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Chapter VII

AI Planning and Intelligent Agents

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ABSTRACT

This chapter provides an overview of complementary research in the active research areas: AI planning technology and intelligent agents technology. It has been widely acknowledged that modern intelligent agents approaches should combine methodologies, techniques and architectures from many areas of computer science, cognitive science, operation research, cybernetics, and so forth. AI planning is an essential function of intelligence that is necessary in intelligent agents applications. This chapter presents the current state-of-the-art in the field of intelligent agents, focusing on the role of AI planning techniques. It sketches a typical classification of agents, agent theories and architectures from an AI planning perspective, it briefly introduces the reader to the basic issues of AI planning, and it presents different AI planning methodologies implemented in intelligent agents applications. The authors aim at stimulating research interest towards the integration of AI planning with intelligent agents.

INTRODUCTION

Intelligent agents is an area of interest that attracts researchers from different Artificial Intelligence fields, such as distributed artificial intelligence, *AI Planning* and robotics, as well as classical computer science fields, such as information systems, databases, and human-computer interaction. Recently, research in intelligent agents has also started taking into consideration issues that are normally examined by cognitive science, operation research and cybernetics researchers. The research efforts of all these groups have contributed expertise and interesting results in intelligent agents technology during the last decade. AI has been considered as the main contributor to the field of intelligent agents (Jennings et al., 1998). However, which AI techniques would be appropriate for developing intelligent agent applications is a matter of thorough investigation.

AI planning seems to have attracted increased research interest in the last five years. The main reason for this significant increase is that planning systems have obviously been upgraded. Planners are becoming faster. They are now capable to synthesize over 100 plans in minutes. The development of new efficient methods and techniques enables more complex real-world problem solutions. Moreover, the implementation of new ideas contributes to better understanding of advanced AI planning techniques.

Intelligent agents are computational entities that *perceive* environmental conditions, *act* to affect conditions and *reason* about conditions and actions. Early research on *AI planning* has been concerned with the design of intelligent agents, because of the assumption that any artificial agent needs an AI planning system to reason and take decisions about its actions.

Agent technology is one of the vehicles of AI planning research towards practical real-world applications. On the other hand, intelligent agents research has taken advantage of AI planning contribution. AI planning is a critical technology for the control of intelligent agents, and especially for multi-agent architectures where plans can facilitate coordinated actions. The term “*planning agent*” means an intelligent agent that constructs and executes a sequence of actions that achieve a given goal.

Intelligent agents are categorized into two broad classes: *robots* and *softbots*. A *robot* is a hardware entity that is equipped with sensors, actuators and software for perception, modeling of the environment, and acting. A *softbot* (software robot) is a *software agent* that interacts with a software environment. Softbots resemble physical robots in several aspects. They both have perception and effectors mechanisms, but while robots have machinery parts, softbots have software parts. Nowadays software becomes more and more complex. An increasing request for finding intelligent ways to support software users have intensified research efforts on software agents.

In the following, this chapter starts with a brief introduction to the basic issues of intelligent agents. Definitions of the notion of an agent, agent terminology and agent classification are presented. The reader can then be familiarized with the basic issues in AI planning. Next, the theoretical foundations of agents and various agent architectures are discussed, emphasizing AI planning. Different AI planning techniques, which are used to control intelligent agents, are also discussed. Then, AI planning techniques for multi-agent environments are presented. The utility of AI planning techniques in various

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