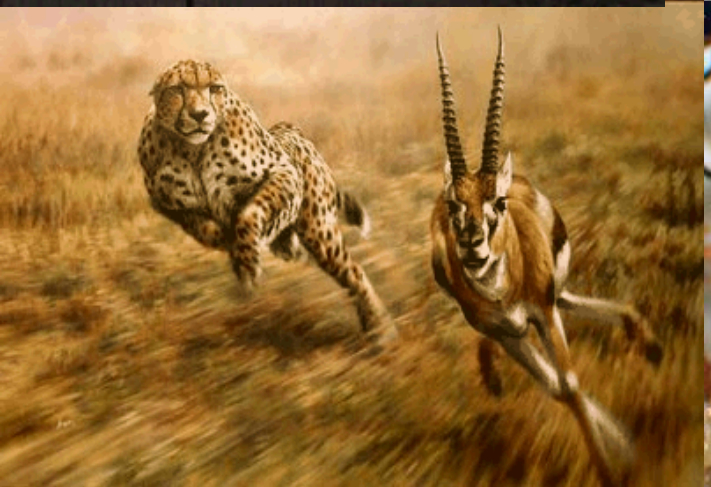
- most network features evolve to be robust, while a few become very fragile;
- details concerning robust features are unimportant/uninformative, while fragile features characterize system-level behavior and must be well-modeled.





Competition of adaptive elements





Cooptition of adaptive elements

Adding intelligent coordination and communication: Thomas Schelling

Tacit coordination

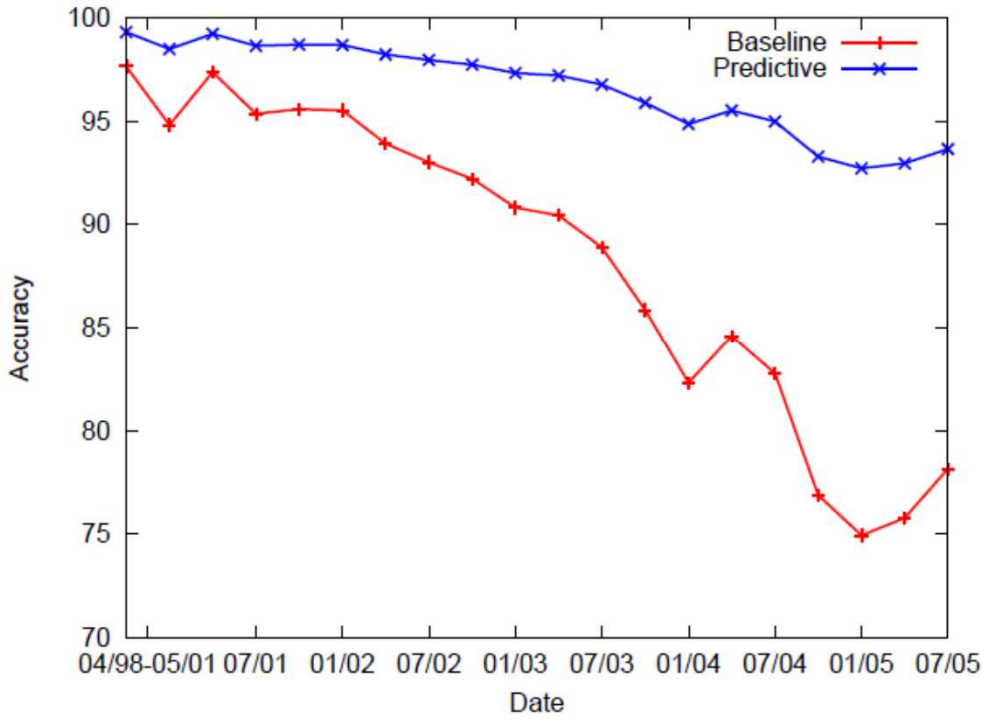
- "People *can* often concert their intentions or expectations with others if each knows that the other is trying to do the same." What is required for coordination without communication is for the two to hit upon the same obvious choice. Two parachutists who want to meet up, or a couple who get separated at the mall, must hit upon the same obvious meeting place. This could be 'lost and found' out of whimsy, or the center, or the main intersection. "
- --Strategies of Conflict, Schelling

