

Approximate Dynamic Programming Solving The Curse

Smart Autonomous Aircraft Yasmina Bestaoui Sebbane.2015-11-18 With the extraordinary growth of Unmanned Aerial Vehicles (UAV) in research, military, and commercial contexts, there has been a need for a reference that provides a comprehensive look at the latest research in the area. Filling this void, Smart Autonomous Aircraft: Flight Control and Planning for UAV introduces the advanced methods of flight contr

Machine Learning, Optimization, and Big Data Panos M. Pardalos,Piero Conca,Giovanni Giuffrida,Giuseppe Nicosia.2016-12-24 This book constitutes revised selected papers from the Second International Workshop on Machine Learning, Optimization, and Big Data, MOD 2016, held in Volterra, Italy, in August 2016. The 40 papers presented in this volume were carefully reviewed and selected from 97 submissions. These proceedings contain papers in the fields of Machine Learning, Computational Optimization and DataScience presenting a substantial array of ideas, technologies, algorithms, methods and applications.

Operations Research Proceedings 2010 Bo Hu,Karl Morasch,Stefan Pickl,Markus Siegle.2011-06-24 This book contains selected papers from the symposium Operations Research 2010 which was held from September 1-3, 2010 at the Universität der Bundeswehr München, Germany. The international conference, which also serves as the annual meeting of the German Operations Research Society (GOR), attracted more than 600 participants from more than thirty countries. The general theme Mastering Complexity focusses on a natural component of the globalization process. Financial markets, traffic systems, network topologies and, last but not least, energy resource management, all contain complex behaviour and economic interdependencies which necessitate a scientific solution. Operations Research is one of the key instruments to model, simulate and analyze such systems. In the process of developing optimal solutions, suitable heuristics and efficient procedures are some of the challenges which are discussed in this volume.

Reinforcement Learning and Dynamic Programming Using Function Approximators Lucian Busoniu,Robert Babuska,Bart De Schutter,Damien Ernst.2017-07-28 From household appliances to applications in robotics, engineered systems involving complex dynamics can only be as effective as the algorithms that control them. While Dynamic Programming (DP) has provided researchers with a way to optimally solve decision and control problems involving complex dynamic systems, its practical value was limited by algorithms that lacked the capacity to scale up to realistic problems. However, in recent years, dramatic developments in Reinforcement Learning (RL), the model-free counterpart of DP, changed our understanding of what is possible. Those developments led to the creation of reliable methods that can be applied even when a mathematical model of the system is unavailable, allowing researchers to solve challenging control problems in engineering, as well as in a variety of other disciplines, including economics, medicine, and artificial intelligence. Reinforcement Learning and Dynamic Programming Using Function Approximators provides a comprehensive and unparalleled exploration of the field of RL and DP. With a focus on continuous-variable problems, this seminal text details essential developments that have substantially altered the field over the past decade. In its pages, pioneering experts provide a concise introduction to classical RL and DP, followed by an extensive presentation of the state-of-the-art and novel methods in RL and DP with approximation. Combining algorithm development with theoretical guarantees, they elaborate on their work with illustrative examples and insightful comparisons. Three individual chapters are dedicated to representative algorithms from each of the major classes of techniques: value iteration, policy iteration, and policy search. The features and performance of these algorithms are highlighted in extensive experimental studies on a range of

control applications. The recent development of applications involving complex systems has led to a surge of interest in RL and DP methods and the subsequent need for a quality resource on the subject. For graduate students and others new to the field, this book offers a thorough introduction to both the basics and emerging methods. And for those researchers and practitioners working in the fields of optimal and adaptive control, machine learning, artificial intelligence, and operations research, this resource offers a combination of practical algorithms, theoretical analysis, and comprehensive examples that they will be able to adapt and apply to their own work. Access the authors' website at www.dsc.tudelft.nl/rlbook/ for additional material, including computer code used in the studies and information concerning new developments.

Adaptive Dynamic Programming with Applications in Optimal Control Derong Liu, Qinglai Wei, Ding Wang, Xiong Yang, Hongliang Li. 2017-01-04 This book covers the most recent developments in adaptive dynamic programming (ADP). The text begins with a thorough background review of ADP making sure that readers are sufficiently familiar with the fundamentals. In the core of the book, the authors address first discrete- and then continuous-time systems. Coverage of discrete-time systems starts with a more general form of value iteration to demonstrate its convergence, optimality, and stability with complete and thorough theoretical analysis. A more realistic form of value iteration is studied where value function approximations are assumed to have finite errors. Adaptive Dynamic Programming also details another avenue of the ADP approach: policy iteration. Both basic and generalized forms of policy-iteration-based ADP are studied with complete and thorough theoretical analysis in terms of convergence, optimality, stability, and error bounds. Among continuous-time systems, the control of affine and nonaffine nonlinear systems is studied using the ADP approach which is then extended to other branches of control theory including decentralized control, robust and guaranteed cost control, and game theory. In the last part of the book the real-world significance of ADP theory is presented, focusing on three application examples developed from the authors' work: • renewable energy scheduling for smart power grids; • coal gasification processes; and • water-gas shift reactions. Researchers studying intelligent control methods and practitioners looking to apply them in the chemical-process and power-supply industries will find much to interest them in this thorough treatment of an advanced approach to control.

