

Algorithmic game theory

Martin Balke

1st lecture

October 10th 2022



Basic info

Basic info

- **Webpage:** <https://kam.mff.cuni.cz/~balko/ath2223/ATH.html>
 - lecture info, topics covered, presentations, lecture notes ...

Basic info

- **Webpage:** <https://kam.mff.cuni.cz/~balko/ath2223/ATH.html>
 - lecture info, topics covered, presentations, lecture notes ...
- **Recommended literature:**
 - **M. Balko:** Algorithmic game theory: lecture notes.
 - The notes are still under construction. Comments are welcome.

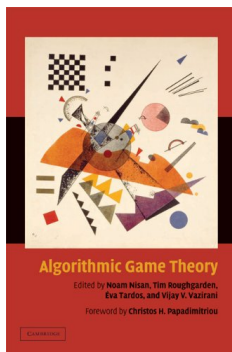


Figure: Algorithmic game theory by [Nisan et al.](#)

Source: <https://amazon.com>

Game theory

Game theory

- study of mathematical models of strategic interaction among rational decision-makers.



Zdroj: <https://quantamagazine.org>

Game theory

- study of mathematical models of strategic interaction among rational decision-makers.



Zdroj: <https://quantamagazine.org>

- We focus on the **algorithmic side** of the game theory.

Game theory

- study of mathematical models of strategic interaction among rational decision-makers.



Zdroj: <https://quantamagazine.org>

- We focus on the **algorithmic side** of the game theory.
- Several **real-word applications**.

Game theory

- study of mathematical models of strategic interaction among rational decision-makers.



Zdroj: <https://quantamagazine.org>

- We focus on the **algorithmic side** of the game theory.
- Several **real-word applications**.
- More than ten game theorists have won the **Nobel Prize** in economics.

Syllabus

Syllabus

- Preliminary plan:

Syllabus

- Preliminary plan:
 - Finding Nash equilibria
 - Nash equilibria and Nash's Theorem,
 - zero-sum games,
 - bimatrix games and the Lemke–Howson algorithm,
 - other notions of equilibria,
 - regret minimization.
 - Mechanism design,
 - auctions (Vickrey),
 - Myerson's lemma and its applications,
 - revenue maximization.

Finding Nash equilibria

Nash's Theorem

Nash's Theorem

- Every normal-form game has a Nash equilibrium.

Nash's Theorem

- Every normal-form game has a Nash equilibrium.

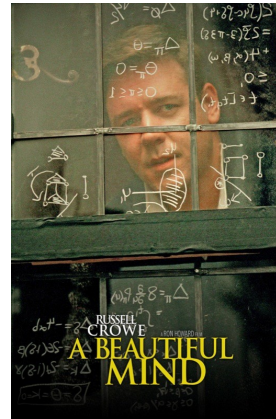


Figure: John Forbes Nash Jr. (1928–2015) and his depiction in the movie **A Beautiful mind**.

Brouwer's Fixed Point Theorem

Brouwer's Fixed Point Theorem

- For each $d \in \mathbb{N}$, let K be a non-empty compact convex set in \mathbb{R}^d and $f: K \rightarrow K$ be a continuous mapping. Then, there exists a fixed point $x_0 \in K$ for f , that is, $f(x_0) = x_0$.

Brouwer's Fixed Point Theorem

- For each $d \in \mathbb{N}$, let K be a non-empty compact convex set in \mathbb{R}^d and $f: K \rightarrow K$ be a continuous mapping. Then, there exists a fixed point $x_0 \in K$ for f , that is, $f(x_0) = x_0$.



Figure: L. E. J. Brouwer (1881–1966).





Figure: John Forbes Nash Jr. receiving a Nobel prize for economics.

Source: <https://pbs.org>



Figure: John Forbes Nash Jr. receiving a Nobel prize for economics.

Source: <https://pbs.org>

Thank you for your attention.