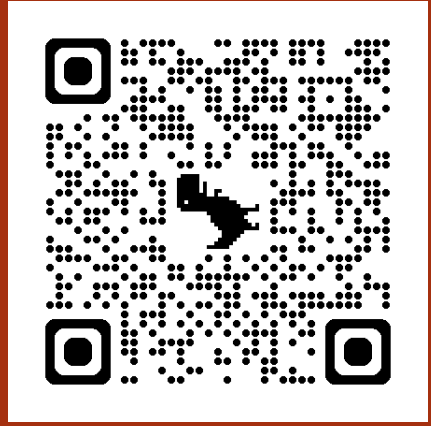
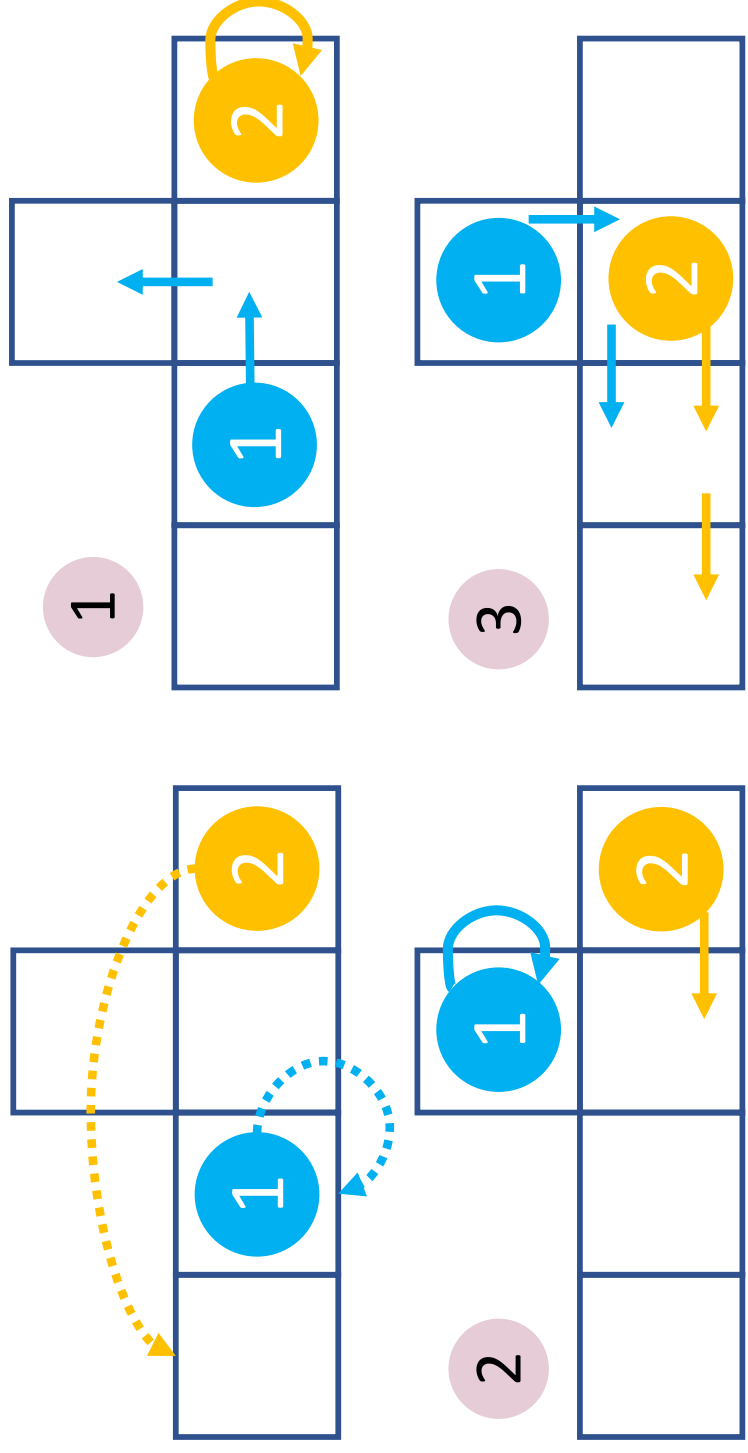




