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Planning with Markov Decision Processes

An AI Perspective

**Mausam
Andrey Kolobov**

*SYNTHESIS LECTURES ON ARTIFICIAL
INTELLIGENCE AND MACHINE LEARNING*

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Planning With Markov Decision Processes An Ai Perspective Mausam

RJ Alexander



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Planning with Markov Decision Processes Mausam, Andrey Kolobov, 2012 Provides a concise introduction to the use of Markov Decision Processes for solving probabilistic planning problems with an emphasis on the algorithmic perspective It covers the whole spectrum of the field from the basics to state of the art optimal and approximation algorithms [Planning with Markov Decision Processes](#) Mausam Natarajan, Andrey Kolobov, 2022-06-01 Markov Decision Processes MDPs are widely popular in Artificial Intelligence for modeling sequential decision making scenarios with probabilistic dynamics They are the framework of choice when designing an intelligent agent that needs to act for long periods of time in an environment where its actions could have uncertain outcomes MDPs are actively researched in two related subareas of AI probabilistic planning and reinforcement learning Probabilistic planning assumes known models for the agent's goals and domain dynamics and focuses on determining how the agent should behave to achieve its objectives On the other hand reinforcement learning additionally learns these models based on the feedback the agent gets from the environment This book provides a concise introduction to the use of MDPs for solving probabilistic planning problems with an emphasis on the algorithmic perspective It covers the whole spectrum of the field from the basics to state of the art optimal and approximation algorithms We first describe the theoretical foundations of MDPs and the fundamental solution techniques for them We then discuss modern optimal algorithms based on heuristic search and the use of structured representations A major focus of the book is on the numerous approximation schemes for MDPs that have been developed in the AI literature These include determinization based approaches sampling techniques heuristic functions dimensionality reduction and hierarchical representations Finally we briefly introduce several extensions of the standard MDP classes that model and solve even more complex planning problems Table of Contents Introduction MDPs Fundamental Algorithms Heuristic Search Algorithms Symbolic Algorithms Approximation Algorithms Advanced Notes **An Introduction to the Planning Domain Definition Language** Patrik Haslum, Nir Lipovetzky, Daniele Magazzeni, Christian Muise, 2022-05-31 Planning is the branch of Artificial Intelligence AI that seeks to automate reasoning about plans most importantly the reasoning that goes into formulating a plan to achieve a given goal in a given situation AI planning is model based a planning system takes as input a description or model of the initial situation the actions available to change it and the goal condition to output a plan composed of those actions that will accomplish the goal when executed from the initial situation The Planning Domain Definition Language PDDL is a formal knowledge representation language designed to express planning models Developed by the planning research community as a means of facilitating systems comparison it has become a de facto standard input language of many planning systems although it is not the only modelling language for planning Several variants of PDDL have emerged that capture planning problems of different natures and complexities with a focus on deterministic problems The purpose of this book is two fold First we present a unified and current account of PDDL covering the subsets of PDDL that express discrete numeric temporal

and hybrid planning Second we want to introduce readers to the art of modelling planning problems in this language through educational examples that demonstrate how PDDL is used to model realistic planning problems The book is intended for advanced students and researchers in AI who want to dive into the mechanics of AI planning as well as those who want to be able to use AI planning systems without an in depth explanation of the algorithms and implementation techniques they use

A Concise Introduction to Models and Methods for Automated Planning Hector Geffner,Blai Bonet,2022-05-31

Planning is the model based approach to autonomous behavior where the agent behavior is derived automatically from a model of the actions sensors and goals The main challenges in planning are computational as all models whether featuring uncertainty and feedback or not are intractable in the worst case when represented in compact form In this book we look at a variety of models used in AI planning and at the methods that have been developed for solving them The goal is to provide a modern and coherent view of planning that is precise concise and mostly self contained without being shallow For this we make no attempt at covering the whole variety of planning approaches ideas and applications and focus on the essentials The target audience of the book are students and researchers interested in autonomous behavior and planning from an AI engineering or cognitive science perspective Table of Contents Preface Planning and Autonomous Behavior Classical Planning Full Information and Deterministic Actions Classical Planning Variations and Extensions Beyond Classical Planning Transformations Planning with Sensing Logical Models MDP Planning Stochastic Actions and Full Feedback POMDP Planning Stochastic Actions and Partial Feedback Discussion Bibliography Author s Biography

