

Roman Barták · Robert A. Morris · K. Brent Venable

An Introduction to Constraint-Based Temporal Reasoning

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Robert A Morris

**Amarnag Subramanya, Partha Pratim
Talukdar**



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An Introduction to Constraint-Based Temporal Reasoning Roman Barták, Robert A. Morris, K. Brent Venable, 2022-05-31 Solving challenging computational problems involving time has been a critical component in the development of artificial intelligence systems almost since the inception of the field This book provides a concise introduction to the core computational elements of temporal reasoning for use in AI systems for planning and scheduling as well as systems that extract temporal information from data It presents a survey of temporal frameworks based on constraints both qualitative and quantitative as well as of major temporal consistency techniques The book also introduces the reader to more recent extensions to the core model that allow AI systems to explicitly represent temporal preferences and temporal uncertainty This book is intended for students and researchers interested in constraint based temporal reasoning It provides a self contained guide to the different representations of time as well as examples of recent applications of time in AI systems

Reasoning with Probabilistic and Deterministic Graphical Models Rina Dechter, 2019-02-14 Graphical models e g Bayesian and constraint networks influence diagrams and Markov decision processes have become a central paradigm for knowledge representation and reasoning in both artificial intelligence and computer science in general These models are used to perform many reasoning tasks such as scheduling planning and learning diagnosis and prediction design hardware and software verification and bioinformatics These problems can be stated as the formal tasks of constraint satisfaction and satisfiability combinatorial optimization and probabilistic inference It is well known that the tasks are computationally hard but research during the past three decades has yielded a variety of principles and techniques that significantly advanced the state of the art This book provides comprehensive coverage of the primary exact algorithms for reasoning with such models The main feature exploited by the algorithms is the model s graph We present inference based message passing schemes e g variable elimination and search based conditioning schemes e g cycle cutset conditioning and AND OR search Each class possesses distinguished characteristics and in particular has different time vs space behavior We emphasize the dependence of both schemes on few graph parameters such as the treewidth cycle cutset and the pseudo tree height The new edition includes the notion of influence diagrams which focus on sequential decision making under uncertainty We believe the principles outlined in the book would serve well in moving forward to approximation and anytime based schemes The target audience of this book is researchers and students in the artificial intelligence and machine learning area and beyond

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

Introduction to Logic Programming Michael Genesereth, Vinay K. Chaudhri, 2022-06-01 Logic Programming is a style of programming in which programs take the form of sets of sentences in the language of Symbolic Logic Over the years there has been growing interest in Logic Programming due to applications in deductive databases automated worksheets Enterprise Management business rules Computational Law and General Game Playing This book introduces Logic Programming theory current technology and popular applications In this volume we take an innovative model theoretic approach to logic programming We begin with the fundamental notion of datasets i e sets of ground atoms Given this fundamental notion we introduce views i e virtual relations and we define classical logic programs as sets of view definitions written using traditional Prolog like notation but with semantics given in terms of datasets rather than implementation We then introduce actions i e additions and deletions of ground atoms and we define dynamic logic programs as sets of action definitions In addition to the printed book there is an online version of the text with an interpreter and a compiler for the language used in the text and an integrated development environment for use in developing and deploying practical logic programs

Introduction to Graph Neural Networks Zhiyuan Liu, Jie Zhou, 2022-05-31 Graphs are useful data structures in complex real life applications such as modeling physical systems learning molecular fingerprints controlling traffic networks and recommending friends in social networks However these tasks require dealing with non Euclidean graph data that contains rich relational information between elements and cannot be well handled by traditional deep learning models e g convolutional neural networks CNNs or recurrent neural networks RNNs Nodes in graphs usually contain useful feature information that cannot be well addressed in most unsupervised representation learning methods e g network embedding methods Graph neural networks GNNs are proposed to combine the feature information and the graph structure to learn better representations on graphs via feature propagation and aggregation Due to its convincing performance and high interpretability GNN has recently become a widely applied graph analysis tool This book provides a comprehensive introduction to the basic concepts models and applications of graph neural

networks It starts with the introduction of the vanilla GNN model Then several variants of the vanilla model are introduced such as graph convolutional networks graph recurrent networks graph attention networks graph residual networks and several general frameworks Variants for different graph types and advanced training methods are also included As for the applications of GNNs the book categorizes them into structural non structural and other scenarios and then it introduces several typical models on solving these tasks Finally the closing chapters provide GNN open resources and the outlook of several future directions

Introduction to Symbolic Plan and Goal Recognition Reuth Mirsky, Sarah Keren, Christopher Geib, 2022-05-31 Plan recognition activity recognition and goal recognition all involve making inferences about other actors based on observations of their interactions with the environment and other agents This synergistic area of research combines unites and makes use of techniques and research from a wide range of areas including user modeling machine vision automated planning intelligent user interfaces human computer interaction autonomous and multi agent systems natural language understanding and machine learning It plays a crucial role in a wide variety of applications including assistive technology software assistants computer and network security human robot collaboration natural language processing video games and many more This wide range of applications and disciplines has produced a wealth of ideas models tools and results in the recognition literature However it has also contributed to fragmentation in the field with researchers publishing relevant results in a wide spectrum of journals and conferences This book seeks to address this fragmentation by providing a high level introduction and historical overview of the plan and goal recognition literature It provides a description of the core elements that comprise these recognition problems and practical advice for modeling them In particular we define and distinguish the different recognition tasks We formalize the major approaches to modeling these problems using a single motivating example Finally we describe a number of state of the art systems and their extensions future challenges and some potential applications

