Symmetry-Breaking Augmentations for Ad Hoc Teamwork

ICLR International Conference On Learning Representations

Motivation

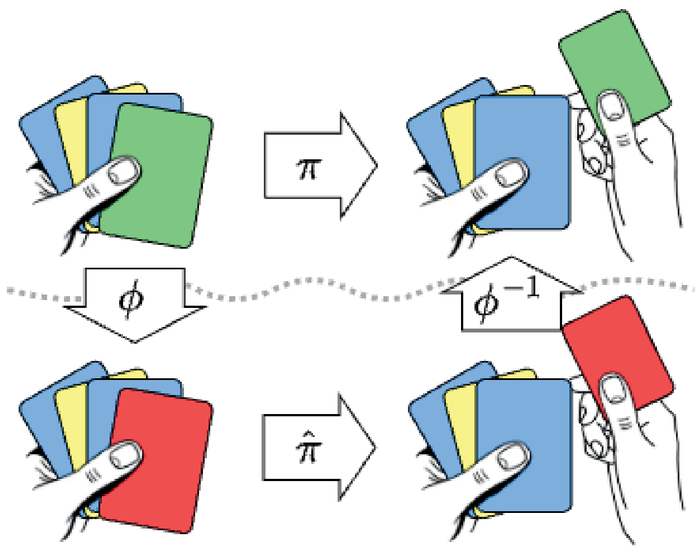
- AI struggles to adapt to new teammates that use **unfamiliar conventions**.
- Human coordination is flexible - agents should be too!
- **AHT** (Ad Hoc Teamwork): collaborate with unseen teammates that use unknown policies.



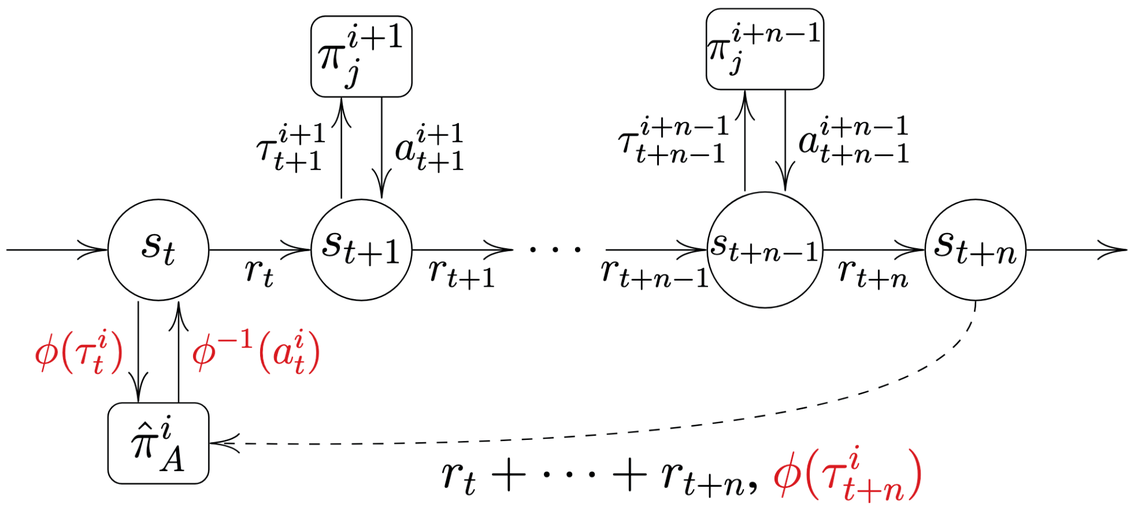
- Augment training teammate **behaviours** to learn to generalise to more diverse, previously unseen strategies.

SBA Framework

- SBA applies a symmetry map ϕ to every observation and its inverse ϕ^{-1} to each action, turning one teammate into **many conventionally-equivalent** ones.



