Improving Multi-agent Coordination by Learning to Estimate Contention

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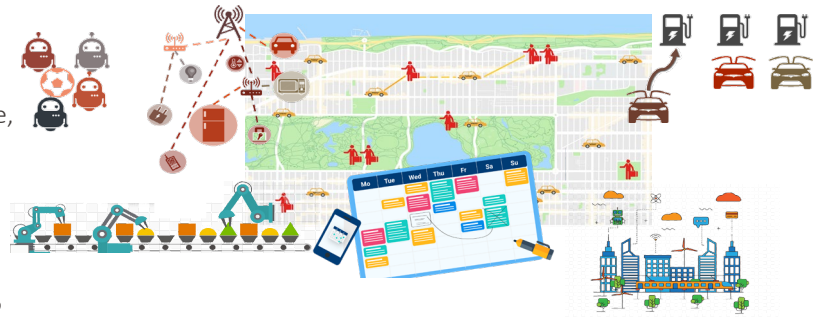
Large-scale Multi-agent Coordination

- Meeting scheduling,
- IoT devices,
- Smart cities,
- Intelligent infrastructure,
- Industry 4.0,
- Autonomous vehicles,
- Mobility-on-Demand,
- etc.



Challenges

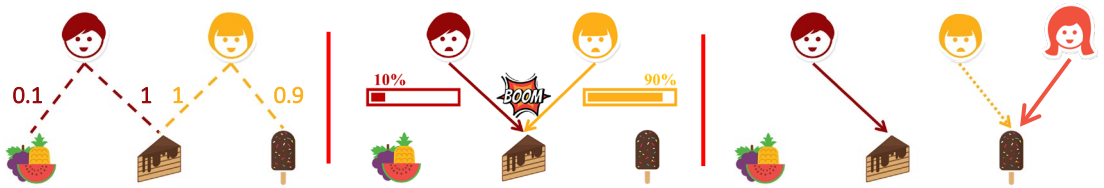
1) Complexity
   - Unboundedly large settings (10^2 – 10^6 agents)
   - E.g., meeting scheduling, resource allocation in urban environments, etc.
   - Number of steps increase with the problem size
   - Real-time constraints limit the size of the problem that can be solved
2) Communication
   - Distributed and information-restrictive
   - Inter-agent communication might not be available

Proposed Approach (ALMA-Learning)

A multi-agent learning algorithm, for efficient and fair allocations in large-scale systems.

- ALMA heuristic for weighted matching [Danassis et al., IJCAI 2019] as coordination mechanism: Constant time convergence, decentralized, no communication
- + Learning: Close the gap in social welfare and increase fairness

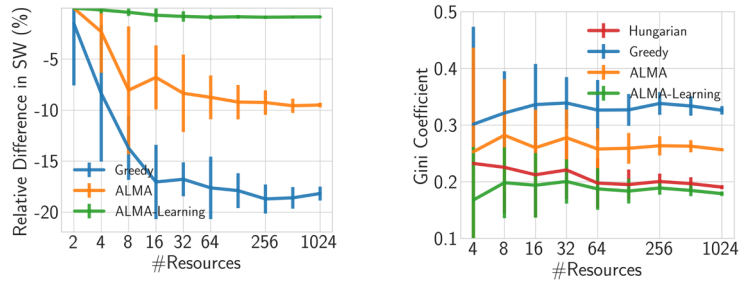
Learning Example



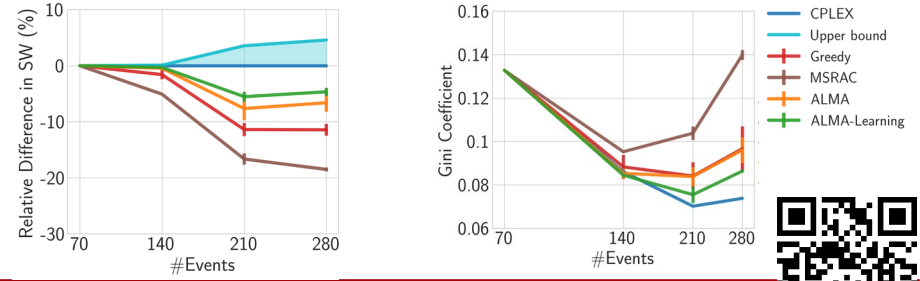
Simulation Results

- Maximum weight matching scenarios
- Constrained Optimization (Real-world meeting scheduling)
- Fast convergence in as little as 64 training steps
- Less than 5% loss in social welfare compared to the optimal
- Up to almost 10% lower inequality vs. the best performing baseline
- Large scale evaluation (up to 1024 agents / resources)

Synthetic Benchmarks



Meeting Scheduling



Read the full paper: