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Artificial Intelligence Nanodegree

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AI planning and search
Series of Historical Developments

AI is the study of rational action, which means that planning - devising a plan of action to achieve one's goal - is a critical part of AI. Planning is the process of computing several steps of a problem-solving procedure before executing any of them. Though this problem can also be solved by search.

The main difference between search and planning is the representation of states. In search, states are represented as a single entity (which may be quite a complex object, but its internal structure is not used by the search algorithm). In planning, states have structured representations (collections of properties) which are used by the planning algorithm.

To represent planning problems we use Artificial Intelligence planning languages that describe environment's conditions which then lead to desired goals by generating chain of actions based on these conditions.

STRIPS

It is an action language which was a part of the first major planning system with the same name.

Shakey, the robot

Originally STRIPS was a name for the planning component in software used in Shakey, the robot developed at the Stanford Research Institute (SRI), which was the first machine to be able to reason about its own actions. Shakey with his abilities (visual analysis, route finding, object manipulation and more) is called an ancestor of self driving cars, military drones, Mars rovers and overall field of Robotics and AI. As a part of this revolution, STRIPS planner gave Shakey the ability to analyse commands (the goals) and break them down into plan of all needed actions.

STRIPS, classical planning language

Representational language used by STRIPS planner has much bigger impact on field of AI than its algorithms and is the base for the most of languages used to describe planning problems. STRIPS as a classical planning language is composed from states, goals and set of actions:

- State is a conjunction of positive literals which cannot contain variables and invoke functions.

- Goal, similarly to the state, is conjunction of positive and ground (no variables and no functions) literals.

- Actions (also called operators) include preconditions and postconditions. Both represented as a conjunction of function-free literals. Preconditions describe the state of world required to perform action, while postconditions describe state of the world after action is executed.

ADL (Action Description Language)

ADL is one of STRIPS extensions which removed some of its constraints to handle more realistic problems. Unlike STRIPS, ADL doesn't assume that unmentioned literals are false, but rather unknown, what is better known as the Open World Assumption. It also supports negative literals, quantified variables in goals.

PDDL (Planning Domain Definition Language)

It was an attempt to standardise planning languages what made International Planning Competition (IPC) series possible. In other words PDDL contains STRIPS, ADL and much more other representational languages.

Automated planning and scheduling is one of the major fields of AI. Current development of Machine Learning (Deep Learning) or Computer Vision put Planning in the shade (esp. in news and social media). But having in mind that it's deeply rooted in our lives (factory robots, intelligent vacuum cleaners, planning agents and more) and its development shapes our future (autonomous cars, drones) — it definitely shouldn't be ignored.

References

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- Shakey the robot, Technical note 323, http://www.cs.uml.edu/~holly/91.549/readings/629.pdf

- Shakey in Computer History Museum: http://www.computerhistory.org/revolution/artificial-intelligence-robotics/13/289