Paper

Problem Definition and Related Work

Multi-Agent Path Finding (MAPF):



Input: each agent with one start location and one target location

Output: optimal **collision-free** paths with given cost function

Learning-based Methods for MAPF:

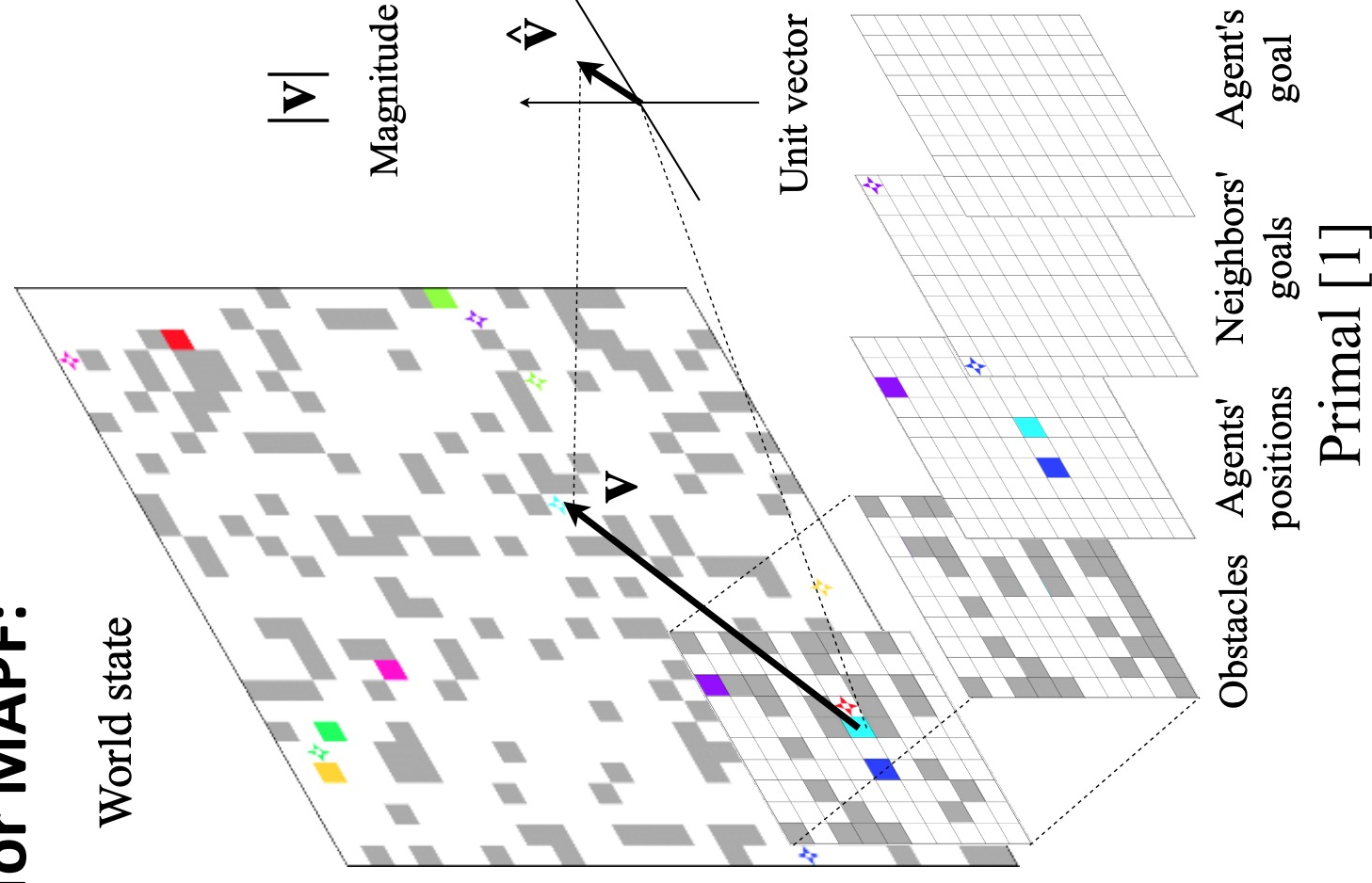
All current MAPF learning-based methods are **agent-based** and **decentralized**.

