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General Game Playing

Michael Genesereth
Michael Thielscher

*SYNTHESIS LECTURES ON ARTIFICIAL
INTELLIGENCE AND MACHINE LEARNING*

Ronald J. Brachman, William W. Cohen, and Peter Stone, *Series Editors*

General Game Playing Michael Thielscher

William L. Hamilton



General Game Playing Michael Thielscher:

General Game Playing Michael Genesereth, Michael Thielscher, 2022-06-01 General game players are computer systems able to play strategy games based solely on formal game descriptions supplied at runtime in other words they don't know the rules until the game starts Unlike specialized game players such as Deep Blue general game players cannot rely on algorithms designed in advance for specific games they must discover such algorithms themselves General game playing expertise depends on intelligence on the part of the game player and not just intelligence of the programmer of the game player GGP is an interesting application in its own right It is intellectually engaging and more than a little fun But it is much more than that It provides a theoretical framework for modeling discrete dynamic systems and defining rationality in a way that takes into account problem representation and complexities like incompleteness of information and resource bounds It has practical applications in areas where these features are important e.g. in business and law More fundamentally it raises questions about the nature of intelligence and serves as a laboratory in which to evaluate competing approaches to artificial intelligence This book is an elementary introduction to General Game Playing GGP 1 It presents the theory of General Game Playing and leading GGP technologies 2 It shows how to create GGP programs capable of competing against other programs and humans 3 It offers a glimpse of some of the real world applications of General Game Playing **General Game Playing**

Fouad Sabry, 2023-07-04 What Is General Game Playing The concept of general game playing sometimes known as GGP refers to the development of artificial intelligence programs that are capable of competing well in more than one game Computers are programmed to play many different games such as chess using an algorithm that is built specifically for that game and cannot be used in any other setting For instance a computer software that is designed to play chess cannot also play checkers On the road to creating artificial general intelligence generic game playing is seen as a necessary milestone How You Will Benefit I Insights and validations about the following topics Chapter 1 General game playing Chapter 2 Artificial intelligence Chapter 3 Machine learning Chapter 4 Game Description Language Chapter 5 List of programming languages for artificial intelligence Chapter 6 Monte Carlo tree search Chapter 7 Deep reinforcement learning Chapter 8 Artificial intelligence in video games Chapter 9 Machine learning in video games Chapter 10 Google DeepMind II Answering the public top questions about general game playing III Real world examples for the usage of general game playing in many fields IV 17 appendices to explain briefly 266 emerging technologies in each industry to have 360 degree full understanding of general game playing technologies Who This Book Is For Professionals undergraduate and graduate students enthusiasts hobbyists and those who want to go beyond basic knowledge or information for any kind of general game playing

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

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

Graph Representation Learning William L. Hamilton, 2022-06-01 Graph structured data is ubiquitous throughout the natural and social sciences from telecommunication networks to quantum chemistry Building relational inductive biases into deep learning architectures is crucial for creating systems that can learn reason and generalize from this kind of data Recent years have seen a surge in research on graph representation learning including techniques for deep graph embeddings

generalizations of convolutional neural networks to graph structured data and neural message passing approaches inspired by belief propagation These advances in graph representation learning have led to new state of the art results in numerous domains including chemical synthesis 3D vision recommender systems question answering and social network analysis This book provides a synthesis and overview of graph representation learning It begins with a discussion of the goals of graph representation learning as well as key methodological foundations in graph theory and network analysis Following this the book introduces and reviews methods for learning node embeddings including random walk based methods and applications to knowledge graphs It then provides a technical synthesis and introduction to the highly successful graph neural network GNN formalism which has become a dominant and fast growing paradigm for deep learning with graph data The book concludes with a synthesis of recent advancements in deep generative models for graphs a nascent but quickly growing subset of graph representation learning

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

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

Federated Learning Qiang Yang,Yang Liu,Yong Cheng,Yan Kang,Tianjian Chen,Han Yu,2022-06-01 How is it possible to allow multiple data owners to collaboratively train and use a shared prediction model while keeping all the local training data private Traditional machine learning approaches need to combine all data at one location typically a data center which may very well violate the laws on user privacy and data confidentiality Today many parts of the world demand that technology companies treat user data carefully according to user privacy laws The European Union s General Data Protection Regulation GDPR is a prime example In this book we describe how federated machine learning addresses this problem with novel solutions combining distributed machine learning cryptography and security and incentive mechanism design based on economic principles and game theory We explain different types of privacy preserving machine learning solutions and their technological backgrounds and highlight some representative practical use cases We show how federated learning can become the foundation of next generation machine learning that caters to technological and societal needs for responsible AI development and application

Network Embedding Cheng Yang,Zhiyuan Liu,Cunchao Tu,Chuan Shi,Maosong Sun,2022-05-31 heterogeneous graphs Further the book introduces different applications of NE such as recommendation and information diffusion prediction Finally the book concludes the methods and applications and looks forward to the future directions

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

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