

Preface

One motivation for studying automated planning is very practical: the need for information processing tools that provide affordable and efficient planning resources. Such tools are needed for use in complex and changing tasks that involve demanding safety and/or efficiency requirements. They are needed for integrating more autonomy and intelligent control capabilities in complex artifacts. Automated planning technology is already capable enough to be useful in a variety of demanding applications, in areas ranging from controlling space vehicles and robots to deploying emergency operations and playing the game of bridge.

Another motivation for automated planning is more theoretical. Planning is an important component of rational behavior. If one purpose of Artificial Intelligence (AI) is to grasp the computational aspects of intelligence, then certainly planning, as the reasoning side of acting, is a key element in such a purpose.

These two motivations create the potential for synergy between theory and practice in automated planning. By observing what works well in practice, it is possible to develop better theories of planning. These better theories will in turn lead to better planning systems for practical applications.

The intent of this textbook is to give readers an understanding of automated planning theory and automated planning practice and how they relate to each other. The book contains a set of theoretical chapters to introduce the theory of automated planning and a set of case-study chapters to illustrate how to adapt and combine automated planning techniques in a variety of application domains.

Material Covered

The published literature related to automated planning is quite large, and it is not feasible in a single book to give detailed discussions of all of it. Our choice of what to cover was motivated by the following considerations.

The bulk of research on automated planning focuses on a restricted form called *classical planning*. We feel strongly that for the field of automated planning to realize its full potential, it needs to move beyond classical planning. For that reason, while covering classical planning as prerequisite introductory material, we have devoted large parts of the book to extended classes of automated planning that relax the various restrictions required by classical planning.

We also devoted a large part of the book to descriptions of application-oriented work. These chapters are mainly illustrative case studies. From the application point

of view, the field of planning is still in an early stage. It has not yet developed a mature engineering methodology to enable us to present a comprehensive mapping from the features of an application domain to the planning techniques that best address these features. We do hope that this book can contribute to the development of such a mature technology.

Using This Book

This book may be used both as a graduate-level textbook and as an information source for professionals in the field. We assume that readers already know the basic concepts of search algorithms, data structures, computational complexity, and programming languages at the level that one might get in an undergraduate computer science curriculum. Prior knowledge of heuristic search and first-order logic would also be helpful but probably is not strictly necessary since Appendices A and B provide overviews of those topics.

The book is composed of twenty-four chapters, which are organized into seven parts, and three appendices. Parts I and II cover a restricted model of planning problems and algorithms for planning within that model. Part III deals with heuristics and control strategies for planning; and Parts III to V discuss several extended models and planning algorithms. Part VI is devoted to five case studies and applications. In Part VII, the last chapter discusses briefly other problems and techniques related to planning, example, planning and acting or planning and learning, to which it was not possible to devote a full chapter.

Figure 1 shows which chapters depend on which others. The required precedence relationship is indicated by solid lines. The figure shows that one may proceed along several possible paths when studying the book. In particular, several of the application-oriented chapters can be tackled quite early. The book contains more material than can fit into a single semester. The precedence relationship between chapters can help teachers decide which chapters to cover.¹

Web Site

The publisher's Web site offers additional material related to this book. It contains links to related work; links to planning programs that may be downloaded at books.elsevier.com/mk/1558608567; copies of slides that have been used in lectures based on this book; and additional illustrations, examples, and exercises as may be appropriate.

1. As an example of what can be covered in a single semester, a recent course on planning at the University of Maryland covered the following chapters: 1, 2 (skipping set-theoretic representation), 3, 4, 5, 6, a quick overview of 7, most of 9, 10, 11, 14, 15, most of 16, most of 17, 20, 22, and 23. The course also included term projects in which the students, in groups of two or three people, proposed and carried out research projects on topics related to automated planning.

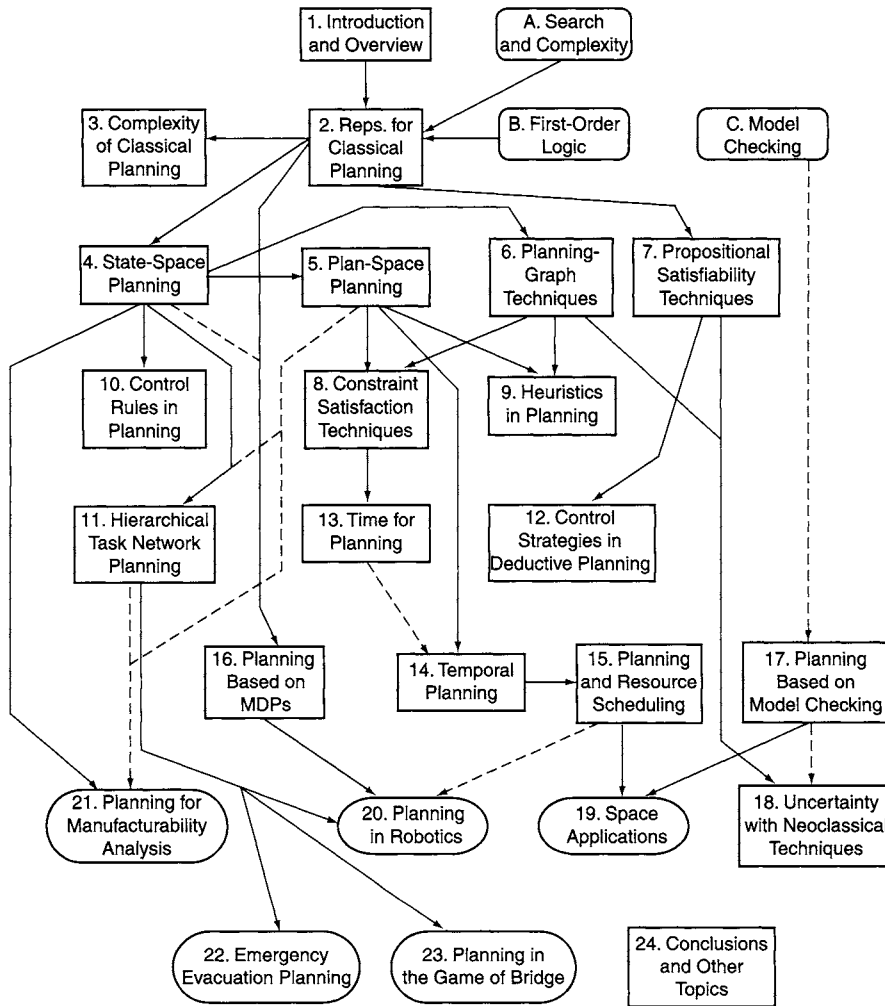


Figure 1: Dependencies among the chapters. Boxes with rounded corners represent appendices, boxes with square corners represent theoretical chapters, and ovals represent case-study chapters. A solid line means that one chapter is needed in order to understand another. A dashed line means that one chapter is not necessary for another but may help the reader understand it more deeply. The dependencies for Chapter 24 are not shown because each of its sections would need a different set of lines.

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