Why?

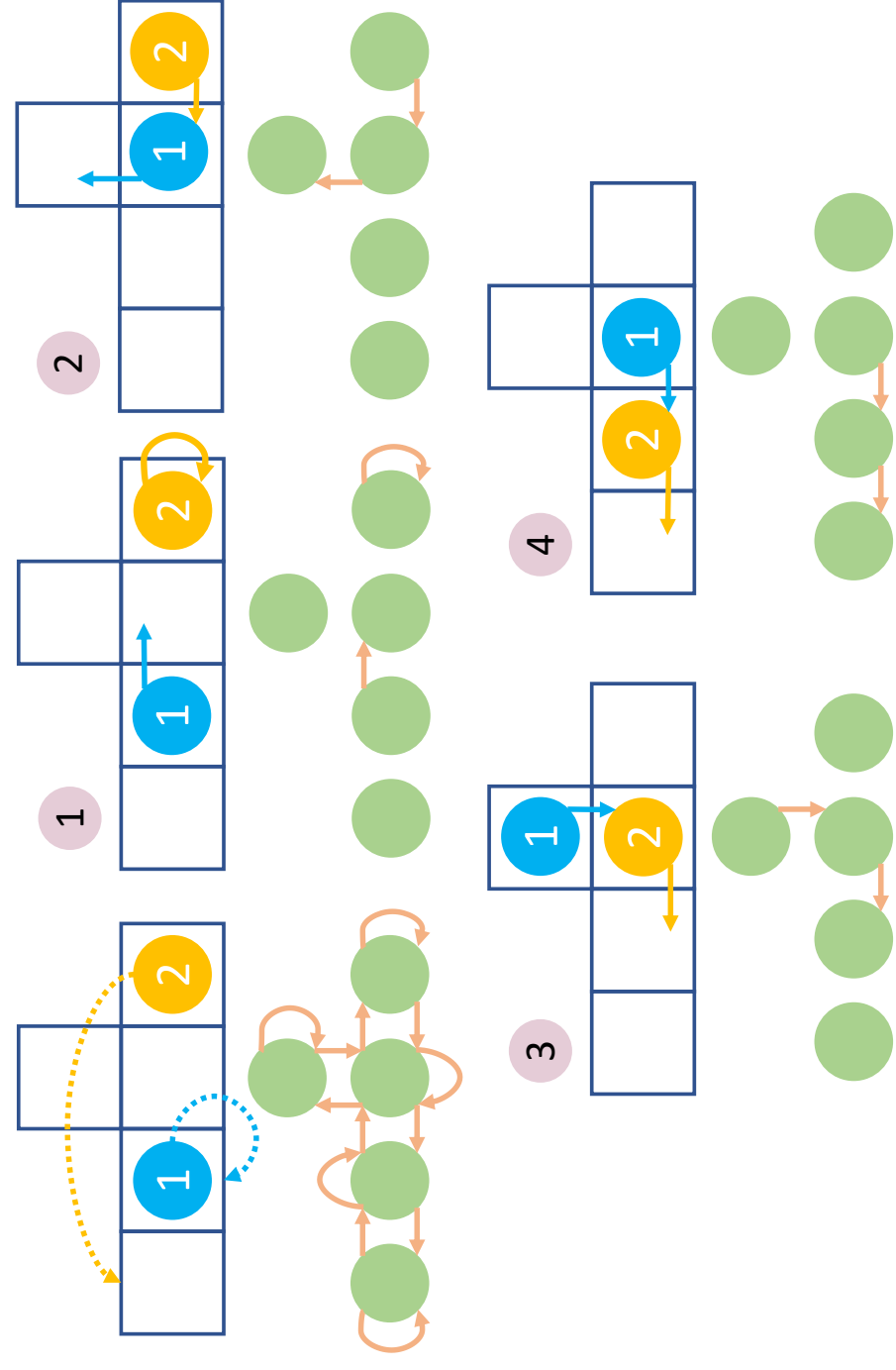
Let's try to design an **agent-based** **centralized** method.