Graph-Based Semi-Supervised Learning Amarnag Subramanya, Partha Pratim

Talukdar, 2022-05-31 While labeled data is expensive to prepare ever increasing amounts of unlabeled data is becoming widely available In order to adapt to this phenomenon several semi supervised learning SSL algorithms which learn from labeled as well as unlabeled data have been developed In a separate line of work researchers have started to realize that graphs provide a natural way to represent data in a variety of domains Graph based SSL algorithms which bring together these two lines of work have been shown to outperform the state of the art in many applications in speech processing computer vision natural language processing and other areas of Artificial Intelligence Recognizing this promising and emerging area of research this synthesis lecture focuses on graph based SSL algorithms e g label propagation methods Our hope is that after reading this book the reader will walk away with the following 1 an in depth knowledge of the current state of the art in graph based SSL algorithms and the ability to implement them 2 the ability to decide on the suitability of graph based SSL methods for a problem and 3 familiarity with different applications where graph based SSL methods have been

successfully applied Table of Contents Introduction Graph Construction Learning and Inference Scalability Applications
Future Work Bibliography Authors Biographies Index Positive Unlabeled Learning Kristen Jaskie,Andreas

Spanias,2022-04-20 Machine learning and artificial intelligence AI are powerful tools that create predictive models extract information and help make complex decisions They do this by examining an enormous quantity of labeled training data to find patterns too complex for human observation However in many real world applications well labeled data can be difficult expensive or even impossible to obtain In some cases such as when identifying rare objects like new archeological sites or secret enemy military facilities in satellite images acquiring labels could require months of trained human observers at incredible expense Other times as when attempting to predict disease infection during a pandemic such as COVID 19 reliable true labels may be nearly impossible to obtain early on due to lack of testing equipment or other factors In that scenario identifying even a small amount of truly negative data may be impossible due to the high false negative rate of available tests In such problems it is possible to label a small subset of data as belonging to the class of interest though it is impractical to manually label all data not of interest We are left with a small set of positive labeled data and a large set of unknown and unlabeled data Readers will explore this Positive and Unlabeled learning PU learning problem in depth The book rigorously defines the PU learning problem discusses several common assumptions that are frequently made about the problem and their implications and considers how to evaluate solutions for this problem before describing several of the most popular algorithms to solve this problem It explores several uses for PU learning including applications in biological medical business security and signal processing This book also provides high level summaries of several related learning problems such as one class classification anomaly detection and noisy learning and their relation to PU learning **Lifelong Machine Learning,**

Second Edition Zhiyuan Chen,Bing Liu,2022-06-01 Lifelong Machine Learning Second Edition is an introduction to an advanced machine learning paradigm that continuously learns by accumulating past knowledge that it then uses in future learning and problem solving In contrast the current dominant machine learning paradigm learns in isolation given a training dataset it runs a machine learning algorithm on the dataset to produce a model that is then used in its intended application It makes no attempt to retain the learned knowledge and use it in subsequent learning Unlike this isolated system humans learn effectively with only a few examples precisely because our learning is very knowledge driven the knowledge learned in the past helps us learn new things with little data or effort Lifelong learning aims to emulate this capability because without it an AI system cannot be considered truly intelligent Research in lifelong learning has developed significantly in the relatively short time since the first edition of this book was published The purpose of this second edition is to expand the definition of lifelong learning update the content of several chapters and add a new chapter about continual learning in deep neural networks which has been actively researched over the past two or three years A few chapters have also been reorganized to make each of them more coherent for the reader Moreover the authors want to propose a unified framework

for the research area. Currently there are several research topics in machine learning that are closely related to lifelong learning, most notably multi task learning, transfer learning and meta learning, because they also employ the idea of knowledge sharing and transfer. This book brings all these topics under one roof and discusses their similarities and differences. Its goal is to introduce this emerging machine learning paradigm and present a comprehensive survey and review of the important research results and latest ideas in the area. This book is thus suitable for students, researchers and practitioners who are interested in machine learning, data mining, natural language processing or pattern recognition.

Lecturers can readily use the book for courses in any of these related fields.

Adversarial Machine Learning Yevgeniy Vorobeychik, Murat Kantarcioglu, 2022-05-31

The increasing abundance of large, high quality datasets combined with significant technical advances over the last several decades have made machine learning into a major tool employed across a broad array of tasks including vision, language, finance and security. However, success has been accompanied with important new challenges: many applications of machine learning are adversarial in nature. Some are adversarial because they are safety critical, such as autonomous driving. An adversary in these applications can be a malicious party aimed at causing congestion or accidents, or may even model unusual situations that expose vulnerabilities in the prediction engine. Other applications are adversarial because their task and/or the data they use are. For example, an important class of problems in security involves detection, such as malware, spam and intrusion detection. The use of machine learning for detecting malicious entities creates an incentive among adversaries to evade detection by changing their behavior or the content of malicious objects they develop. The field of adversarial machine learning has emerged to study vulnerabilities of machine learning approaches in adversarial settings and to develop techniques to make learning robust to adversarial manipulation. This book provides a technical overview of this field. After reviewing machine learning concepts and approaches as well as common use cases of these in adversarial settings, we present a general categorization of attacks on machine learning. We then address two major categories of attacks and associated defenses: decision time attacks, in which an adversary changes the nature of instances seen by a learned model at the time of prediction in order to cause errors; and poisoning or training time attacks, in which the actual training dataset is maliciously modified. In our final chapter, devoted to technical content, we discuss recent techniques for attacks on deep learning as well as approaches for improving robustness of deep neural networks. We conclude with a discussion of several important issues in the area of adversarial learning that, in our view, warrant further research. Given the increasing interest in the area of adversarial machine learning, we hope this book provides readers with the tools necessary to successfully engage in research and practice of machine learning in adversarial settings.

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