Explainable Human-AI Interaction Sarath Sreedharan,Anagha Kulkarni,Subbarao Kambhampati,2022-05-31 From its inception artificial intelligence AI has had a rather ambivalent relationship with humans swinging between their augmentation and replacement Now as AI technologies enter our everyday lives at an ever increasing pace there is a greater need for AI systems to work synergistically with humans One critical requirement for such synergistic human AI interaction is that the AI systems behavior be explainable to the humans in the loop To do this effectively AI agents need to go beyond planning with their own models of the world and take into account the mental model of the human in the loop At a minimum AI agents need approximations of the human s task and goal models as well as the human s model of the AI agent s task and goal models The former will guide the agent to anticipate and manage the needs desires and attention of the humans in the loop and the latter allow it to act in ways that are interpretable to humans by conforming to their mental models of it andbe ready to provide customized explanations when needed The authors draw from several years of research in their lab to discuss how an AI agent can use these mental models to either conform to human expectations or change those expectations through explanatory communication While the focus of the book is on cooperative scenarios it also covers how the same mental models can be used for obfuscation and deception The book also describes several real world application systems for collaborative decision making that are based on the framework and techniques developed here Although primarily driven by the authors own

research in these areas every chapter will provide ample connections to relevant research from the wider literature The technical topics covered in the book are self contained and are accessible to readers with a basic background in AI

Computational Science and Its Applications - ICCSA 2021 Osvaldo Gervasi,Beniamino Murgante,Sanjay Misra,Chiara Garau,Ivan Blečić,David Taniar,Bernady O. Apduhan,Ana Maria A. C. Rocha,Eufemia Tarantino,Carmelo Maria Torre,2021-09-10 The ten volume set LNCS 12949 12958 constitutes the proceedings of the 21st International Conference on Computational Science and Its Applications ICCSA 2021 which was held in Cagliari Italy during September 13 16 2021 The event was organized in a hybrid mode due to the Covid 19 pandemic The 466 full and 18 short papers presented in these proceedings were carefully reviewed and selected from 1588 submissions The books cover such topics as multicore architectures mobile and wireless security sensor networks open source software collaborative and social computing systems and tools cryptography human computer interaction software design engineering and others Part III of the set includes papers on Information Systems and Technologies and the proceeding of the following workshops International Workshop on Automatic landform classification spatial methods and applications ALCSMA 2021 International Workshop on Application of Numerical Analysis to Imaging Science ANAIS 2021 International Workshop on Advances in information Systems and Technologies for Emergency management risk assessment and mitigationbased on the Resilience concepts ASTER 2021 International Workshop on Advances in Web Based Learning AWBL 2021 **Statistical Relational Artificial Intelligence**

Luc De Raedt,Kristian Kersting,Sriraam Natarajan,David Poole,2022-05-31 An intelligent agent interacting with the real world will encounter individual people courses test results drugs prescriptions chairs boxes etc and needs to reason about properties of these individuals and relations among them as well as cope with uncertainty Uncertainty has been studied in probability theory and graphical models and relations have been studied in logic in particular in the predicate calculus and its extensions This book examines the foundations of combining logic and probability into what are called relational probabilistic models It introduces representations inference and learning techniques for probability logic and their combinations The book focuses on two representations in detail Markov logic networks a relational extension of undirected graphical models and weighted first order predicate calculus formula and Problog a probabilistic extension of logic programs that can also be viewed as a Turing complete relational extension of Bayesian networks **Predicting Human**

Decision-Making Ariel Rosenfeld,Sarit Kraus,2022-05-31 Human decision making often transcends our formal models of rationality Designing intelligent agents that interact proficiently with people necessitates the modeling of human behavior and the prediction of their decisions In this book we explore the task of automatically predicting human decision making and its use in designing intelligent human aware automated computer systems of varying natures from purely conflicting interaction settings e g security and games to fully cooperative interaction settings e g autonomous driving and personal robotic assistants We explore the techniques algorithms and empirical methodologies for meeting the challenges that arise

from the above tasks and illustrate major benefits from the use of these computational solutions in real world application domains such as security negotiations argumentative interactions voting systems autonomous driving and games The book presents both the traditional and classical methods as well as the most recent and cutting edge advances providing the reader with a panorama of the challenges and solutions in predicting human decision making