Map size: (n, m)
Each agent feature size: k
Maximum number of agents: $N = nm$
Total feature size: nmk

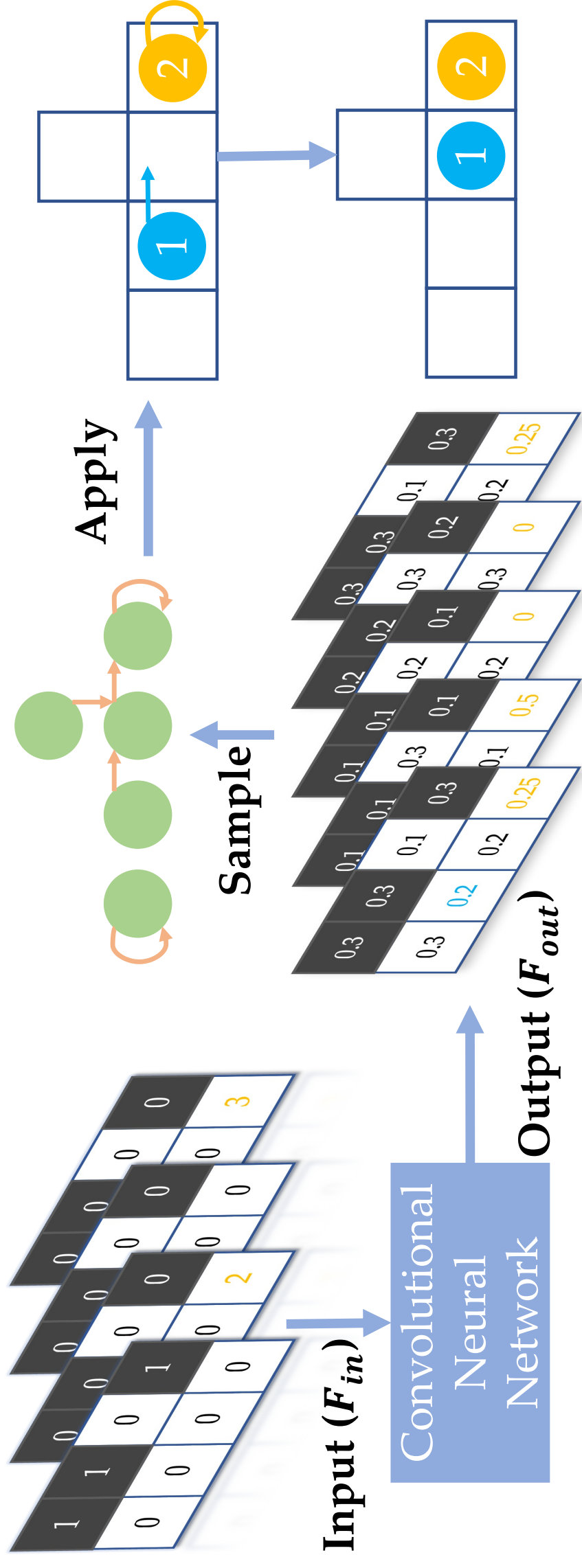
This dependence on map size means that we cannot create a policy to cover all different maps if we construct the features **agent by agent**.



