# The Development on Planning Methods

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The most exciting and fundamental section of reaching Artificial Intelligence is planning and searching. There are three core elements in Artificial Intelligence, including goals, actions and states, which are frequently applied by an intelligent agent to complete certain required goal by reasoning about future states and plotting a sequence of actions according to this goal. This short report will cover three main developments in the planning and searching development of Artificial Intelligence, which are linear planning, non-linear planning and temporal planning.

Firstly, let's discuss linear planning, which was developed in the early 70's of the last century. Basically, an agent is to work on a single goal up upon the completely completion of the problem, which is the basic theory behind linear planning. This means that the agent should complete the first goal and then move on to the next task. And this linear planning requires its algorithms to depend on totally ordered action sequences, where problems can be decomposed into subgroups. Linear planning system is advantageous compared to other techniques in their simplicity. Linear planning techniques require a smaller search space then the later techniques, for the reason that goals are resolved in a serial way. However, linear planning also owns some disadvantages. For example, it might create suboptimal solutions depending on the predefined ordering of goals. In addition, sometimes the solutions can be over specific, where some of the ordering are accidental by forcing an ordering of input operators where they aren't required to be mutually ordered. Furthermore, after completing another sub-goal, by naively pursuing a sub-goal, the second goal might clobber the first goal.

Secondly, we will discuss non-linear planning, which was developed in the 80's in of the last century. The fundamental concept behind non-linear planning is to treat the goal as a set of unordered operators but not a stack of ordered individuals. The outstanding point of non-linear planning is that it creates optimal results and executions that make it more flexible in parallel execution of subgroups through using decomposition and partial ordering of the subgroups. We can see that non-linear planning is more efficient as there is a set of ordered linear plans in the non-linear plan, and it can avoid back tracking in the graph when state conflicts are detected. Also, the non-linear has some drawbacks. One of them is that it produces a much bigger search space in the growth in the number of possible states. And the larger space needs more complex search algorithms to process.

Lastly, we will talk about temporal planning. As we have known, both of the two classical planning methods as mentioned above, linear planning and non-linear planning, have a discrepancy in accounting for time. One assumption that they both set before running is that all actions do not have any duration and transform their state instantaneously. But interestingly in the really life situation things like scheduling and robotics could be disordered, which means that things occur over a span of time and even could overlap, and no need to say run concurrently and create dependencies. When it comes to this situation, we need the last tools that we are discussing, the temporal planning. It includes the notion of time and accounts for duration of agent's actions. Temporal planning allows actions to overlap with working concurrently, and a variety of actions can be taken simultaneously while their durations may be different, and actions

or events may have complex interdependencies.

References

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