DeepMind

# Multiagent Evaluation under Incomplete Information

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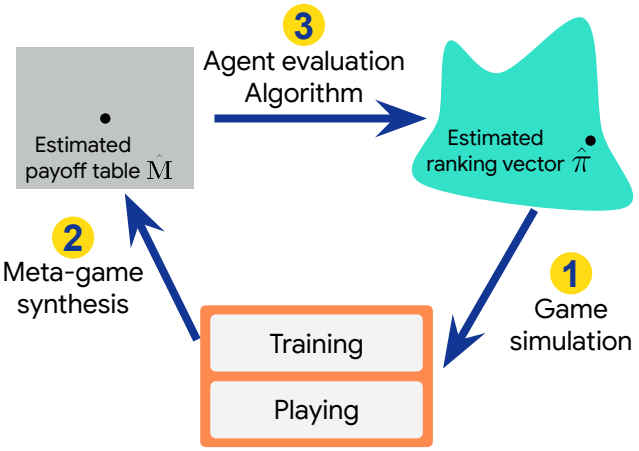
# Motivation

- **Problem of interest:**
  - Multiagent evaluation under incomplete information
  - >2-player, general-sum games with noisy payoffs

- **Prototypical application:** multiagent iterative training
  1. Train agents via simulations in the underlying game
  2. Construct meta-game comparing performance of all agent match-ups
  3. Evaluate (i.e., rank or score) agents in the meta-game



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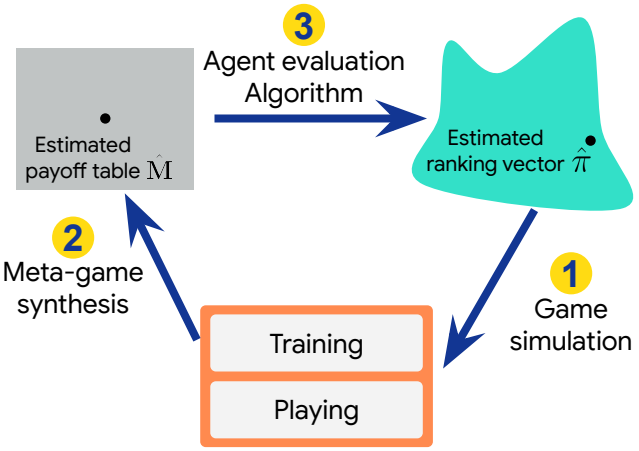
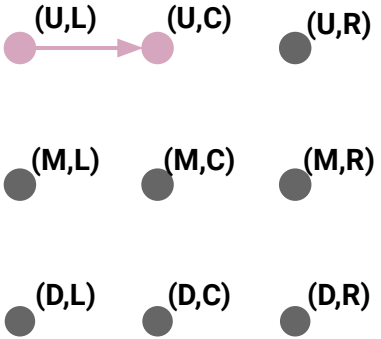


# Multiagent Evaluation at a Glance

## $\alpha$-Rank Overview

1. **Construct response graph capturing player-wise evolutionary deviations:** graph over the pure strategy profiles, with **directed edges** if deviating player's new strategy is a better-response

| | | Player 2 | | |
|---|---|---|---|---|
| | | L | C | R |
| Player 1 | U | 2, 1 | 1, 2 | 0, 0 |
| | M | 1, 2 | 2, 1 | 1, 0 |
| | D | 0, 0 | 0, 1 | 2, 2 |



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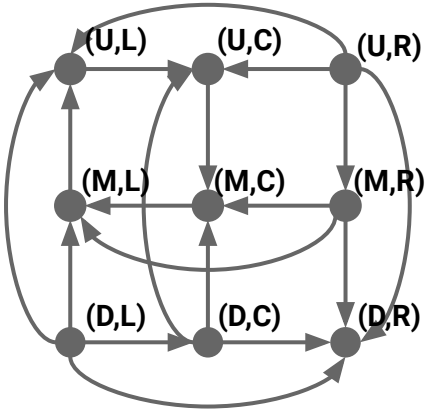

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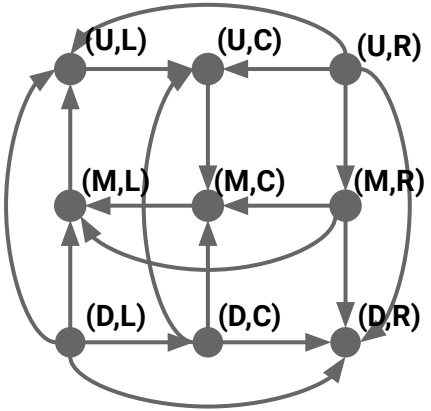


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3. **Stationary distribution masses** → $\alpha$-Rank

