Game Theory
for
Strategic Advantage

15.025

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Class 1 Game Plan

1) Introductions

2) Why study game theory?

3) Overview of the course

4) Examples of games

Game Theory is …

… the science of strategic interaction:

- the best course of action for each player depends on what other players do.

- Interdependence on:
  - opponents' decisions
  - their expectations about each other's behavior.

- Requires **allocentric** thinking

Game Theory: over Time

1930s A branch of applied math

1940s An asset during WWII *(zero-sum games)*

1950s A lens through which to look at the Cold War *(deterrence)*

1960s "Imported" into the social sciences: politics, international relations *(threats & bargaining)*

1970s Evolutionary biology *(stable strategies)*

1990s Management *(bidding in auctions)*

2000s Market and auction design (*FCC, Google*)

2010s Networks & communication protocols

Game Theory: Today

Applied to numerous settings:

- oligopoly
- politics
- organizations
- networks
- communities

… and all relationships

Why Study Game Theory?

Because **managers** tell us to…

"This fundamental redefinition of our business would not have been possible without a game-theoretic approach to business strategy"

Raymond W. Smith (Bell Atlantic), Sep. 1996

"The idea that your best move depends on what your competitors are doing – and on how you can influence their actions – is seldom taken into consideration"

Rory Sutherland (Ogilvy & Mather), Dec. 2013

Why Study Game Theory?

Because **Sloan alumni** tell us to…

"My application of game theory was extremely elementary, but the effect was profound, you would be most proud!"

Former 15.010 student

Game theory is much more like the real world: the correct answer is "it depends," and the theory helps you understand "on what?"

Former 15.025 student

"I-banking turned out to be more about game theory than about pure math. There are so many games happening behind the scenes!"

Current 15.025 TA

Game Theory for Strategic Advantage

- Game theory (and microeconomics more generally) should be valuable for managers.

A **theory** must be:

