Research Review for the AIND Planning-Master assignment

Full scale of PDDL2 description is out of scope of this report. Instead the focus here is mark the changes that were introduced with the PDDL3. The Planning Domain Definition Language (PDDL) is an attempt to standardize Artificial Intelligence planning languages (Wikipedia: https://en.wikipedia.org/wiki/Planning_Domain_Definition_Language).

PDDL3 version was introduced by Gerevini and Long (2005). The authors proposed increasing plan quality by introducing hard and soft constraints on plan trajectories and plan goals. Soft constrains are those that are desired to be achieved but their achievement is not necessary for the plan to be acceptable. For example, in air cargo domain, a plan can be preferred where all planes are used, rather than a plan using 100 units of fuel less.

To achieve state trajectory constraints new basic modal operators *always, sometime, at-most-once* and *at-end* were introduced (Gerevini and Long, 2005). These modal operators are not-nested. Goal should be interpreted with respect to an entire trajectory in contrast to the original semantic where a state is matched to the goal: $State \vDash Goal$. Goal definition was changed to incorporate state trajectory.

Gerevini and Long (2005) proposed additions to the PDDL were eventually accepted and became to be known as PDDL3. New changes enhanced expressiveness of the planning language allowing tackling more modern tasks.

GRAPHPLAN was introduced by Blum and Furst (1995). GRAPHLAN provided an algorithm that allowed extracting a plan directly from the planning graph (Russell and Norviq). At that GRAPHPLAN was faster by about an order of magnitude compared to partial-order planners (Blum and Furst, 1997).

Representation language used in various planners was actually started by STRIPS (Fikes and Nilsson, 1971). STRIPS introduced a world model that was defined by well-formed formulas (wffs) and first-order predicate calculus. STRIPS separated the process of theorem proving from the process of searching through a space of world models. Search tree was created where each node represented the state of the world. Predicates were moved in/out of ADD and DELETE lists for every action.

Blum, A. L. and Furst, M. (1995) Fast planning through planning graph analysis. *In IJCAI-95,* pp. 1636 – 1642.
Blum, A. L. and Furst, M. (1997) Fast planning through planning graph analysis. *AIJ*, 90(1-2), pp. 281 – 300.
Gerevini, Alfonso and Long, Derek (2005) Plan Constraints and Preferences in PDDL3, *The Language of the Fifth International Planning Competition*, Technical Report.
Fikes, R. E. and Nilsson, N. J. (1971) STRIPS: A new approach to the application of theorem proving to problem solving, *Artificial Intelligence*, 2, 189 – 208.
Norviq, P. and Russell, S. J., Artificial Intelligence: A Modern Approach, 3rd edition.