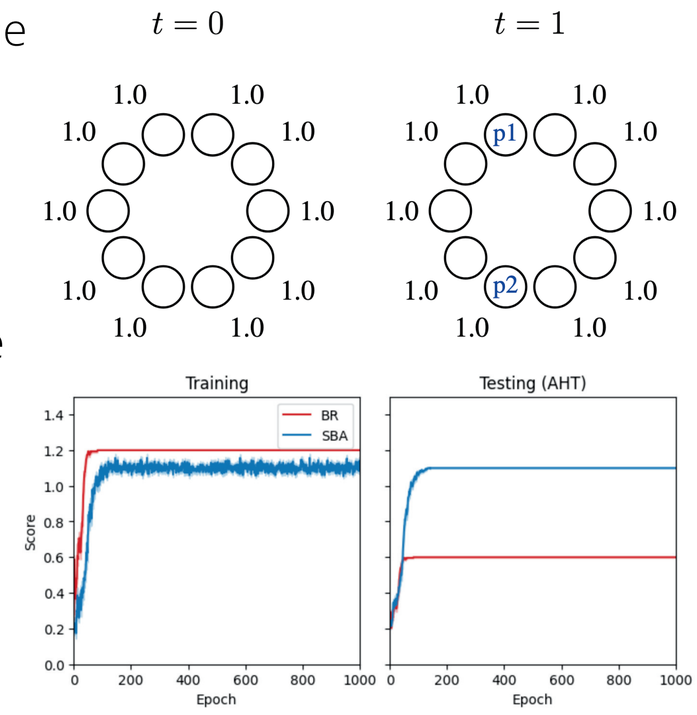
- Each training episode draws a fresh random ϕ, so the same replay data covers a combinatorial range of conventions **without needing extra partners.**



- Lightweight & algorithm-agnostic: because ϕ/ϕ^{-1} just wraps the agent's observations & actions, SBA adds only O(1) overhead and **plugs into any RL learner.**

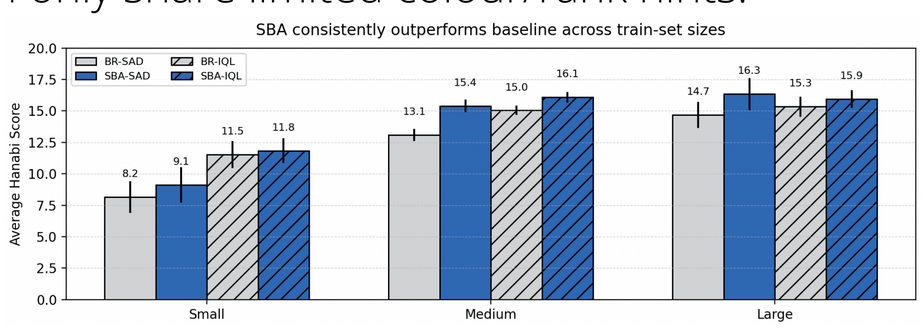
Lever Game

- Two-round lever game tests fast adaptation to unseen partner conventions.
- Random lever permutations expose **every convention during training**.
- SBA ≈ **1.1 return** vs baseline ≈ 0.6 on held-out partners.

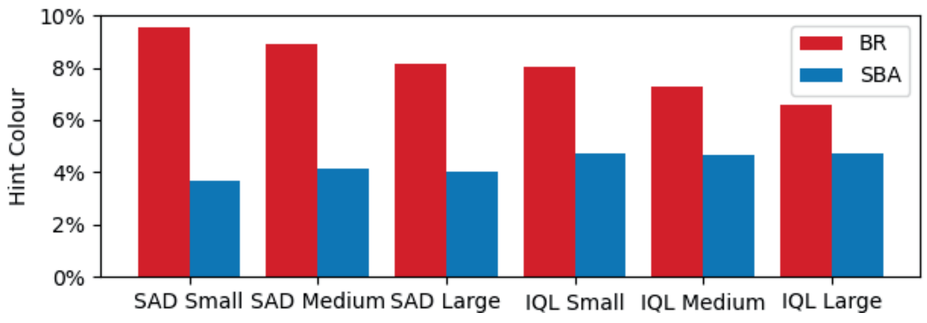


Hanabi

- Cooperative card game (25-point max) where players can only share limited colour/rank hints.



- Consistent improvment: **+1** **+2.3** points over baseline across all train-set sizes
- Limits: No change on symmetry-invariant policies



- SBA gives fewer colour hints avoids triggering teammate-specific colour conventions, leading to **safer coordination**.

Takeaways

- **SBA** = simple, big payoff – one mapping per episode expands training diversity without extra teammates.
- **Plug-and-play** – works with any RL backbone (DQN, PPO, etc.) at O(1) overhead.
- **Learns safer signals** – fewer colour hints, fewer convention clashes.
- **Future** – apply to real-world symmetries (robotics, driving) and combine with search.

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