Planning Historical Developments Research Review

This is a brief review of major planning and search developments, the relationship between them and their influence in the artificial intelligence field.

1) Stanford Research Institute Problem Solver (STRIPS)

STRIPS is an automated planner designed by Richard Fikes and Nils Nilsson [1]. The automated planner's goal was to find a series of operators in a space of models to alter an initial state into a model in which a given goal can be proven to be true.

During the development of Shakey, which was the first AI-based robot, developed at the Artificial Intelligence laboratory of Stanford Research Institute, the researchers devised a planner called STRIPS which the robot used to perform task such as route planning, and object rearrangement. The STRIPS representation, which is based on either primitive or derived features, is used in determining primitive values in a state relative to the previous state and on which action an agent will take next.

The impact of STRIPS in the artificial intelligence field was greater in terms of the representation language it created [2], which is very close to the "classical" planning language. This language described a set of applicable operators that allowed to transform one state into a different state. This definition of a framework to solve complex planning problems has been a central to much of there search in artificial intelligence [3]. STRIPS was primarily used for robot research at SRI (Stanford Research Institute) [1].

2) Planning Domain Definition Language (PDDL)

The PDDL was the first modeling language to be used widely for solving planning problems and it has remained the standard for the International Planning Competition since 1998 [2].

The PDDL was primarily inspired by STRIPS (discussed above), and ADL (The Action Description Language), which is a simpler representation of STRIPS that allows to encode more realistic problems by relaxing some of the STRIPS restrictions [2].

The usage of a common language for representing and solving planning problems encourages great erre use of research, allows to analyze different approaches in an easier way and thus aids faster progress in the artificial intelligence field [4].

Later, in an attempt to standardize the various AI planning languages, and which was influenced by STRIPS, researchers defined the Planning Domain Definition Language or PDDL. PDDL consists of two parts, the domain definition and the problem specification. [4]

The domain definition is constituted by the predicates of the domain and its operators. The problem definition has the objects present in the problem instance, a description of the initial state and the desired goal. PDDL is still heavily used today and is considered state-of-the-art for planning and AI planning competitions such as International Planning Competition or IPC. [4]

3) Graphplan

Graphplan is an algorithm which is used in a planner and was developed in 1995. It takes as input, a planning problem, that has been implemented in STRIPS, and will attempt to output a series of actions that will lead to the final goal state of the problem. It is called a graphplan because it uses a planning graph to minimize the search time and to find a more direct path without having to search the entire state space, which is costly in terms of computational complexity. [5]

4) WARPLAN

Early research in the planning domain normally used linear programming [2], which considers totally ordered action sequences. This approach was soon learned to be incomplete and the notion of inter leaving; being able to interleave actions from different sub-plans within a single sequence was introduced.

WARPLAN is a planner written by David Warren which implements a solution known as goal regression planning to the interleaving problem.

WARPLAN was the first planner to be written in a logic programming language (Prolog) [2]. The implementation of a planner using such language was able to showcase the great benefits in terms of reduced complexity that can be achieved by using logic programming languages. WARPLAN is only100 lines of code [2].

All of these topics are intertwined by the initial development of the STRIPS planner. It ushered in a new world of planning procedures and algorithms that are still being developed today in order to more effectively find solutions to hard problems in a reasonable amount of time. We can thank these researchers at Stanford for pushing the world of AI search into the future.

References

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