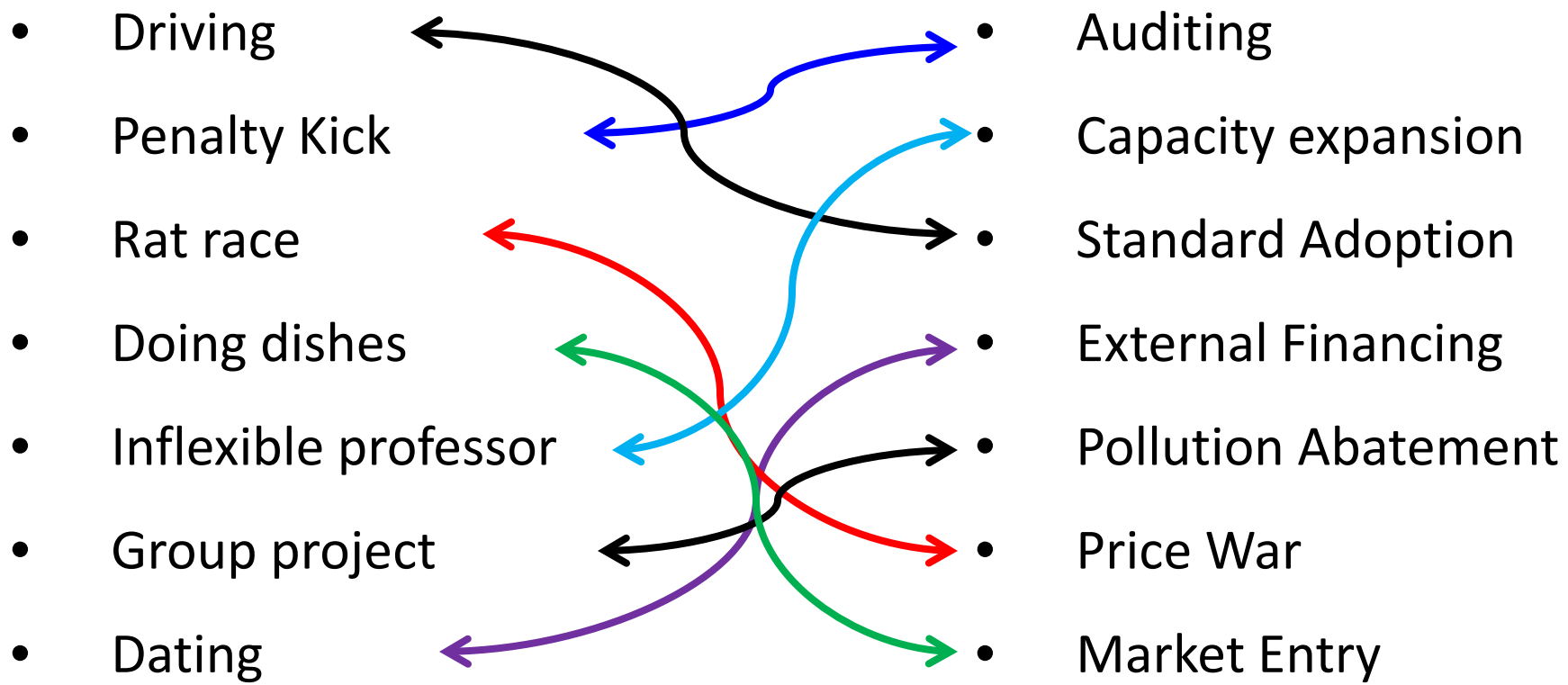
1. Rigorous
2. Relevant
3. Useful

Game Theory: Rigorous

- Consistent, formal analysis
- Applicable beyond the original motivation
- Cases → Theory → Case → Categorization → Action
- Frequent reality checks: when does the theory work? When does it not? Why does it not?

need context

Game Theory: Relevant



Games We Play

• Driving	coordination
• Penalty Kicks	hunter & hunted
• Rat race	prisoners' dilemma
• Doing dishes	war of attrition
• Inflexible professor	commitment
• Group projects	free-riding
• Dating	hidden information

Games Businesses Play

• Standard adoption	coordination
• Auditing	hunter & hunted
• Price war	prisoners' dilemma
• Market entry	war of attrition
• Capacity expansion	commitment
• Pollution abatement	free-riding
• External financing	hidden information

Game Theory: Useful for …

- Allocentric reasoning to guide strategy-setting
- Quantitative assessment of optimal behavior
- Disciplined thinking even in the absence of a well-structured game

- **No quick answers** (*if everyone can do it, you can't make money on it*), few numerical answers, **but…**

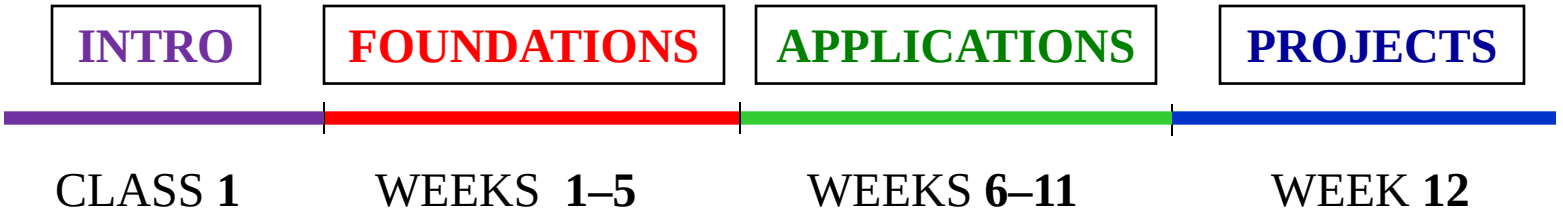
*"At Bell Atlantic, we have found that the lessons of game theory give us a **wider view of our business situation** […] that would have been **unheard of** in a traditional planning environment."*

