Evolution of knowledge representation in planning problems

AI planning as a topic of study emerged from research and the needs of industry. Research in the areas of state-space search, theorem proving and control theory and practical needs in areas such as robotics and scheduling gave rise to a huge number of solving algorithms and representational techniques that evolved and cross-pollinated to increase efficiency and the available of solutions for problems of different nature. The representation of the problem was fundamental to achieve progress in the domain and one of the pioneer methods with a novel representation approach was **STRIPS** (Fikes and Nilsson 1971). The acronym stands for STanford Research Institute Problem Solver. This methodology helps to find a sequence of operators in a state-space to prove that a goal state can be true. The main motivation behind STRIPS was to create a framework to solve class problems with robots re-arranging objects and navigating, where the representation model is quite complex and general in comparison with the ones needed for certain puzzles and games. One of the great benefits of the methods was given by its combination of **GPS** (General purpose solver) and theorem proving methods allowing the representation of much more complex state-spaces (a drawback of the GPS method) and provides much more power search heuristics (a drawback of theorem proving methods). However, the real value of STRIPS was given more by its representation model than by its algorithmic approach. Most of what we know now as ‘classical’ language is similar to STRIPS.

An evolution of STRIPS was presented as **ADL** (Pednault, 1986), which stands for Action Description language. ADL relaxed some of the restriction of STRIPS and allowed to encode more realistic real world problems, such as capturing the nondeterministic effect by actions in the real world. Contrary to STRIPS, where everything not mentioned in the conditions is assumed to be false, in ADL the open world assumption is taken and if something is not present in the conditions, is assumed to be unknown.

A new representational language was presented in 1998, **PDDL** (Ghallab et al, 1998). This acronym stands for Planning Domain Descriptive Language and the language was created as a way to standardize the syntax to represent planning problems. The adoption of a common formalist to represent problems in the field helped to foster its development by allowing comparison of system and approaches and the reuse of research (Fox M., Long D., 2002). The language among other reasons was created to make the IPC (International Planning Competition) possible and evolved with each competition. The most current one is the PDDL 3.1 which introduced object-fluents, allowing not only the representation of numbers but any object-type also (Helmert. E., 2008). Additional variants and extension appeared to account for more complex situations such as PPDDL (Probability PDDL), NDDL (New Domain Descriptive Language) used by NASA in the planning of its space missions.