Examples of tacit coordination

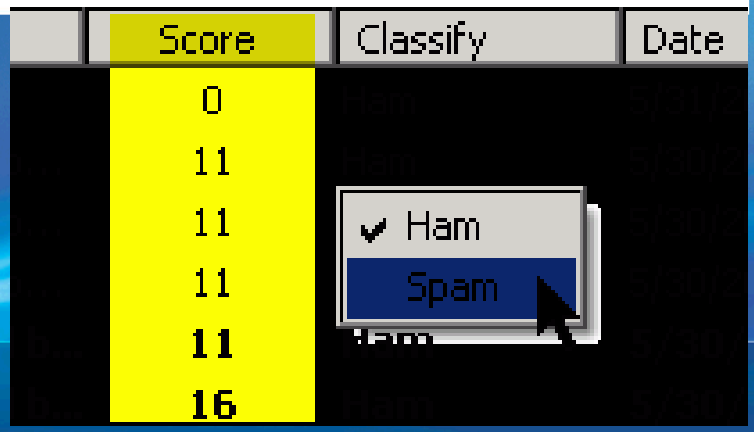
- You know the date to meet someone in NYC but can now no longer communicate. Where and when will you meet?
- Name any amount of money. If you and your partner name the same amount, you will receive it.

Sample exploitation of co-adaptation: Spam filters

Naïve Bayes spam filter decays much faster than NB filter trained to anticipate co-adaptation



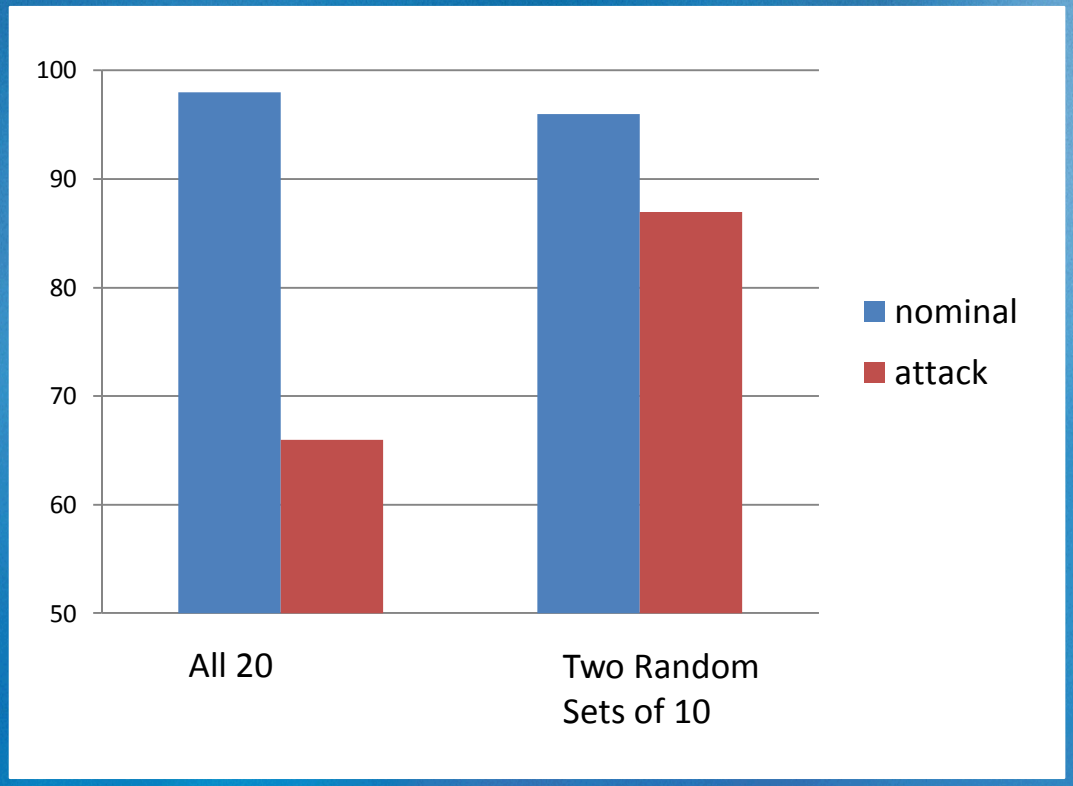
Secret Sauce: Co-adaptive dynamics are powerful and often dominate other causes.



