

Behavioral Game Theory

with Application to Networks of Corruption

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What is game theory?





Only with
two or more
players does
a problem
becomes
game
theoretical!

“If it’s true that we are here to help
others, then what exactly are the
others here for? ”

- George Carlin

Framework

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- **Do incentives matter?**

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- **Strategic interaction:** behavior of one person depends on that what person expects others to do
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- **Do incentives matter?**
- **Goal:** Gain insight into how incentives affect the way people behave!

Game Theory

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- Mathematically capture multi-person behavior/decision problems

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Basic assumptions:

1. decision-makers are rational

i. consistent preferences

ii. e.g., maximize utility

2. take into account their knowledge or expectations of other decision-makers behavior

Why study game theory?

Games We Play

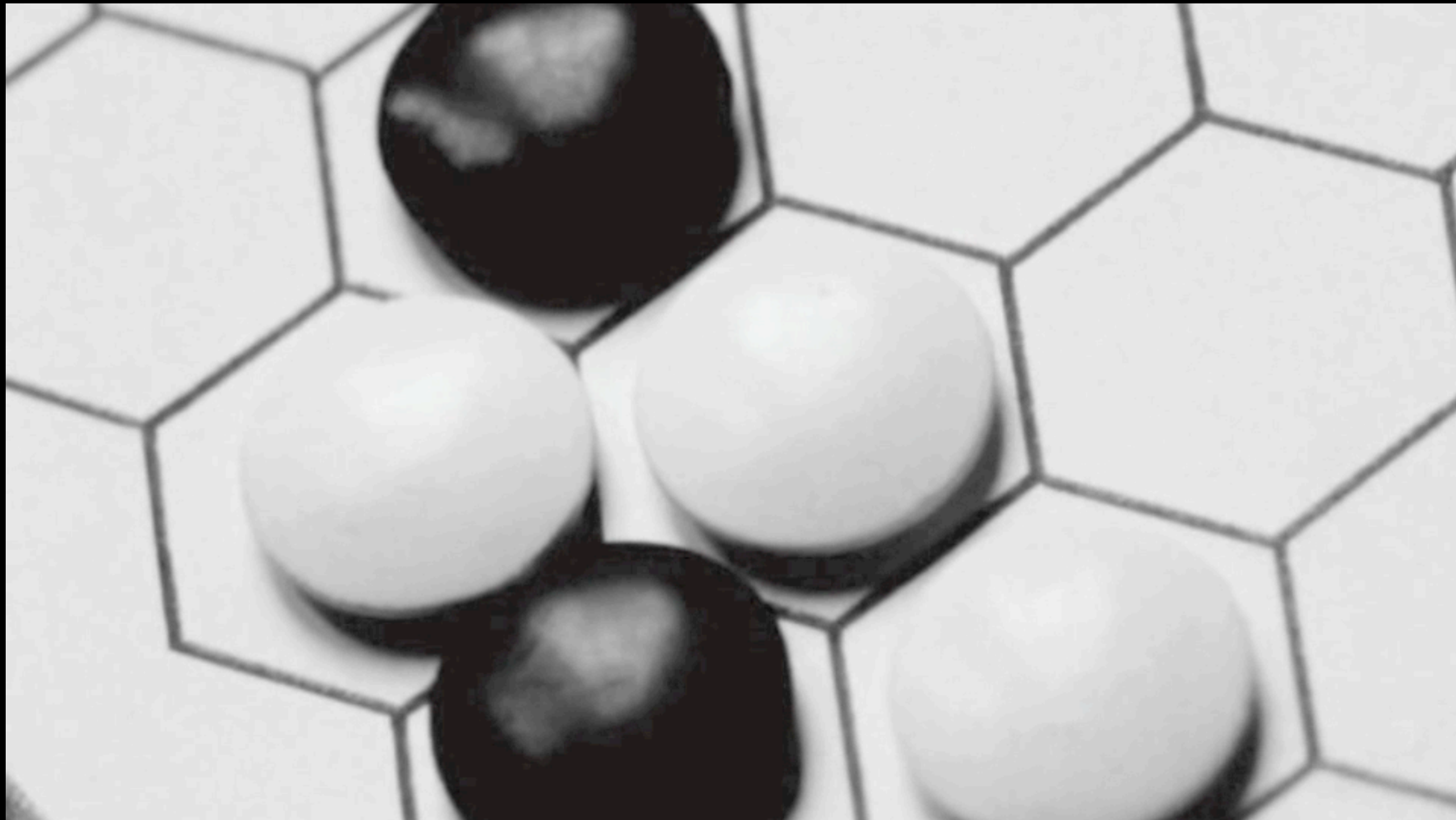
- Group projects - free-riding, reputation
- Flat tire - coordination
- Mean professors - commitment
- Poker - credibility
- Dating - information manipulation
- Market entry - commitment
- Patent races - game of chicken
- Stock options - compensation schemes

