Solving Continuous Games With Oracle Algorithms

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Domain

- Adversarial games
- for two players
- zero sum
- action spaces are continuums

Nash Equilibrium

- a stable state
- none of the players have a reason to deviate
- (from the adopted strategy)

Solving NE

- solved for games with finite action spaces
- Linear program:
- $maximize x_0$
- s.t. $M^T x - 1x_0 \geq 0$
- $\sum_{j \in A_{max}} x_j = 1$
- $x \geq 0$

Infinite Games

- LP no longer applicable (cannot enumerate actions)
- $\rightarrow$ What else, then?
- settle $\epsilon-$NE instead
- iterative algorithms based on *oracles*
- *oracles*:
  - *bestResponse oracle*: picks from the whole continuum
  - *value oracle*: the LP from previous slide, solves a subgame with finite action spaces

Algorithms

- Fictitious Play: the original one. Play *bestResponse* against the average of opponnent' history
- Double Oracle: Proved by FEL ČVUT (2021) to converge to $\epsilon - NE$ (much faster than FP)
- Expected Regret Minimization: Generalization of online learning into two-player setting, proposed 2023