Departures from (ir)rationality (Schelling, Strategies of Conflict)

- "…even among the emotionally unbalanced…there is often observed an intuitive appreciation of the principles of strategy…inmates of mental hospitals often seem to cultivate, deliberately or instinctively, value systems that make them less susceptible to disciplinary threats and more capable of exercising coercion themselves."
- A careless or even self-destructive attitude (I'll cut a vein in my arm if you don't…) can be a genuine strategic advantage.
- "So can a cultivated inability to hear or comprehend, or a reputation for frequent lapses of self-control that make punitive threats ineffectual as deterrents. (Again I am reminded of my children.)"
- "It is not a universal advantage in situations of conflict to be inalienably and manifestly rational in decision and motivation."

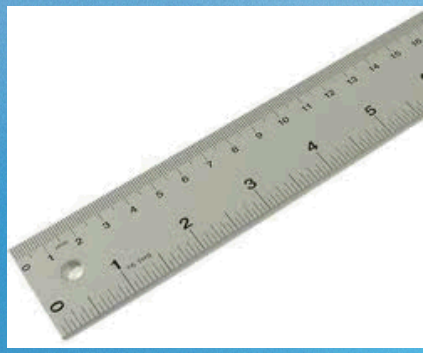
Minimizing adversary learning

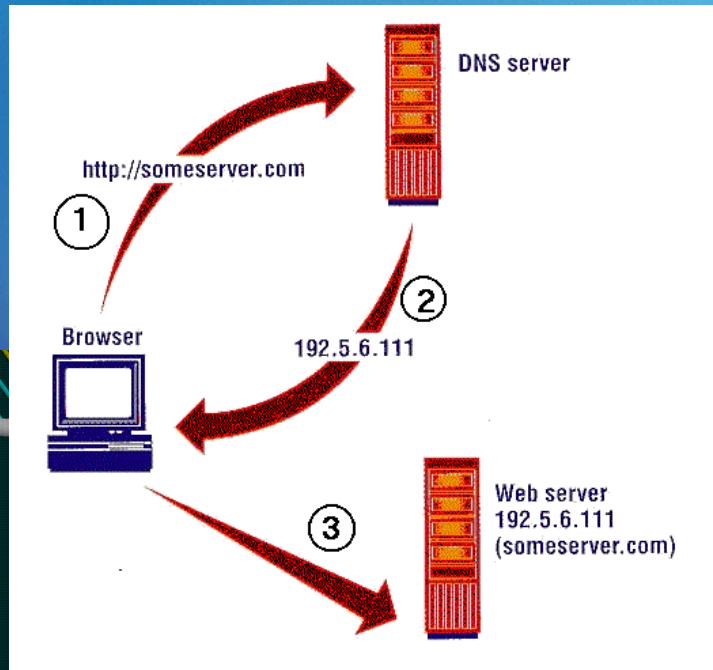


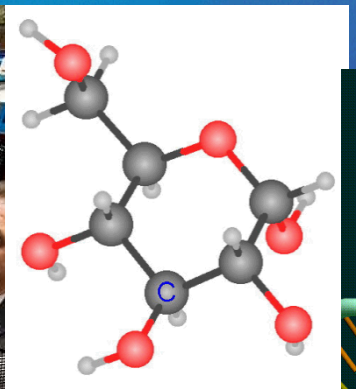
The co-evolutionary filter leveraged 20 features. An adversary could optimize against this new filter, approaching the limit of the red bar on the left. Alternatively, the co-evolutionary filter could use a random 10 of the 20 features at any given time, and switch randomly. About the best an adversary could do is optimize against the mean of this ever-changing filter, resulting in the red bar on the right.