“Game theory can explain
why oligopolies tend to be unprofitable,
the cycle of over capacity and overbuilding,
and the tendency to execute real options
earlier than optimal.”

Tom Copeland
Director of Corporate Finance
McKinsey

“Game theory forces you to see a business situation over many periods from two perspectives: yours and your competitor’s.”

Judy Lewent
CFO, Merck



His ideas apply to poker and world trade.

Princeton mathematician wins a Nobel in economics

By Anthony Gnoffo Jr.
INQUIRER STAFF WRITER

PRINCETON — A couple is negotiating over vacation plans. He wants Alaska. She wants Europe. He appeals to her sense of adventure, then to her love of the

Princeton mathematician at Princeton University, yesterday won a share of the Nobel Memorial Prize in economics.

It was a long time coming: Nash first proposed the theory in a 23-page doctoral thesis at Princeton in 1950. He was 22

Understanding incentives matters...

- Provides **quantitative tools** to understand issues that arise when decision makers interact
 - The value of information
 - Rational and optimal strategies
- Questions often arise in applications in **business, economics, sociology and engineering**
 - Solution concepts
 - Large socio-technological systems (internet)

Examples

- Do bicycle helmets cause less injuries?
- Should airplanes require children to be in their own seats?
- Why shut down a plant operating at capacity?
- Why cannibalize your own sales?
- Why offer price guarantees to consumers?

From Intuition to Prediction

- If you have had some experience of playing similar games, you have probably intuited good strategies for them (value of quantification?)
- Not all lessons of game theory are obvious.
- General principles extend the intuitions across many related situations
- Unify and systematize such intuitions !? Unification of behavioral sciences?

Why call it a game?

Game theory models

- Step back!
- Throw out what is irrelevant to the problem
- Define a model that captures the essence
- Reduce the elements of social and economic interactions to forms that resemble parlor games
- Family of games

What is a solution?

Solution to a game

- Systematic description of the outcomes that may emerge in a family of games
- **Good news:** Framework for thinking about strategic interaction
- **Bad news:** Knowing game theory does not guarantee winning

Disclaimers

- Do not assume that your opponents' behavior is fixed
- Predict their reaction to your behavior! Who is your opponent?
- A theory provides a way to organize our thinking
- Game theory is the science of behavior, not the art
- Define concepts precisely + verify consistency of conceptual models

Types of games

- Zero-sum and non-zero-sum
- Simultaneous and sequential
- Cooperative
- Non-cooperative
- Symmetric and asymmetric (information)

General forms of modeling games

- Strategic (normal)
 - each player chooses his plan of action once and for all
 - all players' decisions are made simultaneously
- Extensive
 - dynamic model, possible orders of events
- Perfect information
 - fully informed about each others' moves
- Imperfect information
 - more realistic but less mature

Focus

What this class is about...

