
Paths Ahead @ LIDS: Networks & Information

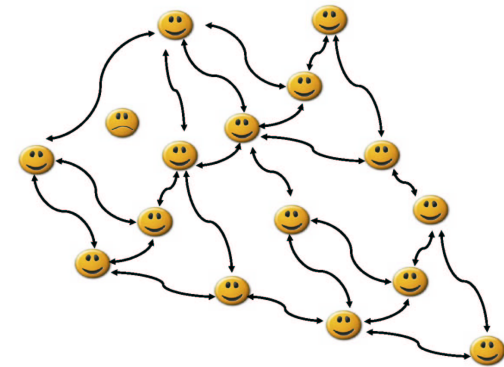
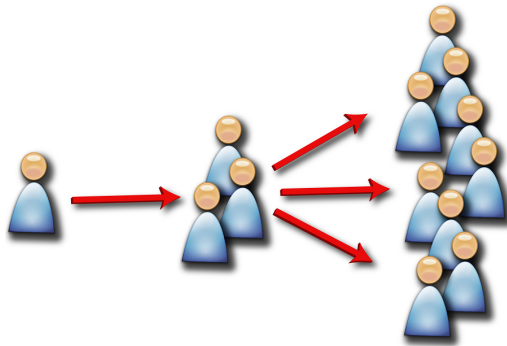
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Social network models

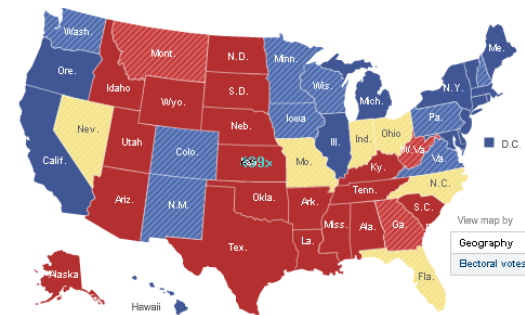
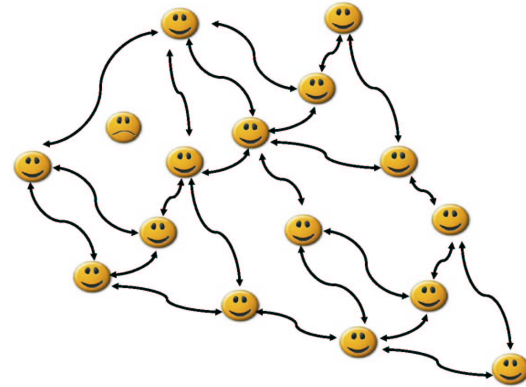
- Lots of social network models
 - Social network formation
 - Evolution of convention
 - Social learning
 - Belief diffusion
 - ...



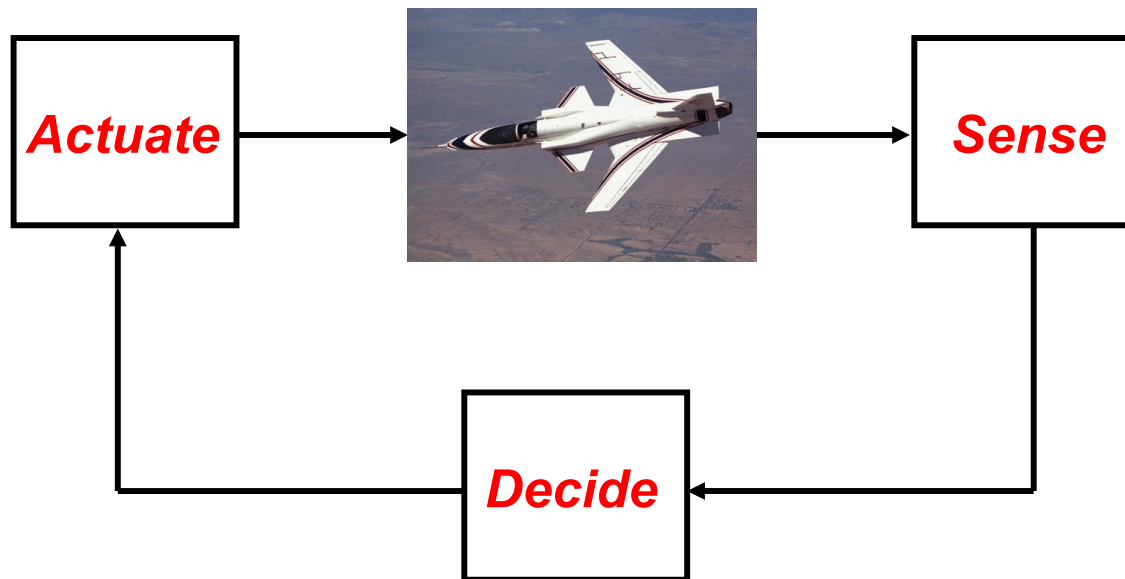
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Challenge: Influencing social networks

