Research Review for Planning Module Project

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Historical developments in knowledge representation and reasoning in AI Planning & Search

One of the key developments in the AI Planning field has been the means by which to represent problems. A "representational language" used by STRIPS was one of the first planning systems used to encode a planning problem[1] . The STRIPS system was used as the planning system for the software for the Shakey robot project.

Action Description Language (ADL) and more recently Problem Domain Description Language PDDL (Ghallab et al. 1998) have also been used to represent problems. The advantage of these languages is that they are computer-parsable, and use a standard syntax for representing more realistic planning problems[1]. The implication and impact of such languages has allowed for "far greater reuse of research and allows more direct comparison of systems and approaches, and therefore supports faster progress in the field"[2].

A practical example of the application of a planning system can be observed in the video game F.E.A.R.[3]. F.E.A.R used an implementation of STRIPS to determine real-time planning of the AI based enemy agents, instead of storing all the possible actions for an enemy agent using finite-state-machines, in order to "eliminate-threats". This allowed the developers of F.E.A.R to create agents that were able to handle unexpected situation, which however came at the cost of CPU cycles[4].

Developments in heuristic prediction

Heuristic search was pioneered by Simon and Newell in the 1970s, which allowed an efficient means to find a solution in large combinatorial spaces[5]. They applied this idea to help create the General Problem Solver (GPS), a state-space search software system that uses "means-end analysis"[1], and which was one of the first pieces of software that would separate its knowledge of problems from its strategy on how to solve problems[6]. The GPS helped to develop the basis of the SOAR, a project whose goal is to build the computational building blocks necessary in order to build an AI agent with general intelligence.

Is there a best approach to planning?

The two predominant approaches to planning – constraint based approaches such as GRAPHPLAN and SATPLAN and search-based approaches. Constraint based approaches are best suited to NP-hard problems (Herbert 2001), while they struggle in domains where there are many objects because that must create many actions. Search-based approaches "do better in domains where feasible solutions can be found without backtracking"[7].

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[1] AIMA Chapter 10, p400

[2] (Fox, M.; Long, D. (2002). "PDDL+: Modeling continuous time dependent effects". *Proceedings of the 3rd International NASA Workshop on Planning and Scheduling for Space*).

[3] Three States and a Plan: The A.I. of F.E.A.R http://alumni.media.mit.edu/~jorkin/gdc2006_orkin_jeff_fear.pdf

[4] Agent Architecture Considerations for Real-Time Planning in Games http://alumni.media.mit.edu/~jorkin/aiide05OrkinJ.pdf

[5] 100 Year Study on AI (AI100) Stanford University https://ai100.stanford.edu/2016-report/appendix-i-short-history-ai

[6] https://en.wikipedia.org/wiki/General_Problem_Solver

[7]