

Games and Theory Building

Political Science 225
North Dakota State University

An Introduction to Game Theory

- Game theory is a tool for analyzing strategic situations
- A game is a strategic situation where other people's behavior affects one's ability to obtain goals
- Games are simple models of goal-directed interaction between people

Why Bother with Game Theory?

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- Strategic decision-making is at the heart of social science
- Provides a coherent theoretical framework
- Encourages logical deductive theorizing
- Generates testable hypotheses
- Highlights counterfactuals

The Components of a Game

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- Actors
- Strategies
- Payoffs

Nash Equilibrium

Definition

A set of strategies is a Nash equilibrium if each actor pursues a strategy that is a best response to the strategies of the other actors.

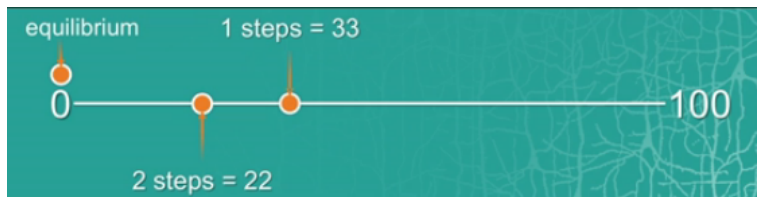
- No actor wants to unilaterally deviate
- Relies on beliefs about the behavior of others
- Not necessarily a situation where everyone does well
- A stable state of affairs

Nash Equilibrium: Example

- Choose a number from 0 to 100
- Guess closest to $\frac{2}{3} \times$ average wins

Nash Equilibrium: Example

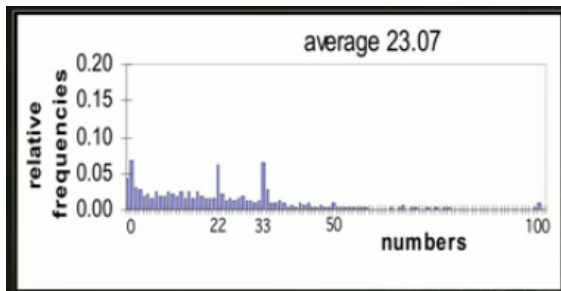
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See http://www.ted.com/talks/colin_camerer_neuroscience_game_theory_monkeys.html

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Normal Form Games

- Payoff matrix
- Strategies on rows and columns
- Payoffs for row player are listed first

		Actor 2	
		Strategy 2A	Strategy 2B
Actor 1	Strategy 1A	P1AA, P2AA	P1AB, P2AB
	Strategy 1B	P1BA, P2BA	P1BB, P2BB

Battle of the Sexes

		Alex	
		Boxing	Opera
Sasha	Boxing	10, 5	0, 0
	Opera	0, 0	5, 10

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Chicken/Hawk-Dove

		Chuck	
		Swerve	Straight
Ren	Swerve	Tie, Tie	Lose, Win
	Straight	Win, Lose	Crash, Crash

What's the preference ordering?

Chicken/Hawk-Dove

		Chuck	
		Swerve	Straight
Ren	Swerve	Tie, Tie	Lose, Win
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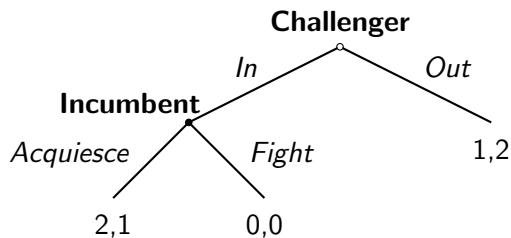
What's the preference ordering?

Win > Tie > Lose > Crash

The Prisoner's Dilemma

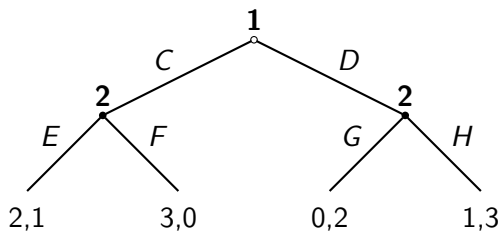
- Actors: two perps
- Strategies: rat or stay quiet
- Payoffs:
 - Cops have enough to put both perps away for 2 years
 - If either perp talks she'll receive a one year sentence reduction
 - If the other person rats on you, you'll get convicted of a second charge that will add 10 years to your sentence