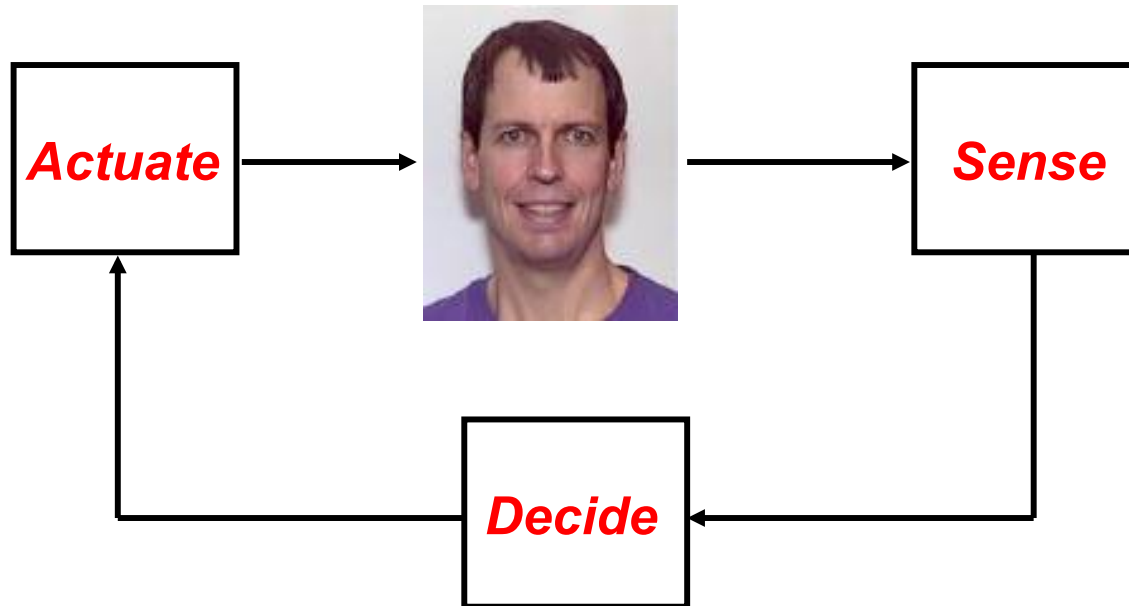
- Motivating scenarios:
 - Competing for customers
 - Influencing political mindsets & beliefs
- Example:
 - Network of customers
 - Competing firms
 - Firms spend resources on customers
 - Customers' propensity to buy product:
 - Propensity of neighbors
 - Received resources
 - Intrinsic compliance



- Benefits of feedback (Astrom):
 - Reliable behavior from unreliable components
 - Mitigate disturbances & component variations
 - Stabilize & shape dynamic behavior



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- Model:

$$\text{Propensities}^+ = F(\text{Propensities}, \text{Neighbors}, \text{Resources}, \text{Intrinsic})$$

- Control problem:

How should a firm expend limited resources over time to maximize network propensity?

- Game problem:

In presence of competing firm?

Contrasts & issues

- ***Repeatable first principles:***
 - When I press accelerator, then ... ?
 - When I curb rioting through deployment of military force, then ... ?
- ***Hidden states/beliefs of beliefs:***
 - System dynamics depends on beliefs about controller
- Model uncertainty:
 - Network structure? Agent compliance? Influence measure? Hidden dynamics?
- Sensing:
 - Measured quantities are not physical variables. What can we measure?
 - Aggregate vs individual?
- Actuation:
 - What measures are available to exert influence?
 - How will this affect dynamics?
- Time constants:
 - What is the time frame for influence to evolve?

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Model uncertainty:

“Thus unless we know quite a lot about the topology of interaction and the agents’ decision-making processes, estimates of the speed of adjustment could be off by many orders of magnitude.”

H.P. Young, **“Social Dynamics: Theory and Applications”**
& Individual Strategy and Social Structure

Existing work & limitations

- Parsimony:
 - Models tailored towards analytical tractability
 - ***Deliberate*** limitation on degrees of freedom to gain insights
- Asymptotic:
 - Models typically characterize long term emergent behavior
 - Lacking “real time” analysis
- Nash equilibrium:
 - ***Can place unreasonable demands on rationality***
- Disequilibrium:
 - Evolving and unfamiliar landscape limits applicability of equilibrium concepts

Sequential decision making in dynamic & uncertain environments

- Challenges **underscore** relevance of feedback control
 - Reliable behavior from unreliable components
 - Mitigating disturbances & component variations
 - Stabilize & shape dynamic behavior