The Approach

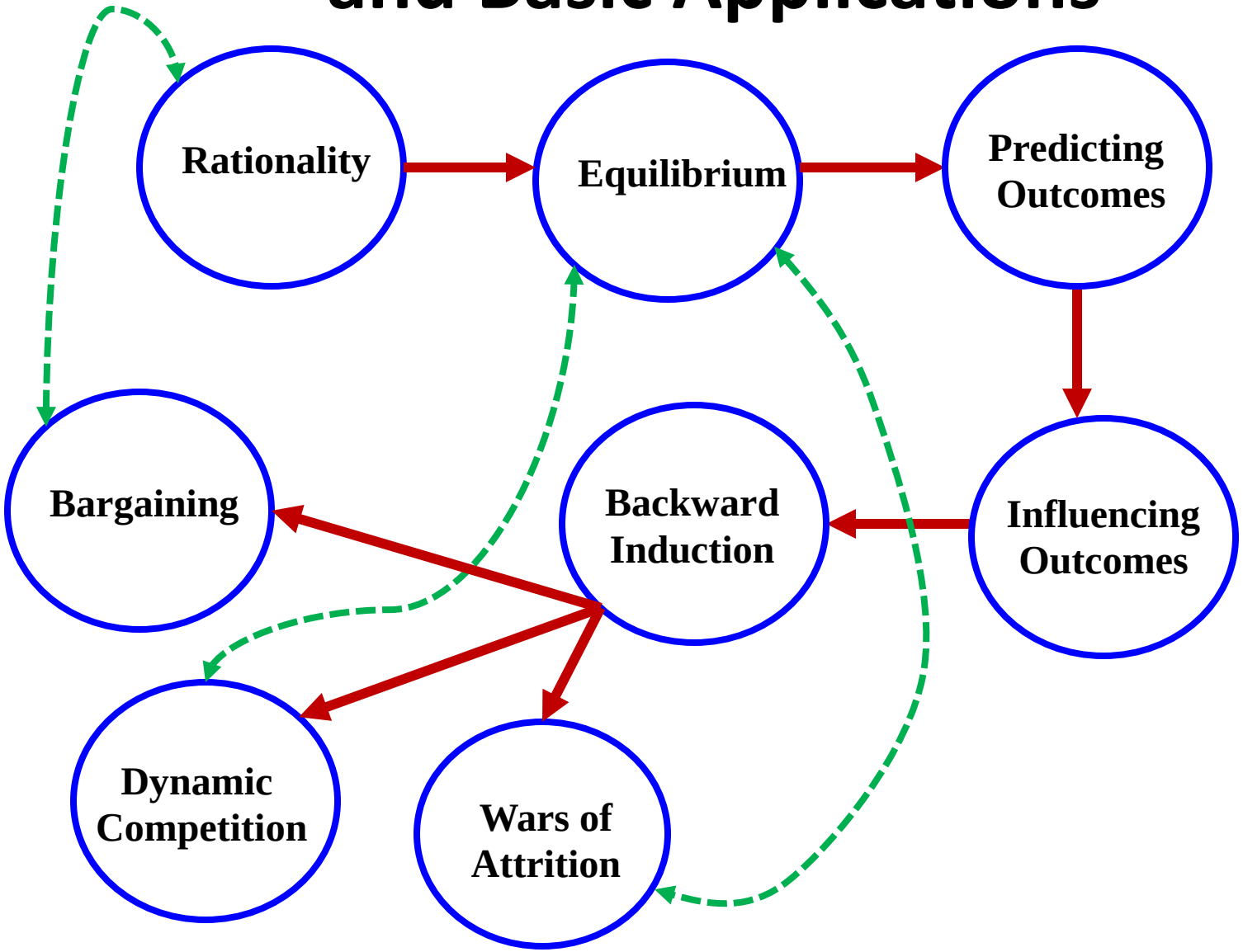
- Learn some tools ➔ Put them to work
  - first ⅓: more investment in **tools**
  - second ⅔: enrich the theory ➔ "big" **applications**.

- **Flexibility!!** My goal is not to show you how much game theory *I know*, but to deliver:
  - key strategic insights
  - business applications