- Behavioral Game Theory and Mechanism Design
- Complex Networks (400CIS011) - Decentralized MD
 - Games over Networks (dynamics)
(ubiquitous in modern society, social life is organized around networks)
 - Effects of network structure
(determine our information, influence our opinions, and shape attitudes)
- Tool for research
 - Theoretical foundations, mathematical tools, modeling, equilibrium notions
- Computational social sciences
 - Corruption (incentives and policy design)

Games on networks

- Substrate for dynamics -

Premise

- Basic properties can be observed on a large scale (only recently)
- Interaction leads to complex collective behavior
- Democratization of technology

Availability of data

- News
- Online communities
- Online communication
- Social media (blogging)
- Online worlds



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Web 2.0 - massive network data
(user interaction,
user generated content)



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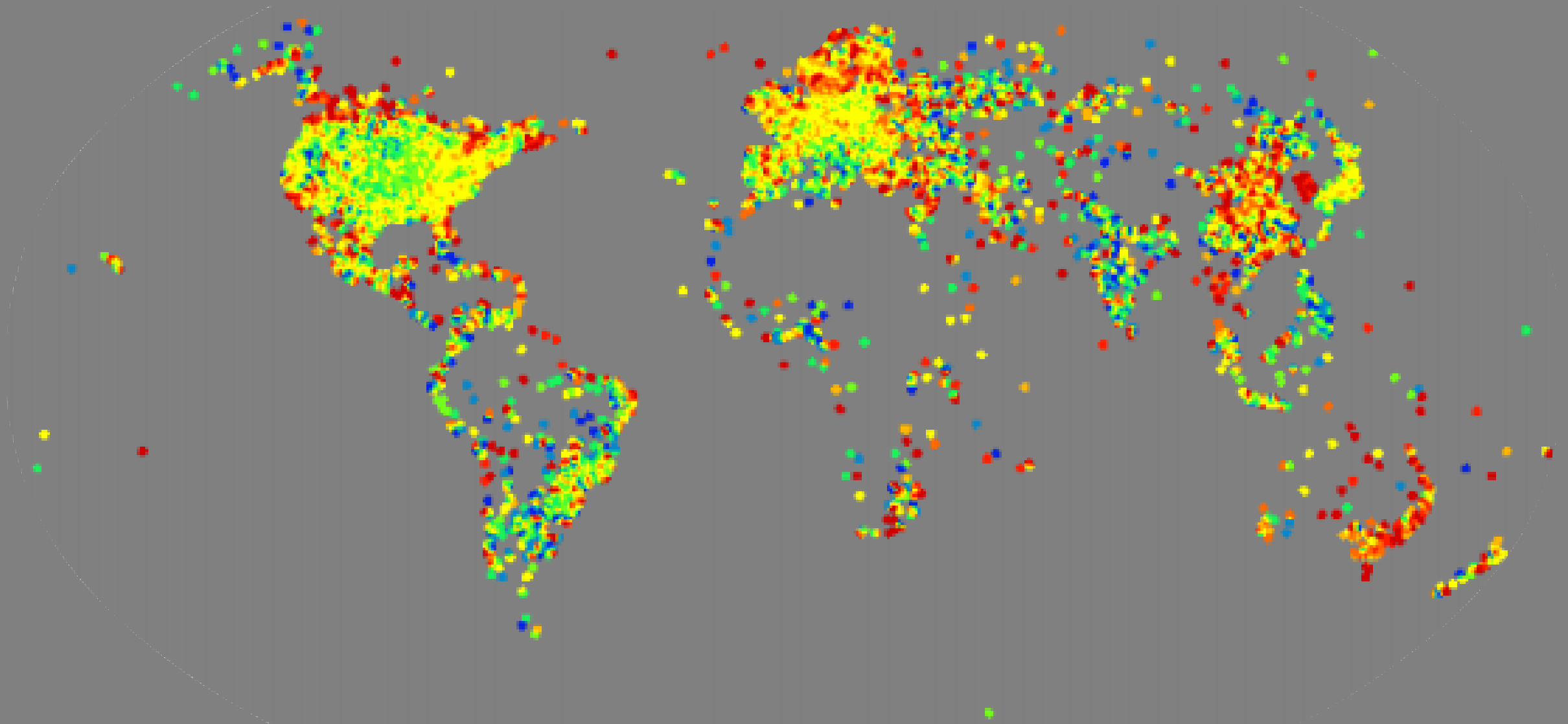
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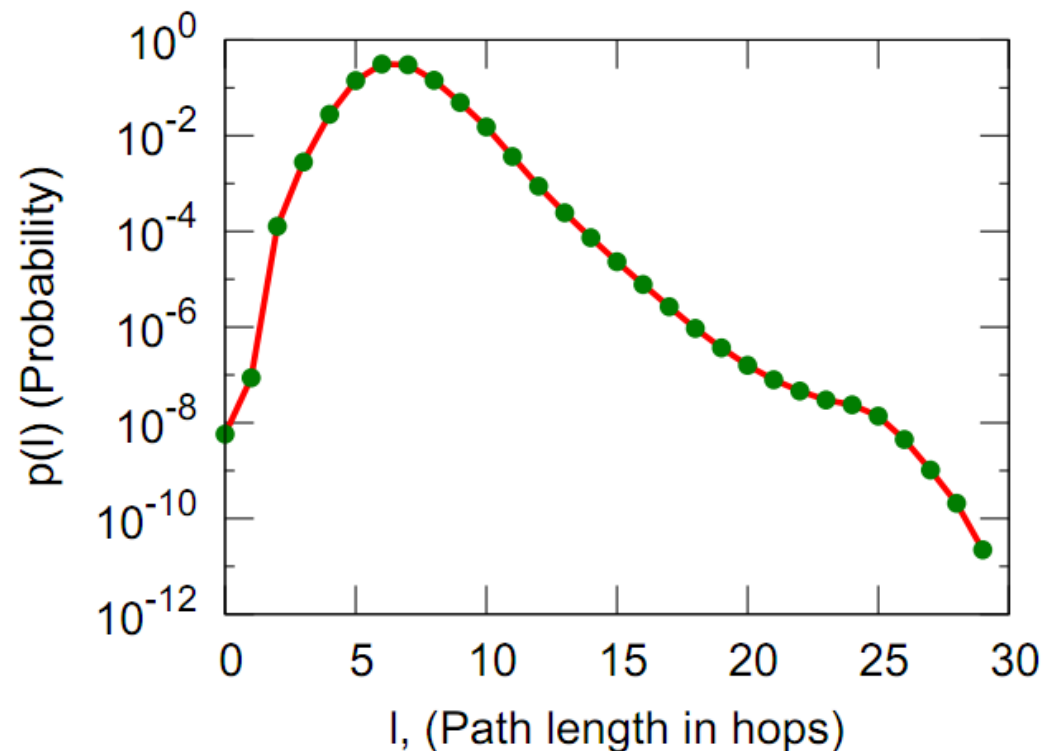
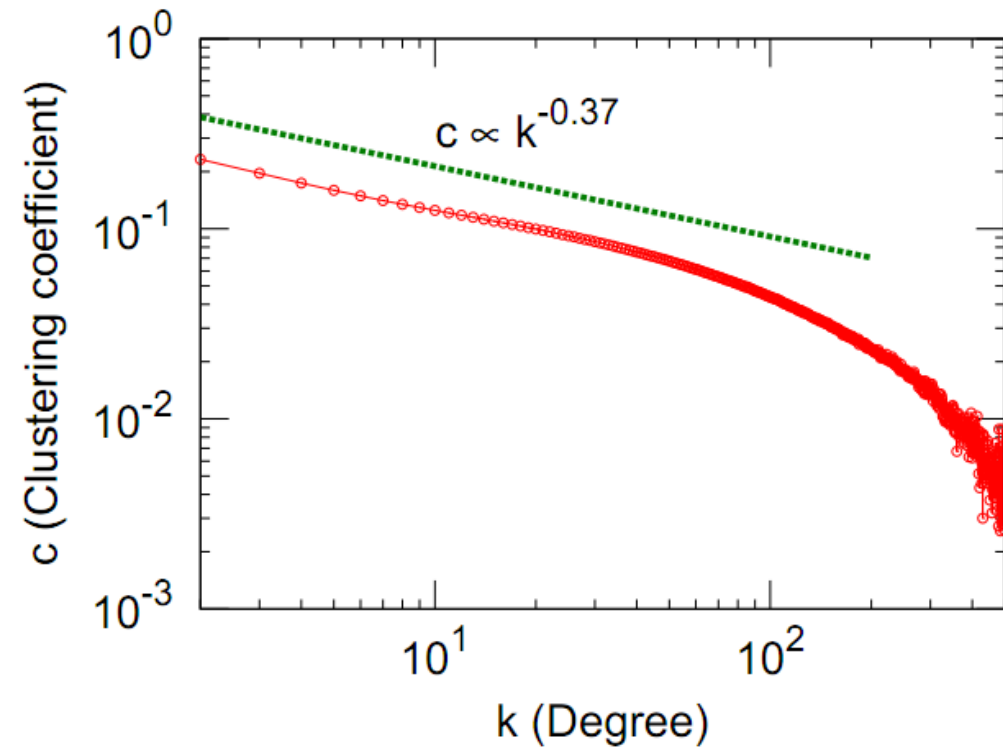
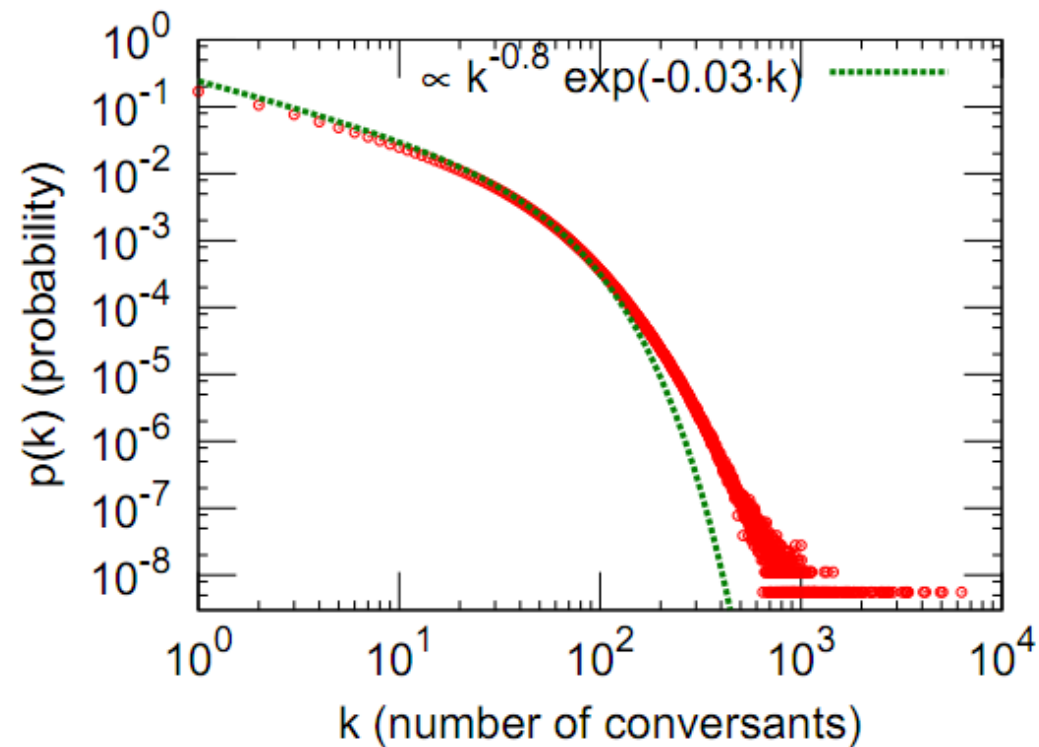


