Computational Game Theory

summer semester 2024

Strategic Games
a model for game-like situations

Question: What strategic choices will rational/selfish players make?

e.g.

(Nash-)Equilibria
a situation where no player can improve by changing strategy

Questions: Existence? Computation? Complexity? ...

Congestion Games
players compete for resources with cost depending on load
e.g. cars in road networks

Question: Can we improve the quality of resulting equilibria (e.g. with tolls)?

Mechanism Design
design game to achieve certain desired outcomes

Questions: Auctions that incentivise truthful bidding?
Games that incentivise cooperation?

Who? Master students in Computational Mathematics, Informatik, AI Engineering
When? Tuesday 14:15-15:45 and Wednesday 10:15-11:45 (lecture); Thursday 16:00-17:30 (exercise)
Where? HK 28, VR 003 (lecture); IM, HS 12 (exercise)

A Game Theory Puzzle:

Once upon a time, there existed a kingdom wherein there existed many poisons which all had the following property: If one drinks any of those poisons, one dies within an hour. However, if during this hour one drinks another, stronger poison, one survives. Not all poisons were known, but it was known that there existed a strict order over all poisons and each poison belongs to one of two groups: Magical and medical.

One day, the King gave the master of medical poisons and the master of magical poisons the following task: "Within a week, bring me the strongest poison of your area you can find. Upon your return, each of you will first drink the other's poison and then your own. Hence, whoever finds the strongest poison will survive, while the other will die. Do not try to cheat: If I find out about it, you both will be executed!"

A week later both returned with a flask in their hand. They proceeded to drink as ordered by the King. An hour later, both died.

Question: *What happened?*
What would your strategy be in the position of one of the masters?

This puzzle is taken from the paper "Cooking Poisons: Thinking Laterally with Game Theory" by Timothy Y. Chow, https://arxiv.org/abs/2404.05053
Spoiler-Warning: This paper not only provides the anwer to this puzzle, but also a very nice introduction to several fundamental concepts of game theory (which we will also discuss in this lecture)