**Introduction**

Nash and Correlated Equilibria

Nash equilibrium has been central in many recent landmark results in AI revolving around zero-sum game solving. However, it suffers from many drawbacks in multiplayer general-sum games:

- **Equilibrium selection:** An equilibrium strategy may perform poorly against the “wrong” equilibrium
- **Computational Intractability:** Nash equilibria are hard to compute in general games [5]

A competing notion of rationality, proposed by Aumann [1], is that of correlated equilibrium.

Unlike Nash equilibrium, there are uncoupled no-regret learning algorithms converging to correlated equilibria in general games.

Accelerated No-Regret Learning Dynamics for Correlated Equilibria in Normal-Form Games

There has been a considerable amount of interest in developing faster no-regret learning algorithms in normal-form games that outperform the adversarial $\Theta(T^{−1/3})$ barrier:

- [3, 6]: $O(T^{−1})$ convergence to Nash equilibria in zero-sum games
- [7]: $O(T^{−2/3})$ convergence to coarse correlated equilibria
- [2]: $O(T^{−3/4})$ convergence to correlated equilibria
- [4]: $O(T^{−1})$ convergence to coarse correlated equilibria

This substantially improves over the prior best rate of $O(T^{−1/2})$.

**Main Result**

**Theorem 1.** On any perfect-recall general-sum multiplayer extensive-form game, there exist uncoupled no-regret learning dynamics which lead to a correlated distribution of play that is an $O(T^{−1/2})$-approximate. Here the $O(\cdot)$ notation suppresses game-specific parameters polynomial in the size of the game.

**Our Construction**

We develop a general template for performing accelerated $\Phi$-regret minimization.

**Main Ingredients**

$\Phi$-regret is a powerful framework for hindsight rationality. To employ our template we establish the following components:

1. Predictive regret minimizer for the set of trigger deviation functions
2. Stability analysis of the fixed points

**Experiments**

We support our theory with experiments on benchmark games:

- 3-player Kuhn poker
- 2-player Sheriff
- 2-player Liar’s dice

We investigate the performance of dynamics with a $\text{CFR}^+$ decomposition under 3 different local regret minimizers:

(i) multiplicative weights (MW)

(ii) optimistic multiplicative weights (OMW)

(iii) regret matching

The y-axis illustrates the EFCE-gap. Surprisingly, we observe that OMW substantially outperforms regret matching on Sheriff, a game specifically introduced for its interesting correlated equilibria.

**References**


