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Some important historical developments in the field of AI planning and search

Automated planning and scheduling, sometimes denoted as simply planning, is a key ability for intelligent systems, increasing their autonomy and flexibility through the construction of sequences of actions to achieve their goals [1]. Unlike classical control and classification problems, the solutions are complex and must be discovered and optimized in multidimensional space and it has been an area of research in artificial intelligence for over three decades [2]. Planning techniques have been applied in a variety of tasks including robotics, process planning, web-based information gathering, autonomous agents and spacecraft mission control.

Action language is a language for specifying state transition systems, and is commonly used to create formal models of the effects of actions on the world. Action language describes how actions affect the states of systems over time, and may be used for automated planning [3]. Below are some details on three important historical developments of the action languages in the field of AI planning and search.

Stanford Research Institute (SRI) **Problem Solver** (STRIPS) is an automated planner developed by Richard Fikes and Nils Nilsson in 1971 at SRI International [4]. The same name was later used to refer to the formal language of the inputs to this planner. STRIPS instance is composed of an initial state, goal states, and actions (preconditions and effects). Once the problem is defined the STRIPS can search all possible states, starting from the initial state, executing various actions, until it reaches the goal [5]. *This language is the base for most of the languages for automated planning problem instances in use today*.

The Planning Domain Definition Language (PDDL) is an attempt to standardize AI planning languages inspired by the well-known STRIPS formulations of planning problems shortly described above. It was first developed by Drew McDermott and his colleagues in 1998 [6, 7] mainly to make the 1998/2000 International Planning Competition (IPC), and have been used as *a standardized syntax for each consecutive IPC* since that time [8]. PDDL model of the planning problem is separated into two major parts: domain description and the related problem descriptions (multiple descriptions can be connected to the same domain), thus domain and a connecting problem descriptions form a planning-problem model serves as an input of a domain-independent AI planner. *PDDL has significantly improved over time to support many sophisticated features*, such as variable types, action costs, action preferences, timed literal, object-fluents etc. even though no planning software available today supports all of these features of modern PDDL [8]. Several successors and extensions of PDDL have been developed since 1998, and some of them represents a planning language with quite significant modifications of the original PDDL.

Multi Agent Planning Domain Definition Language (MA-PDDL) is an attempt to *standardize the description of multi-agent planning (MAP) problems*, similarly to PDDL in the single-agent setting, was introduced in 2012 [9]. MA-PDDL is a modular (allowing to use just some of the features of MA-PDDL) extension of PDDL3.1 that *allows declaration of multi-agent planning domains and problems* with different agents having possibly different actions, goals and metrics, where concurrent/joint actions may interact. Later on, in 2013, the MA-PDDL was extended with partial-observability and probabilistic-effects to *model more realistic domains*, thus *both cooperative and non-cooperative solutions can be achieved* [10].

References:

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