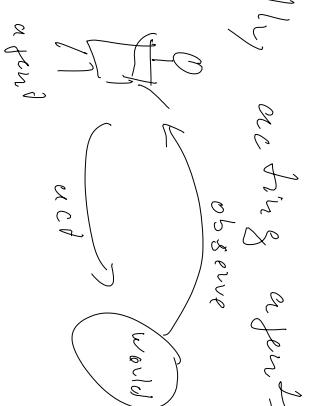


## Game Theory

Bernhard Neumann  
Robert Maynard Miller

Taylor: David Speer

In 1944 // game theory /  
is teaching / ss 15 / game theory /



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Simulation or game theory?



- Many rational agents interacting in decision making, which depends on what - resulting behavior depends on what other agents do - all agents know that the other agents are rational

1. Introduction
2. What is Game Theory?
  - Rationality, acting agents

1. What is Game Theory?
  - Rational agents maximize their (expected) utility.
  - ~ Decision theory, MDP, RL, Planning

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Investigating questions;

- How to model such strategic situations
- "Solving" such situations
- Design games that have a particular purpose

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## 1.2 Example games

### (a) Board and card games

These are very special, because what is good for one player is bad for the other player (strictly competitive games).

### (b) Auctions (e.g., Google ads):

Setting: One object should be allocated to one out of a number of bidders.

#### Problems:

- Bidding protocol
- Who is the winner?
- What does winning bidder have to pay?

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### (c) Se curing;

Setting: a facility (e.g. airport) has to be guarded to avoid attacks.

#### Possible methods:

- visit all critical places

- choose the guard places intelligently & find a probability distribution for the coming threat minimizing expected damage

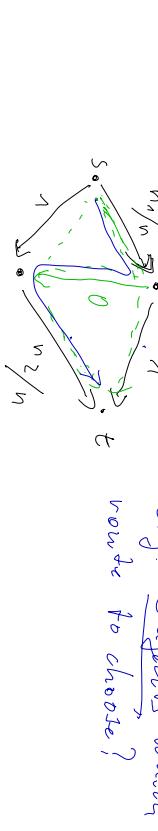
even under the assumption that the attacker can observe the guards.

## 1.3 Reactions

### Setting: Network of streets with

travel costs that is related to the number

of agents choosing a street



### 1.3 Reactions

General assumption: All players want to maximize their own utility and nothing else!

#### Con tracts:

- Altruistic agent: wants to minimize

the utility of the other agents

- Cooperative agent: wants to maximize the group utility

- Byzantine agent: wants to minimize the utility of all the other agents.

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Often agents cannot foresee all the consequences of their decisions (bounded rationality).

Often agents do not know all relevant information about the agents.

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## 1.4 Overview of topics in Game Theory

- strategic games
  - extensive forms, repeated game
  - variations and special cases
- social decision theory
- mechanism design
- cooperative game theory

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