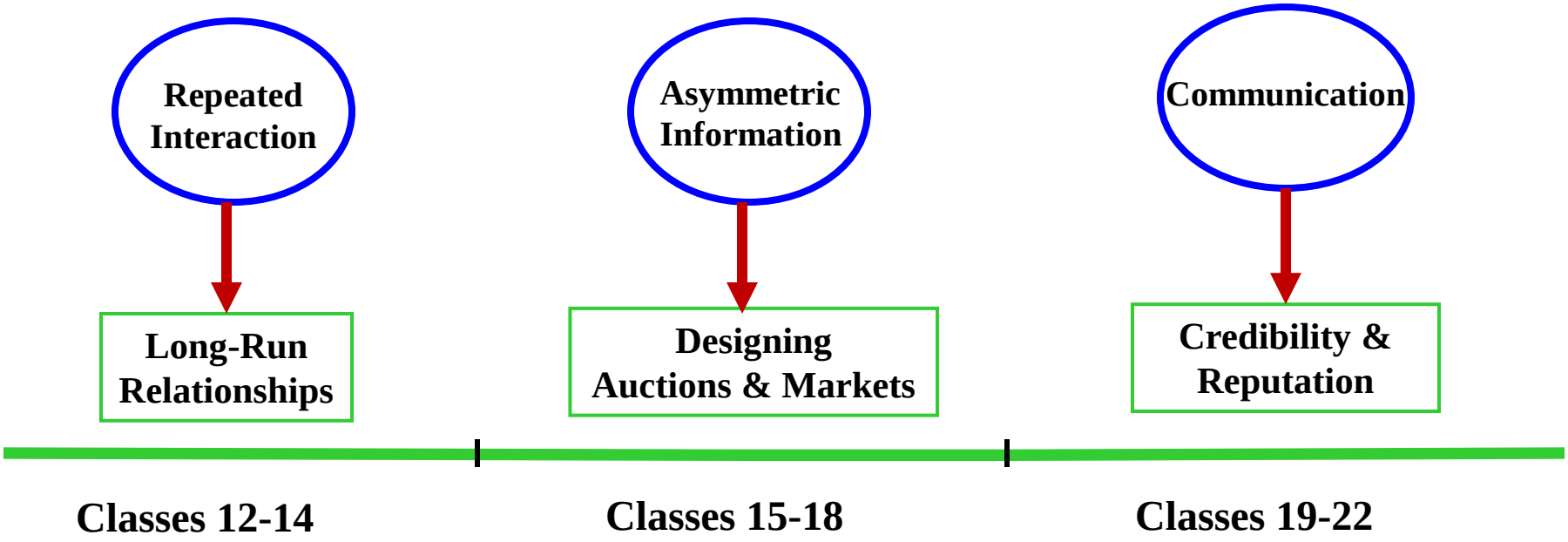
Outline of the Course



Part II: Foundations and Basic Applications



Part III: "Big" Applications



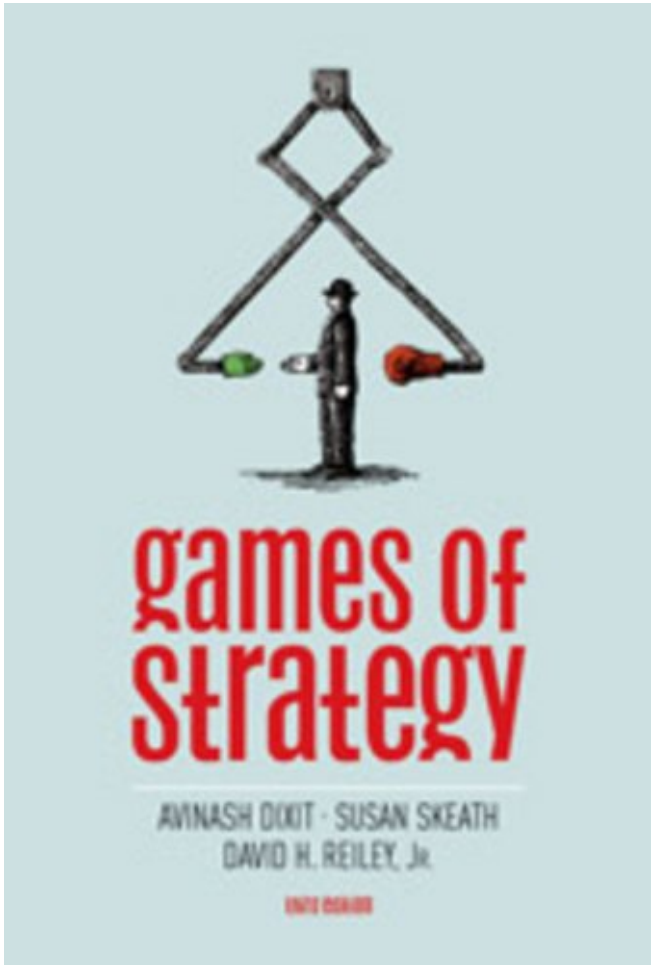
Part IV: Projects

Team Project Presentations

Classes 23-24

(At least) some of you!

Reference


games of strategy
AVINASH DIXIT · SUSAN SKEATH
DAVID H. REILEY, Jr.

The Main Deliverable

- **Team Project**
  - Describe problem that is (or could be) real
  - Give strategic advice to one or more players
  - Memo to client (3-8pp)
  - Appendix to game theorist (2-5pp)
- **Key Dates**
  - February 24: team formation (**3-5** person teams)
  - March 6: projects brainstorming day
  - **March 12:** project proposals due and **in-class presentation** of proposals
  - **May 14:** final project due
- Examples of past projects & proposals available

Grading

- Preparation & participation in class & games 30%
- Problem sets 20%
- Final project 50%

- Most games in class (google docs: laptop or phone)
- A few games require preparation before class
- Why problem sets? (1st due on Tue 2/24)

Key Elements of a Game

- **Players**: Who is interacting?
- **Strategies**: What are their possible choices?
- **Payoffs**: What do they care about?