Extensive Form Games



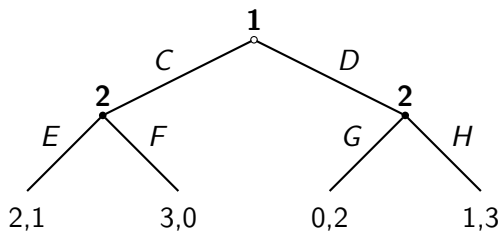
- Players at *nodes*
- Strategy components on *vertices*
- Payoffs at *terminal nodes*
- Strategies are complete sets of actions for each player
- A *subgame* starts at every node

Extensive Form Games: Strategies



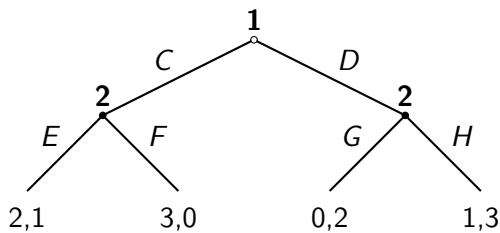
- Player 1 strategy set =

Extensive Form Games: Strategies



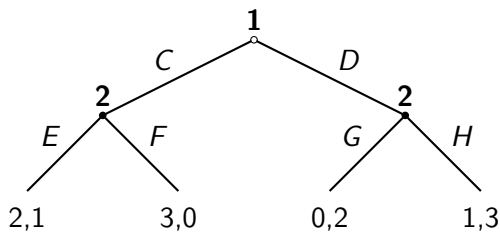
- Player 1 strategy set = $\{C, D\}$

Extensive Form Games: Strategies



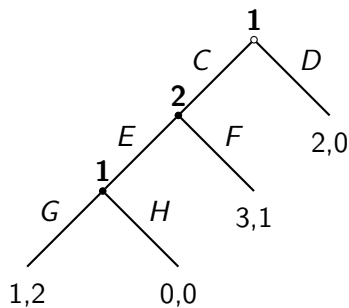
- Player 1 strategy set = $\{C, D\}$
- Player 2 strategy set =

Extensive Form Games: Strategies



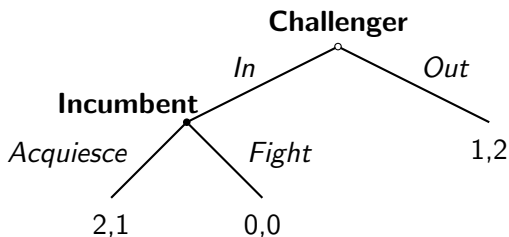
- Player 1 strategy set = $\{C, D\}$
- Player 2 strategy set = $\{EG, EH, FG, FH\}$

Extensive Form Games: Multiple Moves



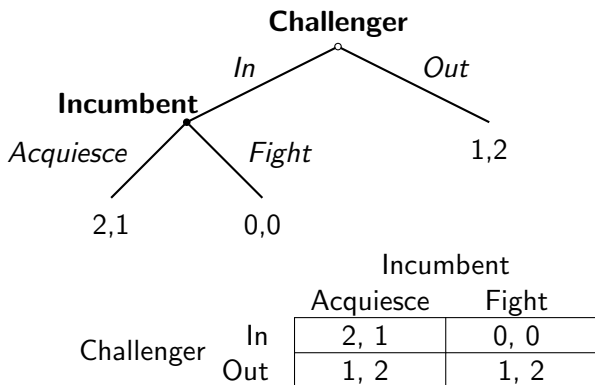
Extensive Form Games: Subgame Perfect Nash Equilibrium

