Artificial Intelligence Nanodegree
AI Planning and Search
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This report sets out to discuss significant developments in planning and search techniques and their impact on the field of AI. This report is based on the book *Artificial Intelligence: A Modern Approach (Third Edition)* by Stuart Russell and Peter Norvig. Additional sources are separately cited.

Problem Domain Description Language

The Problem Domain Description Language (PDDL) was introduced in 1998 as a computer-parsable, standardized syntax for representing planning problems. The hope was that the widespread use of a common syntax could foster greater reuse of research and more direct comparison of different approaches. Since its use as the standard language for the International Planning Competition in 1998, it has since gone through several iterations (the most recent PDDL3.1) and inspired the rise of other languages that have propelled forward the field AI planning. These include PDDL+, New Domain Definition Language (NDDL), Multi-Agent Planning Language (MAPL), Ontology with Polymorphic Types (OPT), Probabilistic PDDL (PPDDL), Abstract Plan Preparation Language (APPL), Relational Dynamic-influence Diagram Language (RDDL) and Multi-Agent PDDL (MA-PDDL).[1]

Partial Order Planning

Partial order planning is an approach to AI planning that specifies all the actions that are needed to be taken to achieve the goal state, but does not specify the exact order for the actions when the order is inconsequential. Partial order planning was introduced in 1975 as a way to improve planning efficiency when compared to total-order planning, which was based on an exact ordering of actions. The key to partial order planning's greater efficiency is in its adherence to the Principle of Least Commitment, that is only making a choice when required to do so. This helps the search avoid doing work that might have to be undone later. One disadvantage of partial order planning is that it can be computationally expensive.
Order. Partial order planning was a popular research topic in AI in the 1970s and 80s, but fell out of favor in the late 90s as faster techniques emerged. However, more recently it is experiencing a resurgence in interest after it was shown that partial order planners can compete with the fastest state-space planners when based on accurate heuristics.[2]

Graphplan

[1] https://en.wikipedia.org/wiki/Planning_Domain_Definition_Language
[2] http://pages.cs.wisc.edu/~dyer/cs540/notes/pop.html and https://arxiv.org/pdf/cs/9412103.pdf

Partial order planning lost in popularity in the late 1990s largely due to the rise of Graphplan. Introduced in 1995, Graphplan was a general-purpose planner based on ideas used in graph algorithms. Given a problem statement, Graphplan explicitly constructed and annotated a compact structure called a Planning Graph, in which a plan was a kind of flow of truth-values through the graph. This graph had the property that useful information for constraining search could quickly be propagated through the graph as it was being built. As a consequence, Graphplan was orders of magnitude faster than partial order planners of the time. Significantly, Graphplan inspired many other planning graph approaches to AI planning, many of them much faster than the original Graphplan. These include IPP, STAN, GraphHTN, SGP, Blackbox, Medic, TGP, LPG.[3]

[3] https://www.cs.cmu.edu/~avrim/Papers/graphplan.pdf, https://www.cs.cmu.edu/~avrim/graphplan.html and https://www.cs.umd.edu/~nau/planning/slides/chapter06.pdf