1. INTRODUCTION

At the AI*IA 1994 meeting in Parma I spoke with a scientist of a different AI field about the planning area and its achievements. This person had the strong feeling that planning research had just concerned toy problems and unrealistic theoretical assumptions, and gave also examples of fields in which on the contrary both the problems addressed and the related theoretical accounts had been more incisive. This external perception of the fields is indeed quite common and maybe is motivated by the fact that older AI textbooks describe automated planning by giving just basic representations, algorithms, and some standard example from the blocks world. Being an active researcher in the area my feeling has always been rather different. In particular, I think that theoretical and practical aspects are close together in a rather unique combination. Moreover, in the last ten years a strong push has pervaded the community towards deeper theoretical work integrated with advancement in tackling realistic domains. At that time, I was not particularly successful in explaining my feeling in that discussion, and later on I happened to be thinking about the way for giving the right “image” of planning research to a broader audience. When I was asked to prepare a special issue on Planning for AI*IA Notizie I decided to make an attempt in that direction inviting a limited number of people to write papers concerning different aspects of active planning research. The reader may directly see the results in this issue. This short introduction gives just an overview of the planning problem and points to different active areas in which the various papers are situated.

2. CURRENT PLANNING RESEARCH

Given a representation of a domain and of a set of actions that an agent (or planner) may perform in that domain, a planning problem consists of synthesizing a sequence of actions that allows the domain to change from a given initial state to a final state in which particular desired aspects (goals) are verified. Investigations on the problem have started since the beginning of AI research and a number of relevant systems have been realized that contain various advancements (e.g., STRIPS, NOAH, NONLIN). All those planners were working considering that certain assumptions hold: (a) the planner considers that actions are instantaneously executed, so no explicit representation of time is needed, (b) actions have deterministic effects, in particular the effects of an action only depend on the action itself and on the state in which the action is applied; (c) the planner has complete knowledge of the initial state and of the world in general; (d) the planner is the only cause of change in the domain. Such assumptions at present characterize the so-called “classical planning” problem. Even if they are rather strong, they satisfactorily describe several real problems. Since mid 80s an increasing amount of research has been devoted to the development of a theory of classical planning. Starting from the work of Chapman several researchers have contributed to clarify the different aspects involved in the representation formalisms and the related algorithms.

In the 80s a lively debate also started to criticize the classical planning assumptions because of the impossibility to tackle a number of very interesting practical problems.

In particular people studying AI and robotics were strongly criticising assumption (d). To build a plan requires some time to the planner. When the plan is executed in the real environment the actual domain may be very different from the one initially described to the planner. A number of studies started that seriously consider the problem of having the planner taking into account a changing external environment. We call “reactive planning” this area of research that indeed includes many different approaches.

Other researchers more recently started to criticize assumption (b) and consider actions having non-deterministic effects. More specifically they study the interesting case in which a probability distribution may be defined over possible different outcomes of an action. This and several other problems are tackled in a research direction we call “planning with uncertainty”.

It should be noted that both reactive and uncertainty planning criticize also assumption (c) assuming at different levels that the planner has a partial knowledge of the domain.

Other research directions somehow accept assumption (b-d) but tried to relax assumption (a). For example, in seve-
real situation the execution of an action requires time, and that time is the relevant part of the planning problem. This and other aspects are dealt with in an area we call “activity management planning”. The area addresses problems like planning of production processes, the integration of planning and scheduling, etc. This research is devoted to build general purpose planning architectures; the emphasis is not much on real-time planning but more on allowing the users to describe complex domains, having flexibility to adapt to different applications, to manage solutions of rather huge dimension, etc.

Examples from the areas defined above can be found in this special issue. Other directions exist that are not considered here, we give just two examples: (a) planning in natural language processing; (b) the emerging problem of planning in multi-agent domains. These and other problems contain their own peculiarities that contribute to make the planning research scenario quite rich.

3. ABOUT THE SPECIAL ISSUE

This issue contains contributions aimed at showing different research examples of how planning is moving away from classical assumptions.

The first paper, by Alfredo Milani is the closest to the classical planning framework. The paper concerns the synthesis of “conditional plans” to enrich the behavior of plans at execution time. Broadly speaking, conditional plans contain conditions to be tested at execution time to obtain more than one possible sequences of actions.

The second paper, by Paolo Traverso considers the reactive planning problem. The paper contains a number of useful distinctions among the different approaches to the problem and presents an attempt to formally describe aspects of reactivity. It is worth noting the rather sharp difference in how the two papers face the problem of plan execution.

The third and fourth papers concern planning architectures for activity management. Austin Tate presents his ideas on the design of a planning ontology. The paper extends the author’s previous work on the representation language used in the O-PLAN architecture to include aspects relevant both to interface a planning system with general software environments and/or users and, more generally, to enable the sharing of planning knowledge among different applications.

The paper by Steve Smith, Ora Lassila, and Marcel Becker addresses other interesting issues. It investigates the requirement of a mixed initiative planning framework in which the system and the user may interact to solve a problem. It also discusses the fact that different application domains have peculiarities that a planning framework should flexibly deal with but avoiding redundancies. Examples are given from the DITOPS architecture. It is to be noted that both papers show the importance that different methodological aspects are taking in this area (see influences from software engineering, constraint programming, object-orientation, etc.).

The final paper, by Tom Dean contains in the first part useful references to planning under uncertainty and points out the importance of studying learning in planning; in the second part the author shares with the readers some reflections on the relation between theoreticians and practitioners in planning research and gives also his personal view on open problems for the future. I do hope his “letter” will find somebody ready to answer.

For the readers who need more introductory material on the subject I just mention the recent book by S.Russell and P.Norvig (Artificial Intelligence: A Modern Approach, Prentice Hall, 1995) where a modern introduction to classical planning and introductory material on some of the other problems may be found.

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