SPNE are NE strategy sets that are optimal in every subgame



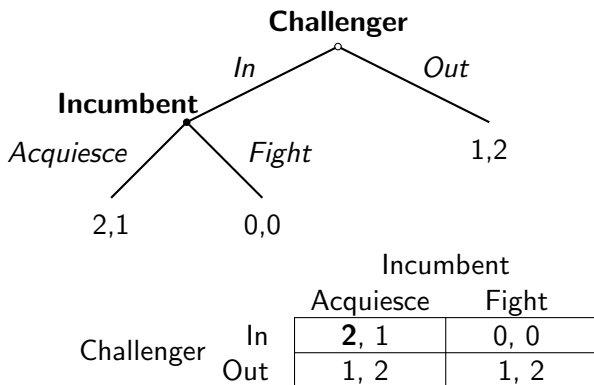
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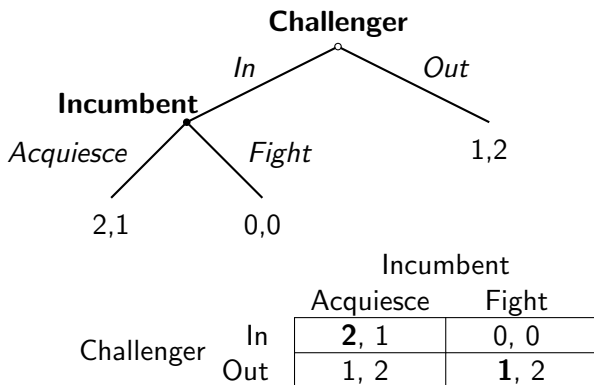
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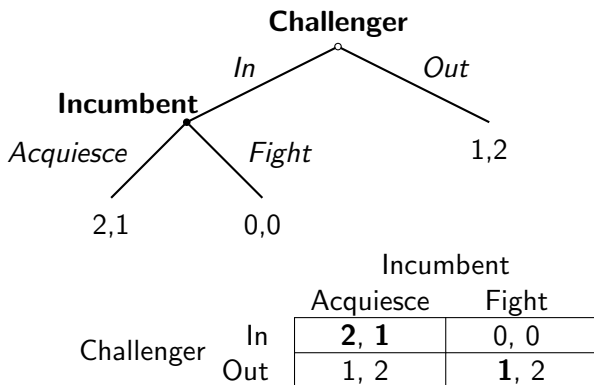
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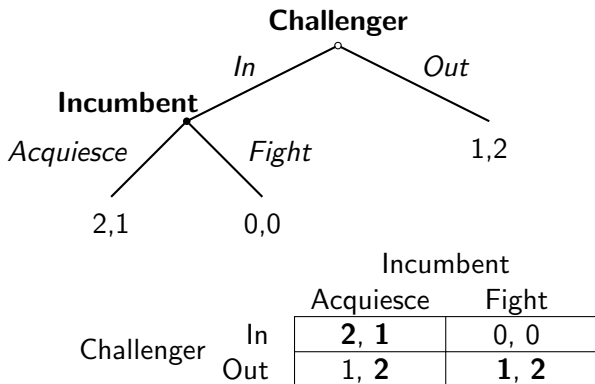
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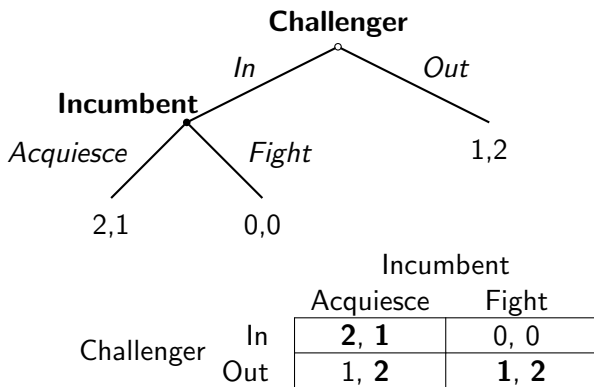


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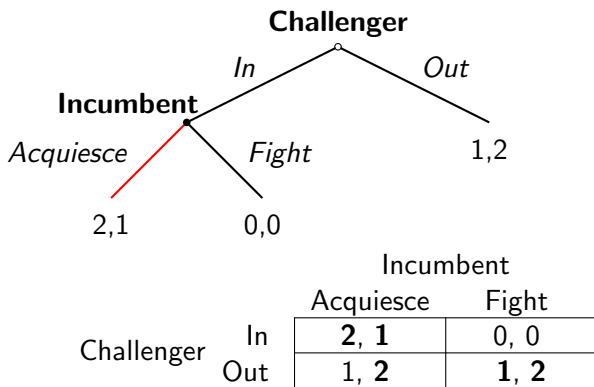
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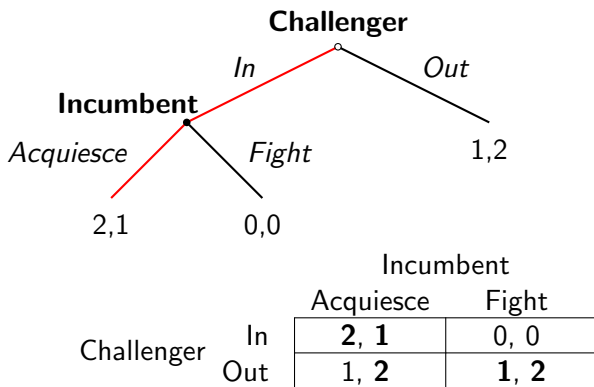
Extensive Form Games: Backwards Induction



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Extensive Form Games: Backwards Induction



Exit, Voice, and Loyalty