Agents and Artificial Intelligence Ana Paula Rocha, Luc Steels, Jaap van den Herik, 2024-03-14 This book contains the revised and extended versions of selected papers from the 15th International Conference on Agents and Artificial Intelligence ICAART 2023 held in Lisbon Portugal during February 22 24 2023 The 23 full papers included in this book were carefully reviewed and selected from 306 submissions The conference was organized in 2 tracks as follows One track focuses on Agents Multi Agent Systems and Software Platforms Distributed Problem Solving and Distributed AI in general The other track focuses mainly on Artificial Intelligence Knowledge Representation Planning Learning Scheduling Perception Reactive AI Systems and Evolutionary Computing and other topics related to Intelligent Systems and Computational Intelligence

Multi-Objective Decision Making Diederik M. Roijers, Shimon Whiteson, 2022-05-31 Many real world decision problems have multiple objectives For example when choosing a medical treatment plan we want to maximize the efficacy of the treatment but also minimize the side effects These objectives typically conflict e g we can often increase the efficacy of the treatment but at the cost of more severe side effects In this book we outline how to deal with multiple objectives in decision theoretic planning and reinforcement learning algorithms To illustrate this we employ the popular problem classes of multi objective Markov decision processes MOMDPs and multi objective coordination graphs MO CoGs First we discuss different use cases for multi objective decision making and why they often necessitate explicitly multi objective algorithms We advocate a utility based approach to multi objective decision making i e that what constitutes an optimal solution to a multi objective decision problem should be derived from the available information about user utility We show how different assumptions about user utility and what types of policies are allowed lead to different solution concepts which we outline in a taxonomy of multi objective decision problems Second we show how to create new methods for multi objective decision making using existing single objective methods as a basis Focusing on planning we describe two ways to creating multi objective algorithms in the inner loop approach the inner workings of a single objective method are adapted to work with multi objective solution concepts in the outer loop approach a wrapper is created around a single objective method that solves the multi objective problem as a series of single objective problems After discussing the creation of such methods for the planning setting we discuss how these approaches apply to the learning setting Next we discuss three promising application domains for multi objective decision making algorithms energy health and infrastructure and transportation Finally we conclude by outlining important open problems and promising future directions

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b pressure test procedures when you pressure test the bop system you must conduct a low pressure test and a high pressure test for each bop component excluding test rams and non sealing shear rams you must begin each test by conducting the low pressure test then transition to the high pressure test

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there are two elements to the pre job well site pressure test 1 wireline valve wlv pressure function test the tests should be performed on the test stump prior to rigging up and involves testing the pressure integrity of the wlv and the individual closed ram assemblies and the ram assembly functionality under pressure

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the purpose of bop stack function and pressure testing is to verify the hydraulic integrity of all the components of the bop stack at their rated working pressure in this article we will discuss the function test and pressure test procedure using cup tester

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all elmar wireline pressure control equipment is certified to be manufactured following api6a specifications to inhibitors for the pressure test the pressure test procedure for each assembly is stated on each assembly drawing equipment is stripped down rebuilt with new elastomers including bop ram outer seals and quick

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pressure all bop equipment tests must include a low pressure test of 250 psi before proceeding to the full pressure test test pressure held and recorded for a minimum of five minutes after full pressure has been established represents a satisfactory pressure test ensure rotary bushings are locked if left in place where h2s is present all

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feb 14 2011 1 prior to supping the well or the first time that bop is installed on the well 2 after repairing or disconnecting of any pressure sealing elements of bop 3 as per mms you can use bop for 21 days 3 weeks before you need to test it

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apr 17 2023 bop test plan bop testing consists of several pressure tests with different valve line ups in order to test all the components of the bop system careful planning is required to ensure all components are tested and in a minimum number of pressure tests in order to ensure efficient execution of drilling operations

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a wireline bop must always be installed between the wellhead and wireline lubricators this bop is a piece of pressure control equipment that can close around the wire and seal off the well pressure below it this enables the pressure to be bleed off above it allowing work or repairs to be carried out on equipment above the bop without pulling

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