Research Review

Artificial Intelligence (AI) planning and search arose from investigations into state-space search, theorem proving, and control theory and from the practical needs of robotics, scheduling, and other domains (Russell and Norvig, 1995). In this research review paper I consider three developments, highlighting the relationships between these developments and their impact on the field of AI as a whole. Specifically, the three such developments to be considered are STRIPS (Stanford Research Institute Problem Solver), ADL (Action Description Language) and PDDL (Planning Domain Definition Language).

STRIPS, developed by Fikes and Nielsen in 1971 at the SRI International is the first major automated planning system (https://en.wikipedia.org/wiki/STIPS). According to Wikipedia, the same name was later used to refer to the formal language of the inputs into this planner. This language is the base for most of languages for expressing automated planning problem instances in use today including ADL and PDDL The first model of planning is STRIPS planning in which an initial state is a finite set of ground atomic formulas, indicating that the corresponding conditions are initially true, and that all other relevant conditions are initially false; the preconditions and post conditions of an operator are ground literals and the goals are ground literals (Tom Bylander, 1994). From this base there is a second model and other extensions that have been developed. In their seminal paper in 1971, Fikes and Nelson, describe STRIPS as having a problem space and search. This structure enables advanced analysis of different problems. STRIPS has been used to prove the complexity of classical planning algorithms such PlanSAT and Bounded PlanSAT (Tom Bylander, 1994). STRIPS has been used extensively in robotics, proving theorems and the development of other approaches and languages.

The Action Description Language is considered an advancement to STRIPS (https://en.wikipedia.org/wiki/Action_Description_Language). The ADL relaxed some of the restrictions on STRIPS and made it possible to encode more realistic problems. Some relaxed restrictions include support for both positive and negative literals, the use of quantified variables in goals, conditional effects and many others. The Planning Domain and Definition Language was inspired by STRIPS, ADL and has been in use at the International Planning Competition since 1998. In their paper, Modeling Continuous time dependent effects (2002) Fox and Long argue for “the adoption of a common formalism for describing planning domains fosters far greater reuse of research and allows more direct comparison of systems and approaches, and therefore supports faster progress in the field. A common formalism is a compromise between expressive power (in which development is strongly driven by potential applications) and the progress of basic research (which encourages development from well-understood foundations). The role of a common formalism as a communication medium for exchange demands that it is provided with a clear semantics.”. In its current version (PDDL3.1) PDDL covers areas of planning and search including the domain description, problem description, numeric fluents, plan metrics, predicates, constraints, object-fluents and many others. A number of extensions and variants of PDDL have been developed since its invention including NDDL (NASA, 2002), PPDDL and RDDL. PPDDL extends PDDL to account for probabilistic effects, reward fluents and goal rewards This eventually allowed PDDL to realise Markov Decision Process planning. The PDDL has been a solid contributor to AI for over a decade through itself and a number of extensions and variations.

These developments have contributed to the development of robust AI planning and search frameworks in terms of representation, analysis of complexity and theorem proving as well as application of other techniques to AI planning such as searching.