Do patterns emerge?
Can we detect them?

Instant-Messaging



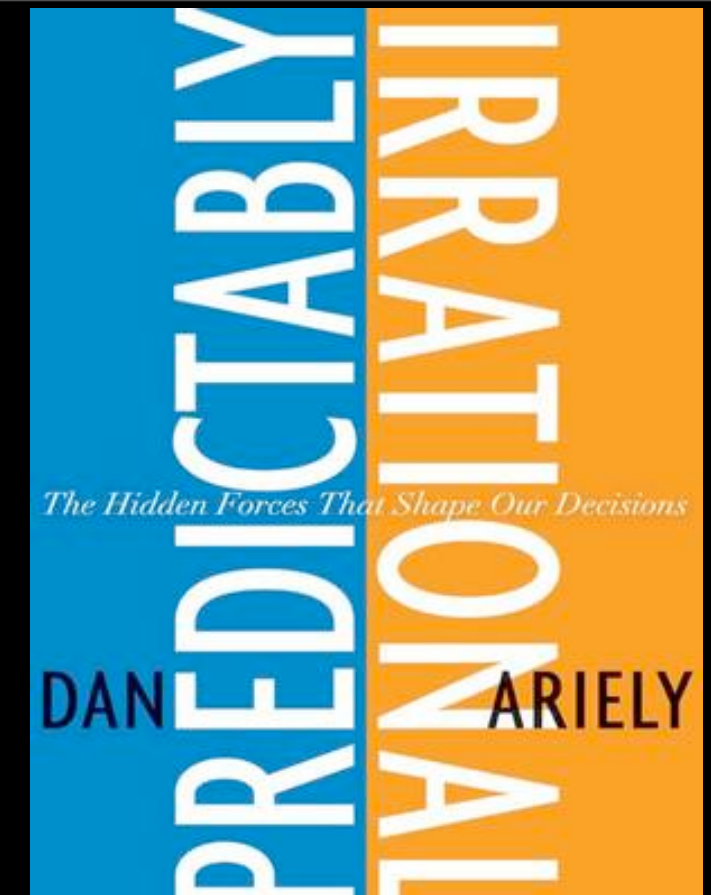
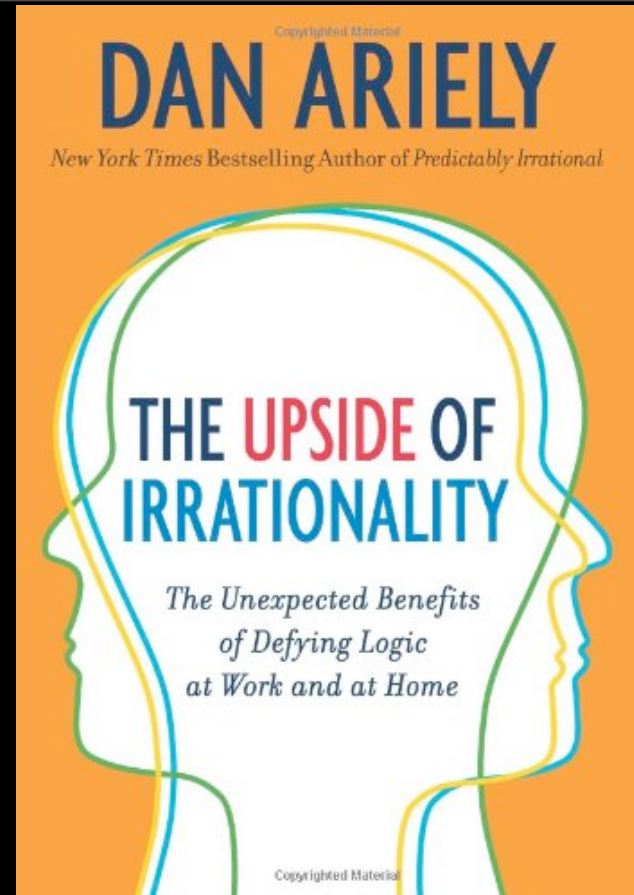
Instant-Messaging



Confirms social
science intuitions?

Behavioral game theory

- Experimental work in game theory -



About this talk

[Open interactive transcript »](#)

Behavioral economist Dan Ariely, the author of Predictably Irrational, uses classic visual illusions and his own counterintuitive (and sometimes shocking) research findings to show how we're not as rational as we think when we make decisions.

About Dan Ariely

It's become increasingly obvious that the dismal science of economics is not as firmly grounded in actual behavior as was once supposed. In "Predictably Irrational," Dan Ariely tells us why. [Full bio and more links](#) 

TED PARTNERSERIES

Presents



EG 2008 CONFERENCE

People frequently do not behave as to maximize their welfare. Understanding the bounds of reason may have a major impact on philosophy, statistics, political science, law and medicine.

Bounded cognitive abilities

- **Judgement:** systemic departures from unbiased forecasts.
 - People tend to conclude that the probability of an event is greater if they recently witnessed an occurrence of that event than if they have not
 - Shortcuts and rules of thumb are predictable
- **Decision-making:** violations of the axioms of expected utility theory.
 - Prospect theory
 - When valuing outcomes

Bounded willpower

- “Weakness of will”
- Immediate v. long-term: impulsive actions **they know** to be in conflict with goals
- **Systemic tendency** to discount near future
- Time-consistent behavior?

Bounded self-interest

- People care about others
- Bounded self-interest does not question the idea of utility maximization but rather the common assumptions about what it entails.
- People are nicer - when treated fairly - and more spiteful - when not - than the agents postulated by neoclassical theory.

Bounds of reason important in modeling human behavior

Just as game theory
without broader social theory is merely
technical bravado, so social theory
without game theory is a handicapped
enterprise.

Herbert Gintis
Bounds of reason (2009)