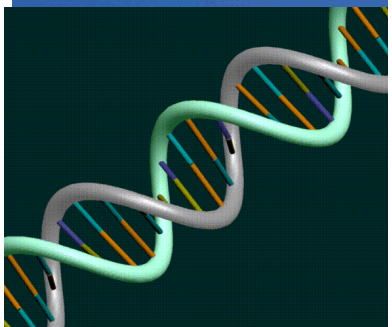
Protocols

- Protocol: A standard for the nature, path, and format of traffic and exchange.
- Protocols tend to be quite simple for efficiency and effectiveness (minimize noise and effort, maximize throughput)
- CAS form protocols so that ‘stranger’ nodes can communicate
- Protocols reveal a great deal about a CAS:
  - Traffic priorities and patterns
  - What is common and what is not
- Protocols are highly exploitable and difficult to change





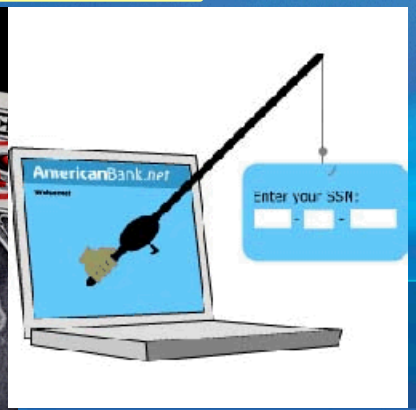




Protocols

- Ellen Langer's research (as reported by Cialdini):
  - "Excuse me, I have five pages. May I use the Xerox machine because I'm in a rush?"
  - "Excuse me, I have five pages. May I use the Xerox machine?
  - "Excuse me, I have five pages. May I use the Xerox machine because I have to make some copies?"

Secret Sauce: Protocols are simple, pervasive, and exploitable.



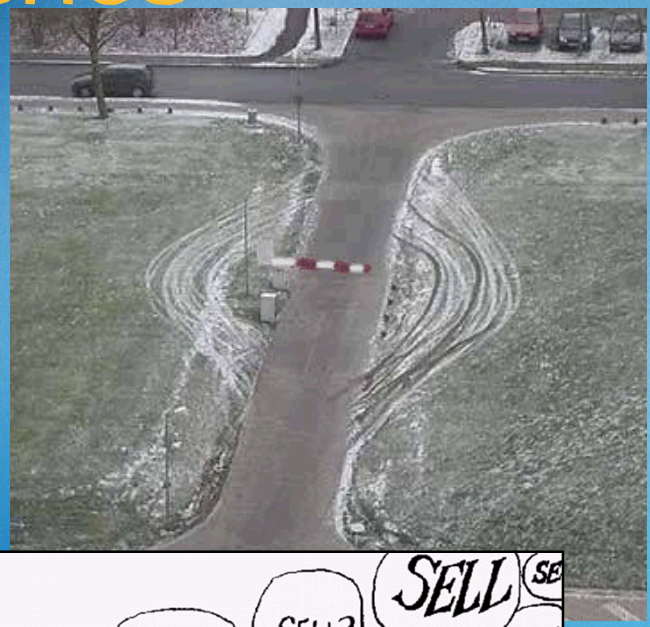
Intrinsics vs. social influence

People often pay attention to the behavior of others, for instance to

- obtain benefits of coordinated actions (fax machine example);
- infer otherwise inaccessible information (restaurant example).

In such situations, *intrinsics* (e.g., product quality in a consumer choice setting) may matter less than *social influence*.

Despite this, standard methods for predicting the behavior of social groups are based upon intrinsics.



Behavior spreads more conservatively than information

Complex contagion

- Behaviors that are controversial or costly (e.g. protest/mobilization, crime, adoption of new technology) may spread as *complex contagions,* requiring social affirmation from multiple sources to propagate [Centola 2010].
- Complex contagion dynamics may depend even more strongly (and more subtly) on social influence than simple contagions, in which case standard prediction methods would not be very useful.

Leveraging social theory

Structural balance theory

Structural balance theory (SBT) [Heider 1946] posits that edge triads in friend/foe networks will be stable if they consist of an odd number of friendly edges (one or three positive edges), and will be unstable otherwise.