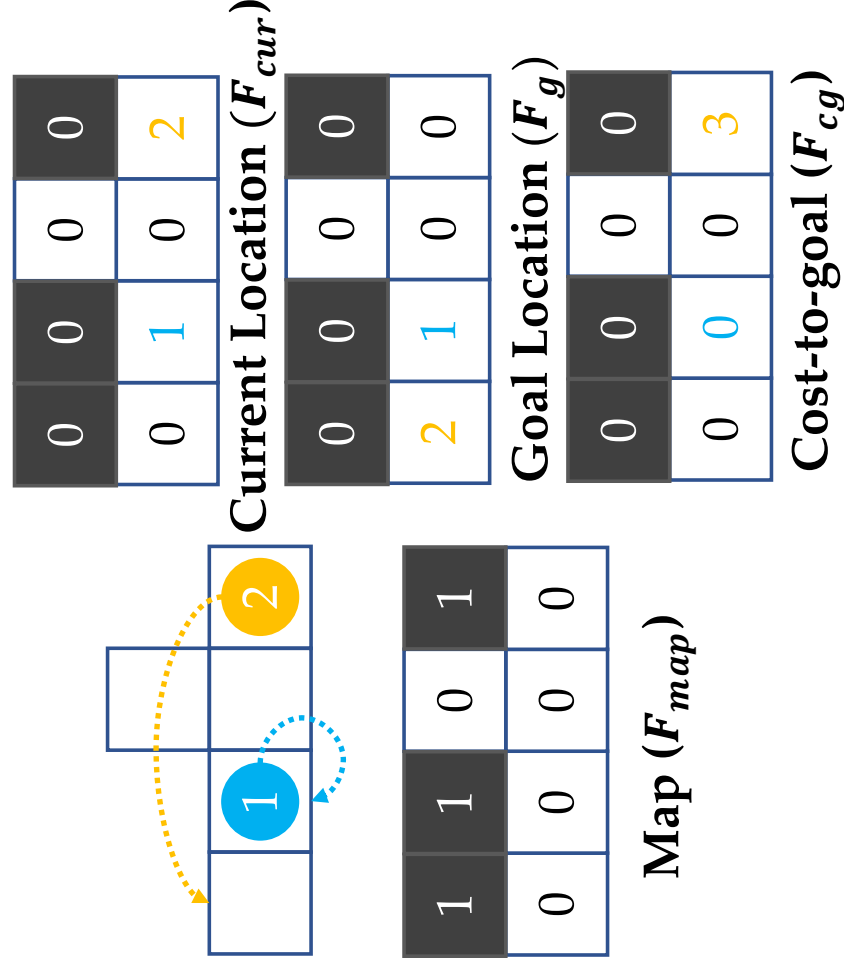
Proposed Method (RAILGUN)



Our insight is that in a valid MAPF solution, there will be no collision, which means there can be **at most one agent in each map grid cell in each timestep**. At any timestep, each agent chooses **one of the five edges** of its grid cell as its action.



After converting the agent-based solution into a representation as a series of specialized graphs, we use a CNN to address the challenge of generating these specialized graphs and generalizing across different maps. This policy can be trained using data from **any MAPF variant**.