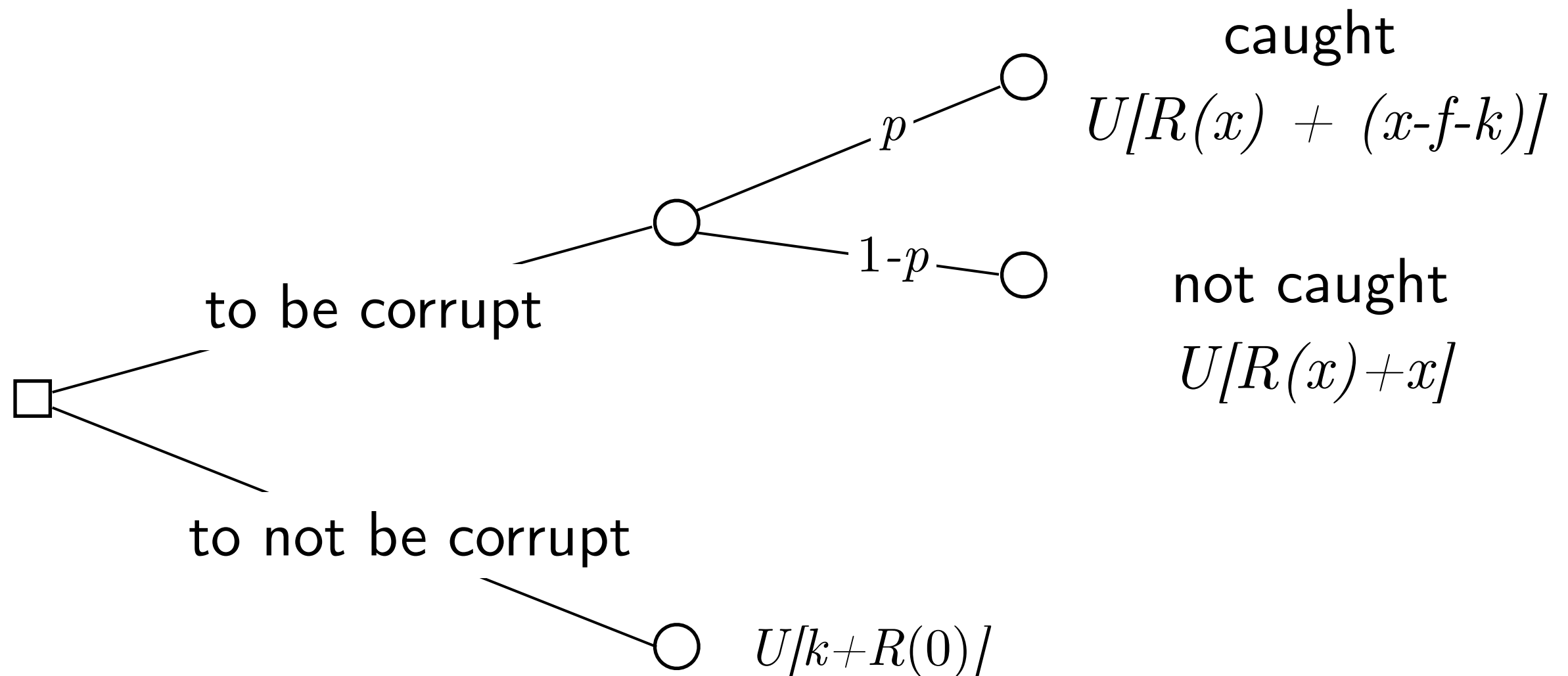
Corruption

- Incentives and anti-corruption policies -

Principal-agent-client model

- Economic approach to corruption
- Agent has two choices: to be corrupt or not to be corrupt
- Agent engages in illicit behavior when the benefits to him outweigh the costs
- A simple decision tree for a potential corrupt agent

Agent's decision tree



Expected utility function of an agent being corrupt:

$$EU = U[R(x) + p(x-f-k) + (1-p)x]$$

Corruption and Game Theory

- Paul J. Beck and Michael W. Maher (1986), “A Comparison of Bribery and Bidding in Thin Markets”
- Olivier Cadot (1987), “Corruption as a Gamble”
- Leonard Kleinrock (1967), “Optimum Bribing for Queue Position”
- Da-Hsiang Donald Lien (1986), “A Note on Competitive Bribery Games”
- Da-Hsiang Donald Lien (1987), “Asymmetric Information in Competitive Bribery Games”
- Jean Tirole (1996), “A Theory of Collective Reputations (With Applications to the Persistence of Corruption and to Firm Quality)”
- Abigail Barr and Danila Serra (2011), “Corruption and culture: An experimental analysis”
- Nina Mazar and Dan Ariely (2006), “Dishonesty in Everyday Life and Its Policy Implications”

Goal

- Way of thinking about corruption/legal rules
- Use formal tools of game theory in analysis
- Take advantage of these tools in studying specific problems
- Show how a rigorous focus on strategic behavior and game theory advances our understanding of corruption

Summary - Defining a game

- Strategic thinking
 - Who are the players (decision makers)?
 - What strategies are available (feasible)?
 - What are the payoffs (objectives)?
- Rules of the game
 - What is the time-frame for decisions?
 - What is the nature of the conflict?
 - What is the nature of interaction?
 - What information is available?
- Framework to understand human behavior/**deviations**

Grading

- Homework 20%
 - 4 homework sets
- Project 1 (paper review) 40%
 - choosing a topic of your interest
 - picking 2-3 papers in the area
 - understand, evaluate, extend research
 - project report + presentation
- Project 2 (experiment) 40%
 - game-theoretic framework
 - contrast with actual data
 - project report + presentation

Schedule (tentative)

- Introduction (week 1)
- Decision Theory and Human Behavior (week 2)
- Basic concepts (weeks 3-4)
- Repeated games (week 5)
- Mixed strategies (week 6)
- Project 1 (week 7)
- Bayesian rationality (week 9)
- Mechanism design (week 10-11)
- Epistemic game theory (week 12)
- Society as a complex adaptive system (week 13-14)
- Project 2 (week 15)

References

- Herbert Gintis. The Bounds of Reason: Game Theory and the Unification of the Behavioral Sciences (Princeton University Press, 2009)
- Herbert Gintis. Game Theory Evolving: Second Edition (Princeton University Press, 2009)
- Drew Fudenberg. Game Theory (MIT Press, 1991)
- Martin J. Osborne. An Introduction to Game Theory (Oxford University Press, 2009)

Next class

- Beliefs, preferences, and constraints
 - Binary relation
 - Preference ordering
 - Consistency
- Utility functions