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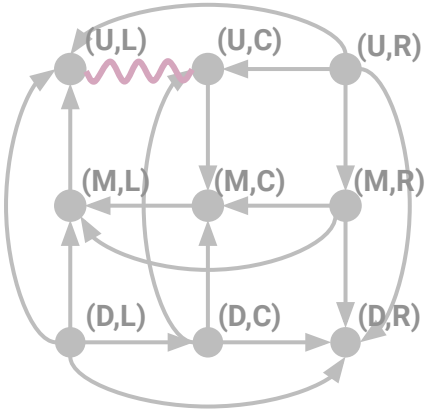


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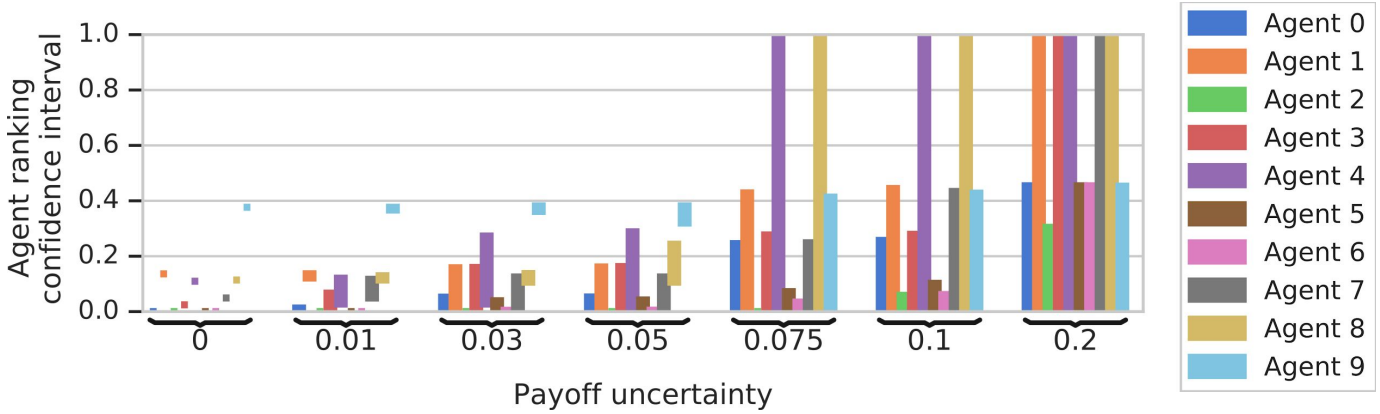
# From Uncertainty in Payoffs to Rankings

- **Key question:** given confidence bounds on the payoff table entries, can we efficiently compute a range of plausible $\alpha$-Rank weights for the agents?



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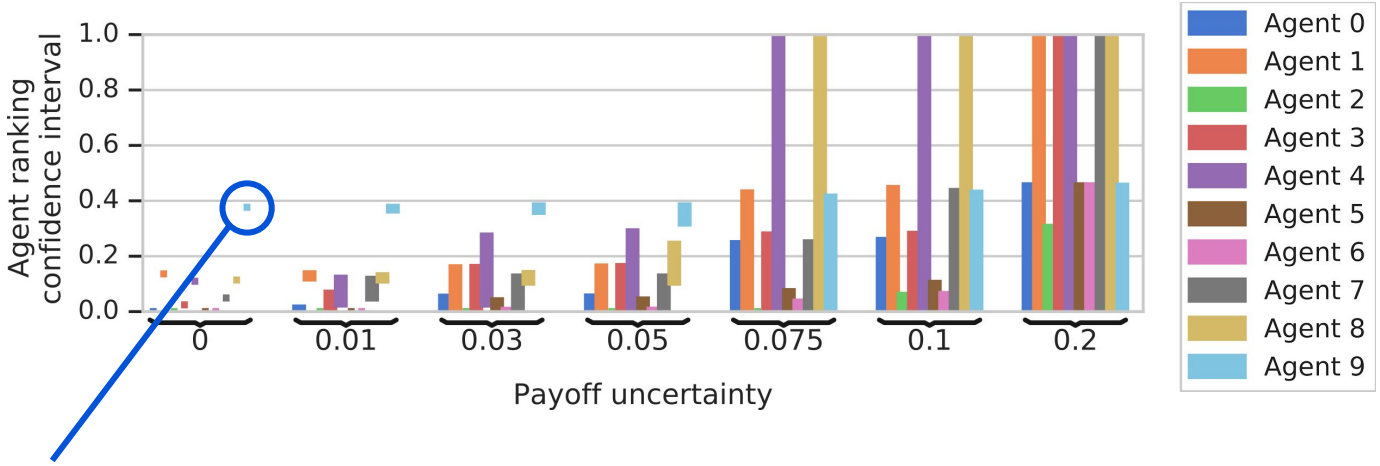


