

Planner Research Review

In this short review, the research papers in the major turning point of planner types are described, highlighting the relationship between them and their influence in the Artificial Intelligence field.

Hierarchical Linear Planners

Hierarchical linear planner was introduced by Sacerdoti (1974) [1], which was called ABSTRIPS (Abstraction-Based STRIPS) in his own article. Before linear planning was introduced, the plans were represented as a whole linear sequence of actions, such as the most famous STRIPS. This article made modification on STRIPS, first decomposed the linear sequence into hierarchies of actions, thus has a huge impact on the AI field.

By using a hierarchy of abstraction space in which successive levels details are introduced, it can easily discriminate between important information and details, unlike previous direct search on the whole linear sequence. This method can significantly increase the problem-solving power of the planner.

Sussman Anomaly

The linear planner was soon found incomplete by Sussman (1975) [2], when he was solving Sussman anomaly on HACKER System. In the problem, three blocks (labeled A, B, and C) rest on a table. The agent must stack the blocks such that A is atop B, which in turn is atop C.

However, it may only move one block at a time. The problem starts with B on the table, C atop A, and A on the table. The linear planners typically separate the goal (stack A atop B atop C) into sub-goals, such as: 1. get A atop B 2.get B atop C. However, no matter which goal is first reached, the second goal cannot be made unless the first goal is undone, which is not allowed in linear planner.

This finding disproved the incompleteness of linear planner, which led to the following finding of non-linear planners.

Hierarchical Non-Linear Planners

Sacerdoti (1975) [3] acknowledged the incompleteness of linear planner, analyzed Sussman Anomaly in detail in this article, and introduced hierarchical non-linear planner, which was called procedural net by him. Instead of linear hierarchical sequence of actions, this method uses network of partial ordering of actions, thus introduces non-linearity.

Sacerdoti (1975) [4] discussed procedure net in more detail. It also developed a computer system called NOAH (Nets of Action Hierarchies), which can implement above algorithm in this system. It first creates a one-step solution to the goal, and then expand the level of the detail of the solution, filling in every detailed action.

After this, following NOAH, more and more non-linear planners were introduced by others.

1. Sacerdoti, Earl D. "Planning in a hierarchy of abstraction spaces." *Artificial intelligence* 5.2 (1974): 115-135.
2. Sussman, Gerald Jay. A computer model of skill acquisition. Vol. 1. New York: American Elsevier Publishing Company, 1975.
3. Sacerdoti, Earl D. The nonlinear nature of plans. No. SRI-TN-101. STANFORD RESEARCH INST MENLO PARK CA, 1975.
4. Sacerdoti, Earl D. A structure for plans and behavior. SRI INTERNATIONAL MENLO PARK CA ARTIFICIAL INTELLIGENCE CENTER, 1975.