Research Review: Search algorithms for distributed AI planning.

In our AI class, we learnt about various search techniques for AI planning such as Forward and Backward techniques. This paper presents an overview of algorithms developed over a period of time to suit to large scale and distributed planning scenarios as mentioned in [1].

Following are the 3 search algorithms mentioned in research papers to cater to distributed planning and search domain:

1. MAD-A*: This is a distributed version of A* algorithm as mentioned in [1], MAD-A* solves a more difficult problem than centralized search because in the privacy preserving setting, each agent has less knowledge than a centralized problem solver. Yet, it is able to solve some problems centralized A* cannot solve. [4] explains how to distribute the work load in distributed environment with a similar algorithm called MAP-A*.
2. MAFS Algorithm as mentioned in [1]. A separate search space is maintained for each agent. Each agent maintains an open list of states that are candidates for expansion and a closed list of already expanded states. It expands the state with the minimal f value in its open list. When an agent expands states, it uses its own operators only. This means two agents expanding the same state will generate different successor states.
3. MA-A* as mentioned in [3]: MA-A* attempts to make the most of the parallel nature of the system, i.e., the existence of multiple computing agents, while respecting its distributed nature, when relevant., i.e., the fact that some information is local to an agent, and cannot be shared.

Result:

As mentioned in above 3 developments, the choice of distributed algorithms depends on various factors (privacy, etc.) and problem domain.

References:

[1] Distributed Heuristic Forward Search for Multi-Agent Systems, Raz Rizzim and Ronen Brafman

https://arxiv.org/pdf/1306.5858.pdf

 [2] An Efficient Algorithm for multi-agent Plan Coordination, Jeffrey S. Cox and Edmund H. Durfee

https://pdfs.semanticscholar.org/4b8f/b03452ddb53621c88e1cc42bd8ea7ec5cf99.pdf

[3] Multi-Agent A* for Parallel and Distributed Systems, Raz Nissim and Ronen Brafman

https://www.cs.bgu.ac.il/~raznis/mafs.pdf

[4] A Case for Domain-Independent Deterministic multi-agent Planning, Michal Stolba

http://robotics.fel.cvut.cz/pair14/wp-content/uploads/2014/09/pair14_submission-stolba.pdf