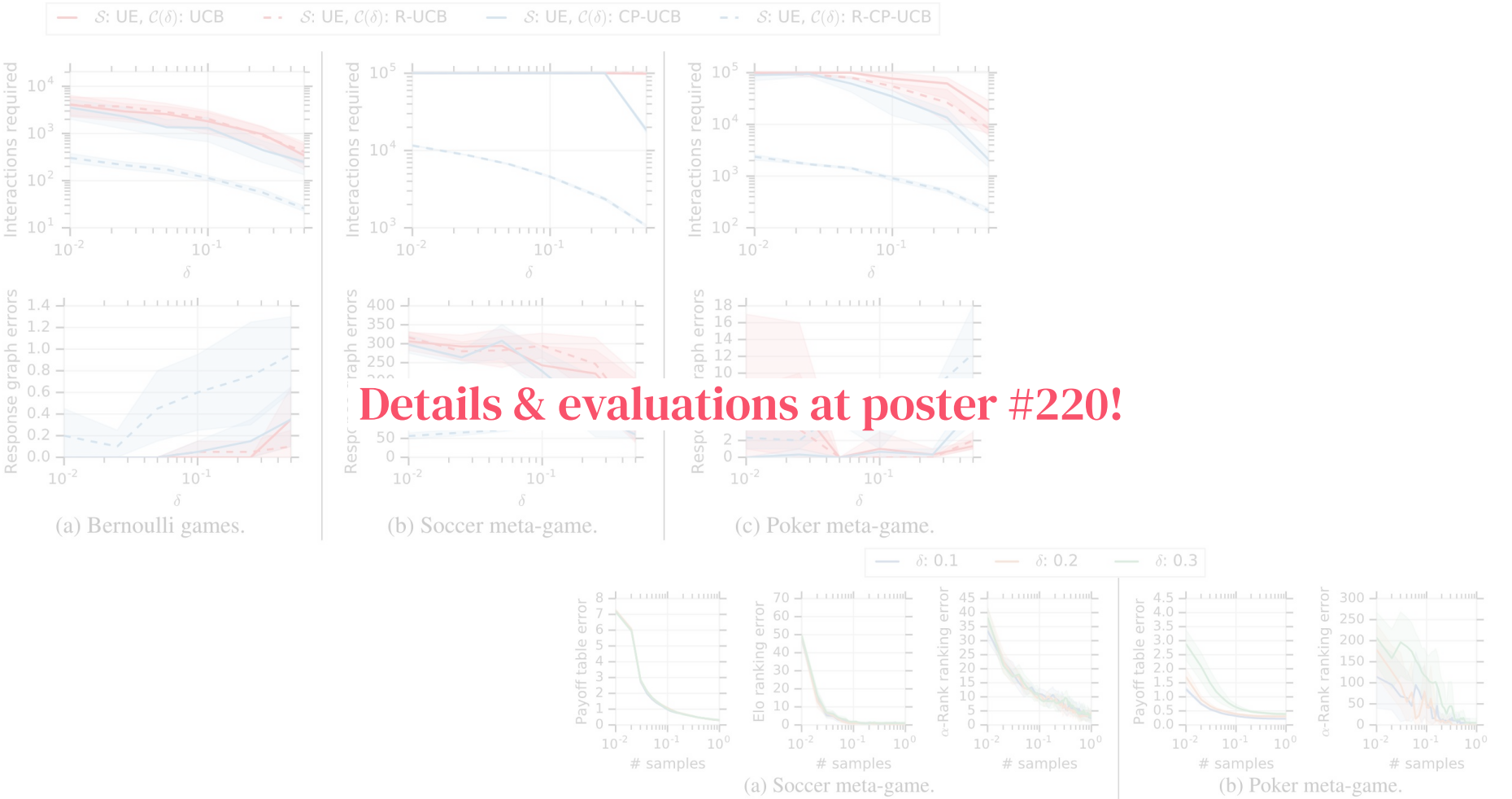

- Top-ranked agent when no payoff uncertainty
- **Takeaway:** need careful consideration of payoff uncertainties when ranking agents

# Contributions

1. Static sample complexity bounds quantifying # of interactions needed to confidently rank agents

2. Algorithm that adaptively simulates agent interactions that are most informative for ranking

3. Analysis of the propagation of payoff uncertainty to the final rankings computed
    - Sample complexity guarantees & efficient alg. for bounding rankings given payoff uncertainty




(a) Bernoulli games. (b) Soccer meta-game. (c) Poker meta-game.

**Details & evaluations at poster #220!**

(a) Soccer meta-game. (b) Poker meta-game.