- **Information**: What do they know?
- **Rationality**: How do they think?

- How to represent a game?

"MicroCase" – Cigarettes

"You ask me what we need to win this war.
I answer tobacco as much as bullets.
Tobacco is as indispensable as the daily ration;
we must have thousands of tons without delay."

General John J. Pershing, U.S. Army, 1917

Cigarette Advertising on TV

- All US tobacco companies advertised heavily on television
- Surgeon General issues official warning
  - Cigarette smoking may be hazardous
- Cigarette companies' reaction
  - Fear of potential liability lawsuits
- Companies strike agreement
  - Carry the warning label and cease TV advertising in exchange for immunity from federal lawsuits.

1964

1970

Strategic Interaction

- **Players:** Reynolds, Philip Morris
- **Strategies:** Advertise, Do Not Advertise
- **Payoffs**: Companies' Profits

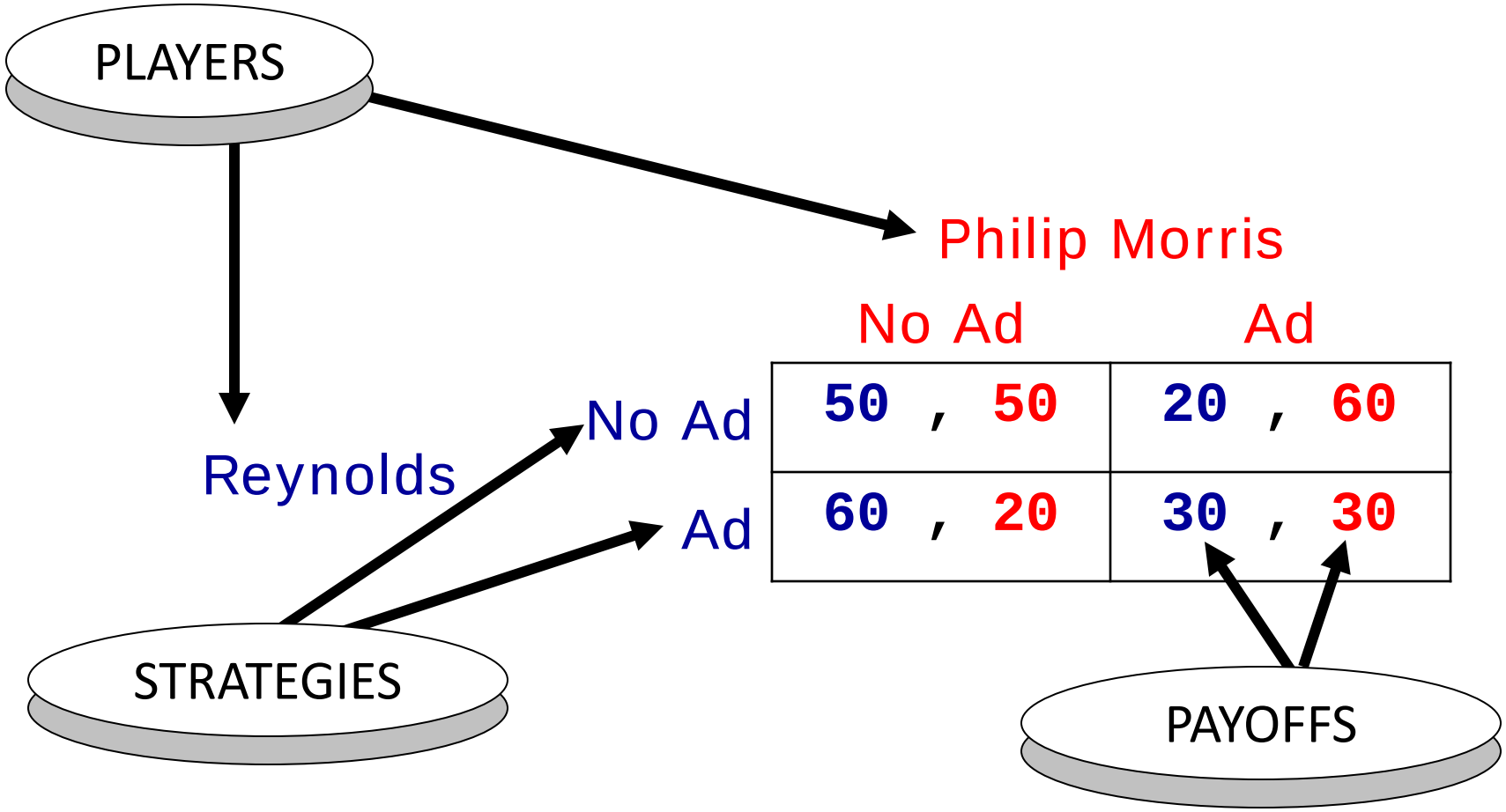
(all three are simplified…)

