DMAPF - A Distributed Multi-Agent Path Finder

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The Multi-Agent Path Finding (MAPF) is a problem of finding a path for multiple agents to reach their targets without colliding with anything, including themselves. The problem has been proven to be NP-hard to solve optimally, either for makespan or flowtime minimization. It is a very active field of research and it has many applications such as automated warehouse, transportation, and games (especially those real-time strategy games). Various techniques have been proposed to solve the problems. They may be categorized into two directions: (*i*) search-based and (*ii*) translational approaches. The search-based approach attempts to come up with algorithms to solve the problem directly. The notable ones are Conflict-Based Search (CBS) and its variants. The representation-based approach attempts to translate a MAPF problem into another problem such as Boolean Satisfiability (SAT) and Answer Set Programming (ASP) problem, then use their respective solvers to solve the problem for them. It is a well-accepted observation that the size of the map affects the search-based approach less than the translational approach, while the translational approach typically performs better in small and dense problems. The issue that both of these approaches share is scalability. The majority of works in the literature have all been designed to solve the MAPF problem in a centralized manner.

Distributed Multi-Agent Path Finder (DMAPF), first published in 2019, is a novel approach to solve the MAPF problems a decentralized and distributed manner. Its main idea is to apply the divide and conquer approach. DMAPF decomposes a given MAPF problem into smaller sub-problems, then assigns each sub-problem to a sub-solver to solve its assigned sub-problem in parallel using existing MAPF solvers such as ASP and CBS. It has been revised and refined over the years. The improvements include better communication protocol between sub-solvers, problem decomposition, and problem regulation. In the presentation, we will provide an overview of the MAPF problem and an introduction to DMAPF; and discuss its improvements, challenges, and future works.