Chapter XV
A Visual Programming Tool for Designing Planning Problems for Semantic Web Service Composition

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ABSTRACT

This chapter is concerned with the issue of knowledge representation for AI planning problems, especially those related to semantic Web service composition. It discusses current approaches in encoding planning problems using the PDDL formal language and it presents ViTAPlan, a user-friendly visual tool for planning. More than just being a user-friendly environment for executing the underlying planner, the tool serves as a unified planning environment for encoding a new problem, solving it, visualizing the solution, and monitoring its execution on a simulation of the problem’s world. The tool consists of various sub-systems, each one accompanied by a graphical interface, which collaborate with each other and assist the user, either a knowledge engineer, a domain expert, an academic, or even an end-user in industry, to carry out complex planning tasks such as composing complex semantic Web services from simple ones in order to achieve complex tasks.
INTRODUCTION

Planning is the process of finding a sequence of actions (steps), which if executed by an agent (biological, software, or robotic), result in the achievement of a set of predefined goals. The sequence of actions previously mentioned is also referred to as plan.

The actions in a plan may be either specifically ordered and their execution should follow the defined sequence (linear plan), or the agent is free to decide the order of executions as long as a set of ordering constraints are met. For example, if someone wishes to travel by plane, there are three main actions that he or she has to take: (a) buy a ticket, (b) go to the airport, and (c) board on the plane. A plan for traveling by plane could contain these three actions in a strict sequence as the one defined previously (first do action a, then b, and finally c), or it could just define that action c (board on plane) should be executed after the first two actions. In the second case, the agent would be able to choose which plan to execute since both a → b → c and b → a → c sequences would be valid.

The process of planning is extremely useful when the agent acts in a dynamic environment (or world), which is continuously altered in an unpredictable way. For instance, the auto pilot of a plane should be capable of planning the trajectory that leads the plane to the desired location, but also be able to alter it in case of an unexpected event like an intense storm.

The software systems that automatically (or semi-automatically) produce plans are referred to as planners or planning systems. The task of drawing a plan is extremely complex and it requires sophisticated reasoning capabilities, which should be simulated by the software system. Therefore, planning systems make extensive use of artificial intelligence techniques and there is a dedicated area of AI called automated planning.

Automated planning has been an active research topic for almost 40 years and during this period a great number of papers describing new methods, techniques, and systems have been presented that mainly focus on ways to improve the efficiency of planning systems. However, there are not many successful examples of planning systems adapting to industrial use. From a technical point of view, this can be mainly explained by four reasons: (a) There is a general disbelief by managers and workers in industry that AI tools can really assist them, (b) There is a need for systems that combine methods from many areas of AI such as planning, scheduling, and optimization, (c) The industry needs more sophisticated algorithms than can scale up to solve real-world problems, and (d) in order for workers in industry to make use of these intelligent systems, they must be equipped with user friendly interfaces that: (i) allow the user to intervene in certain points and (ii) can reason about the provided solution.

The greatest problems that one faces when he or she tries to contact companies and organizations for installing a planning system come from the workers themselves. These problems concern two issues: (a) It has been noticed that people find it hard to trust automated systems when it comes to crucial processes. Many people still think that they can do better than machines. (b) There is a quite widespread phobia toward computers and automated machines due to the lack of information. A large number of people are afraid of being replaced or governed by machines and they try to defend their posts by rejecting everything new.

Although it is necessary for researchers to specialize in very specific parts of their research area, commercial systems, dealing with real time problems, have to combine techniques and methods from many areas. It has been shown that AI planning techniques for example, are inadequate to face with the complexity and the generality of real world problems. For example, it has been proven that scheduling and constraint-solving techniques can handle resources more efficiently. Commercial applications must combine methods...
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