Historical Developments in the field of AI Planning and Search
Relationships between the developments and their impact on the field of AI

Automated Planning and scheduling is one of the most important fields of Artificial Intelligence that concerns the realisation of strategies or action sequences, typically for execution by intelligent agents, autonomous robots and unmanned vehicles. The solutions for these problems are complex and must be discovered and optimised in multidimensional space.

This is further complicated in dynamically unknown environments where the strategy needs to be revisited if the environment changes in some way. Models and policies must be adapted and solutions resort to iterative trial and error processes.

The simplest possible planning problem, often known as the **Classical Planning Problem** is determined by a unique known initial state, duration less actions, deterministic actions which can be taken only one at a time and a single agent.

Investigations into state-space search, theorem proving and control theory and from the practical needs of robotics, scheduling and other domains led to important research work in AI Planning. The first major planning system, **STRIPS** (**S**tanford **R**esearch **I**nstitute **P**roblem **S**olver) developed by Richard Fikes and Nils Nilsson in 1971 at **SRI International** was one of the most important breakthroughs in the field of AI Planning. It was designed as the planning component of the software for the **Shakey robot** project at **SRI**. This robot was the first of its kind general-purpose mobile robot to be able to reason about its own actions. While other robots at that time, had to be instructed on each individual step of completing a larger task, Shakey could analyse commands and break them down into basic chunks by itself. Along with STRIPS, some other notable results of this robot included **A* search algorithm** which is widely used in pathfinding and graph traversal and the **Hough transform**, a feature extraction technique used in image analysis, computer vision and digital image processing.

The same name **STRIPS** was later used to refer to the language that was used to make the planning component of the robot. This language was used as the base for most of the future languages for expressing automated planning problem instances in use today, commonly known as action languages. The **Problem Domain Description Language,** or **PDDL** (Ghallab *et al.,* 1998), one of these action languages, was introduced as a computer-parsable, standardised syntax for representing planning problems and has been used as the standard language for the International Planning Competition since 1998. The first official version of this language separated the model of the planning problem in two major parts **domain description** and the related **problem description**. **PDDL 2.1 i**ntroduced **numeric fluents** (e.g. to model non-binary resources such as fuel-level, time, energy, distance, weight, ...), **plan-metrics** (to allow quantitative evaluation of plans, and not just goal-driven, but utility-driven planning, i.e. optimisation, metric-minimization/maximization), and **durative/continuous actions** (which could have variable, non-discrete length, conditions and effects). This allowed the representation and solution of many more real-world problems than the original version of the language.

To this day, Automated Planning and scheduling is a very important field in Artificial Intelligence domain and is used to solve a lot of complicated problems in the most efficient methods possible, e.g. **NASA's Ames Planning and Scheduling Group** has

developed and demonstrated techniques for planning and scheduling with complex temporal and resource constraints in a wide range of NASA applications involving ground, flight and surface operations. Research at the Department of Applied Informatics of University of Macedonia in the last years focused on the problem of scheduling personal tasks that appear in a user's calendar. The department of Informatics at the Aristotle University of Thessaloniki has investigated the application of AI Planning in e-Learning and composition of semantic web services.

References:

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