Results

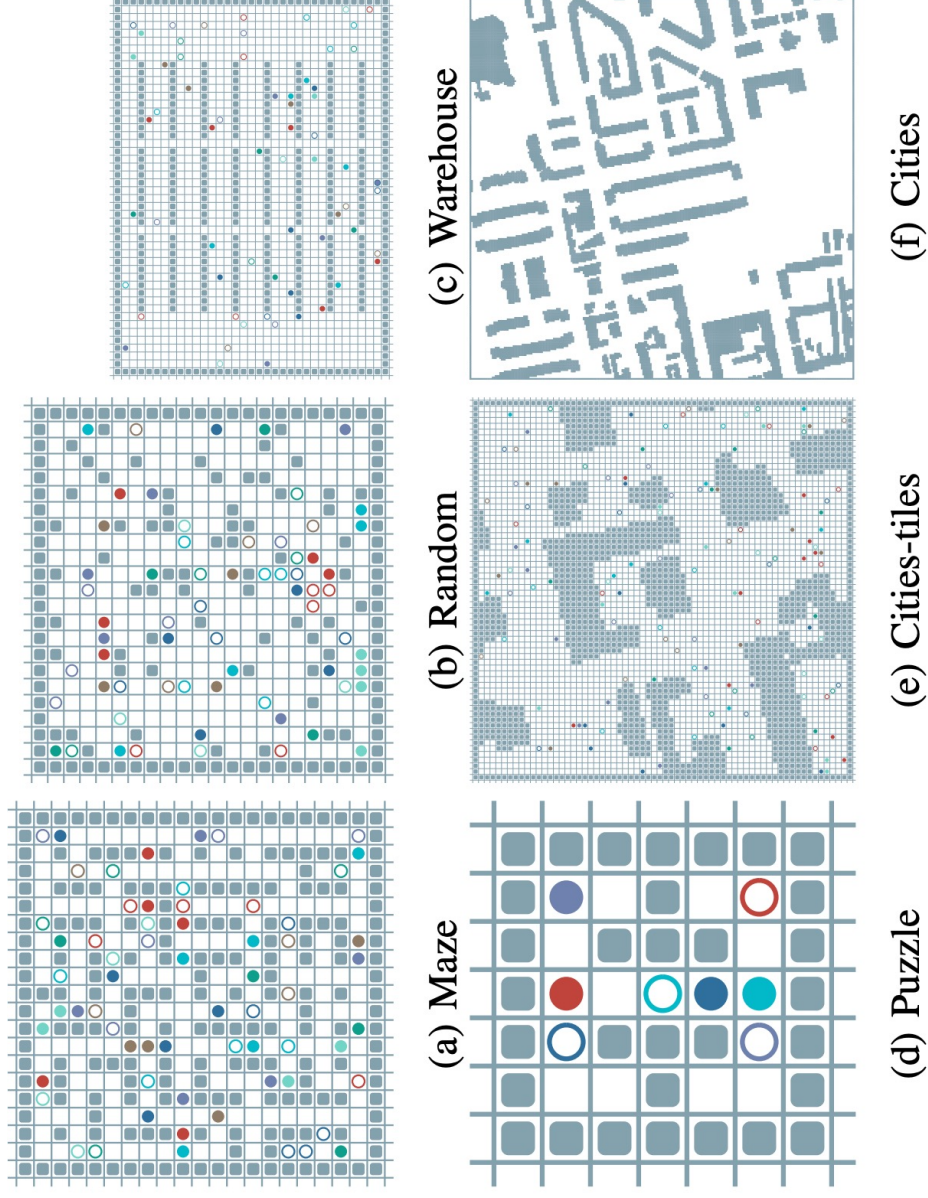
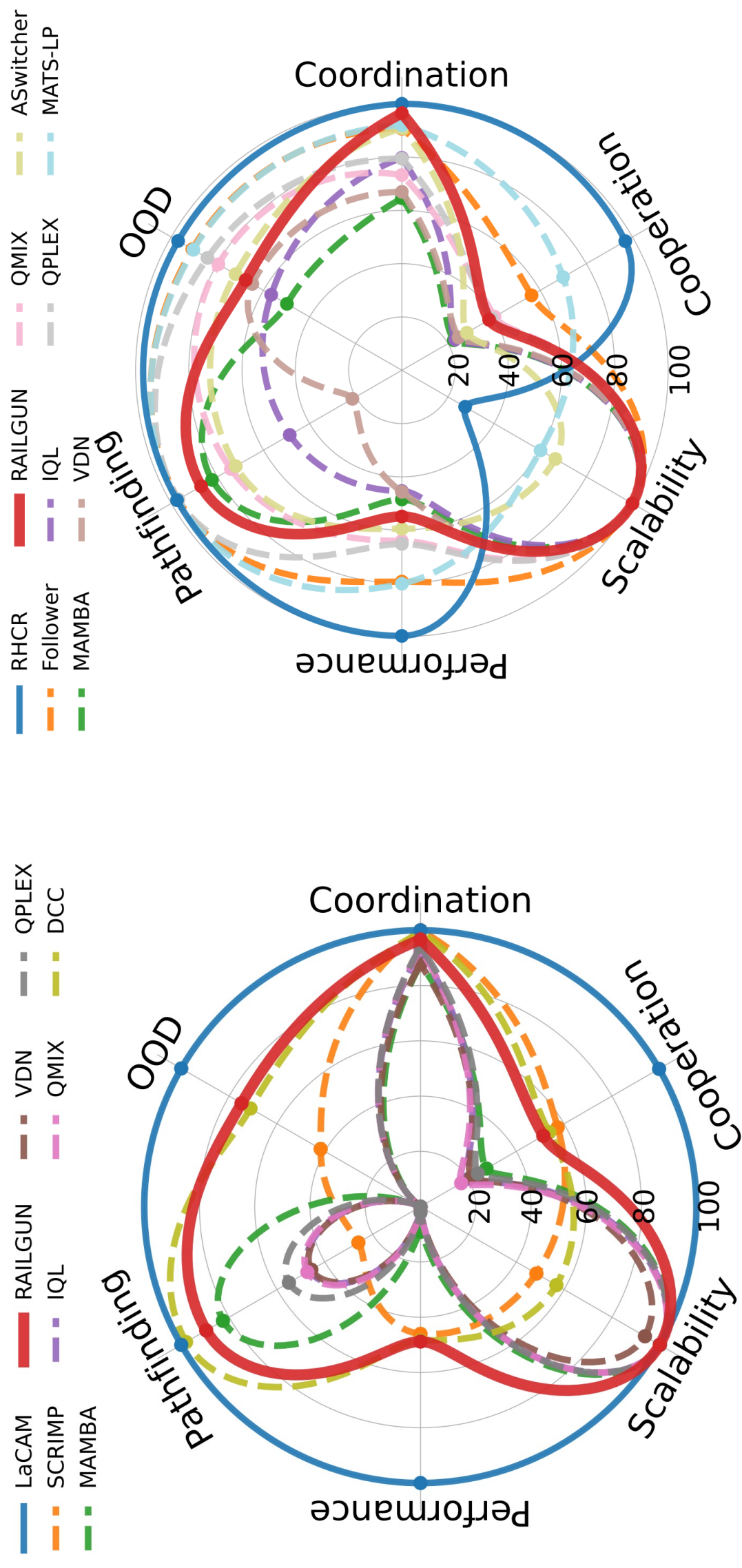


Fig. 3: Examples of POGEA-tested maps. The six metrics—Performance, Coordination, Scalability, Cooperation, OOD, and Pathfinding—are evaluated on the following map sets: Maze, Random, Maze, Random, Warehouse, Puzzle, Cities-tiles, and Cities. Note that Cities-tiles are 64x64 areas selected from larger Cities maps with dimensions of 256x256.



(a) MAPF: RAILGUN outperforms most baseline models in Scalability, Performance, Pathfinding, OOD and Coordination.

(b) LMAPF: RAILGUN still have good zero-shot LMAPF performance in Pathfinding, Coordination, Cooperation and Scalability just training on MAPF dataset.

We trained only on Maze (32x32) with up to 128 agents, and tested on all maps and both MAPF/LMAP tasks with up to 256 agents.