Some structure:

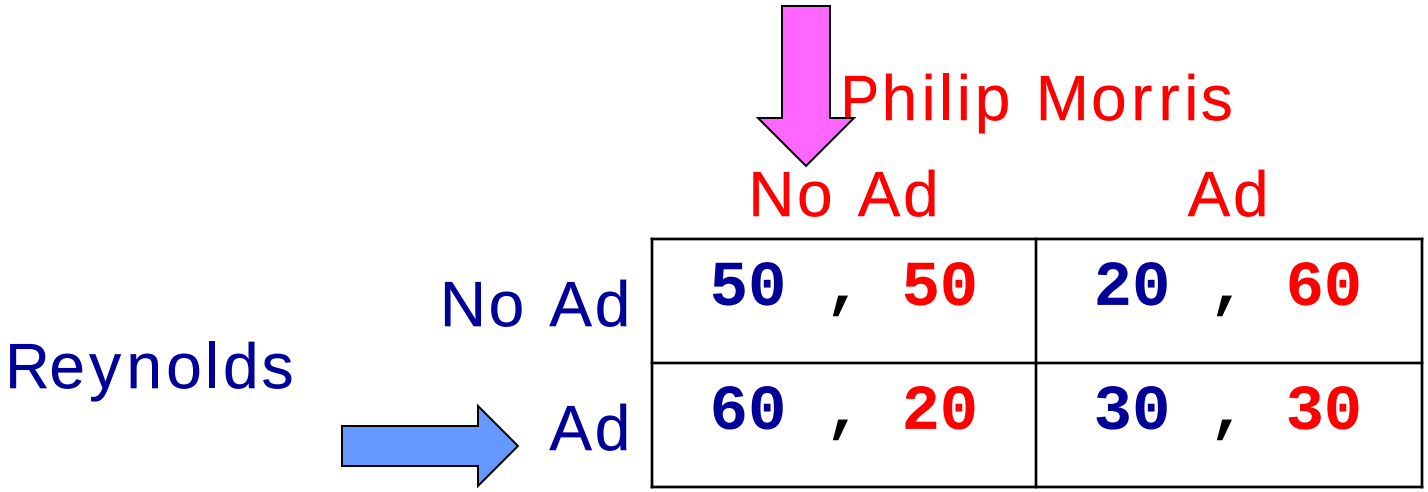
- Each firm earns $50 million from its customers
- Advertising costs each firm $20 million
- Advertising captures $30 million from competitor

- **How can we represent this game?**

Game Matrix


PLAYERS
Philip Morris
No Ad
Ad
50 , 50
20 , 60
60 , 20
30 , 30
Reynolds
No Ad
Ad
STRATEGIES
PAYOFFS

Best responses



- Best response for Reynolds:
  - If Philip Morris does not advertise: $\Rightarrow$ advertise
  - If Philip Morris advertises: $\Rightarrow$ advertise
- Advertise is a **dominant strategy**!
- This is a Prisoners' Dilemma

What Happened?

- After the 1970 agreement, cigarette advertising decreased by $63 million
- Profits rose by $91 million!
- How were the firms able to escape from the Prisoners' Dilemma?

Game-Changer: Gov't-Enforced Collusion?

		Philip Morris: No Ad	Philip Morris: Ad
Reynolds	No Ad	50 , 50	20, X
	Ad	X , 20	Y, Y

- Government made advertising ***illegal***
- If penalty large enough ➔ **X < 50** and **Y < 20**
- The dominant strategy is now No Ad!
- **All payoffs go down ➔ profits go up!**

Takeaways

Game theory provides advantage by

1. Identifying structures ←
    - coordination game, prisoners' dilemma, chicken

and by exploiting:

1. Limits of (knowledge about) rationality ←
    - how sophisticated are my opponents?
2. Commitment ←
    - credibility, threats, promises, and reputation
3. Private information ?
    - When to reveal, and how to handle uncertainty

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