Robust Adaptive Dynamic Programming Yu Jiang, Zhong-Ping Jiang. 2017-05-08 A comprehensive look at state-of-the-art ADP theory and real-world applications This book fills a gap in the literature by providing a theoretical framework for integrating techniques from adaptive dynamic programming (ADP) and modern nonlinear control to address data-driven optimal control design challenges arising from both parametric and dynamic uncertainties. Traditional model-based approaches leave much to be desired when addressing the challenges posed by the ever-increasing complexity of real-world engineering systems. An alternative which has received much interest in recent years are biologically-inspired approaches, primarily RADP. Despite their growing popularity worldwide, until now books on ADP have focused nearly exclusively on analysis and design, with scant consideration given to how it can be applied to address robustness issues, a new challenge arising from dynamic uncertainties encountered in common engineering problems. Robust Adaptive Dynamic Programming zeros in on the practical concerns of engineers. The authors develop RADP theory from linear systems to partially-linear, large-scale, and completely nonlinear systems. They provide in-depth coverage of state-of-the-art applications in power systems, supplemented with numerous real-world examples implemented in MATLAB. They also explore fascinating reverse engineering topics, such how ADP theory can be applied to the study of the human brain and cognition. In addition, the book: Covers the latest developments in RADP theory and applications for solving a range of systems' complexity problems Explores multiple real-world implementations in power systems with illustrative examples backed up by reusable MATLAB code and Simulink block sets Provides an overview of nonlinear control, machine learning, and dynamic control Features discussions of novel applications for RADP theory, including an entire chapter on how it can be used as a computational mechanism of human movement control Robust Adaptive Dynamic Programming is both a valuable working resource and an

intriguing exploration of contemporary ADP theory and applications for practicing engineers and advanced students in systems theory, control engineering, computer science, and applied mathematics.

Discrete Convex Analysis Kazuo Murota.2003-01-01 Discrete Convex Analysis is a novel paradigm for discrete optimization that combines the ideas in continuous optimization (convex analysis) and combinatorial optimization (matroid/submodular function theory) to establish a unified theoretical framework for nonlinear discrete optimization. The study of this theory is expanding with the development of efficient algorithms and applications to a number of diverse disciplines like matrix theory, operations research, and economics. This self-contained book is designed to provide a novel insight into optimization on discrete structures and should reveal unexpected links among different disciplines. It is the first and only English-language monograph on the theory and applications of discrete convex analysis.

Adaptive Dynamic Programming: Single and Multiple Controllers Ruizhuo Song, Qinglai Wei, Qing Li.2018-12-28 This book presents a class of novel optimal control methods and games schemes based on adaptive dynamic programming techniques. For systems with one control input, the ADP-based optimal control is designed for different objectives, while for systems with multi-players, the optimal control inputs are proposed based on games. In order to verify the effectiveness of the proposed methods, the book analyzes the properties of the adaptive dynamic programming methods, including convergence of the iterative value functions and the stability of the system under the iterative control laws. Further, to substantiate the mathematical analysis, it presents various application examples, which provide reference to real-world practices.

Reinforcement Learning and Optimal Control Dimitri P. Bertsekas.2020

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Reinforcement Learning and Stochastic Optimization Warren B. Powell.2022-03-15 REINFORCEMENT LEARNING AND STOCHASTIC OPTIMIZATION Clearing the jungle of stochastic optimization Sequential decision problems, which consist of “decision, information, decision, information,” are ubiquitous, spanning virtually every human activity ranging from business applications, health (personal and public health, and medical decision making), energy, the sciences, all fields of engineering, finance, and e-commerce. The diversity of applications attracted the attention of at least 15 distinct fields of research, using eight distinct notational systems which produced a vast array of analytical tools. A byproduct is that powerful tools developed in one community may be unknown to other communities. Reinforcement Learning and Stochastic Optimization offers a single canonical framework that can model any sequential decision problem using five core components: state variables, decision variables, exogenous information variables, transition function, and objective function. This book highlights twelve types of uncertainty that might enter any model and pulls together the diverse set of methods for making decisions, known as policies, into four fundamental classes that span every method suggested in the academic literature or used in practice. Reinforcement Learning and Stochastic Optimization is the first book to provide a balanced treatment of the different methods for modeling and solving sequential decision problems, following the style used by most books on machine learning, optimization, and simulation. The presentation is designed for readers with a course in probability and statistics, and an interest in modeling and applications. Linear programming is occasionally used for specific problem classes. The book is designed for readers who are new to the field, as well as those with some background in optimization under uncertainty. Throughout this book, readers will find references to over 100 different applications, spanning pure learning problems, dynamic resource allocation problems, general state-dependent problems, and hybrid learning/resource allocation problems such as those that arose in the COVID pandemic. There are 370 exercises, organized into seven groups, ranging from review questions, modeling, computation, problem solving, theory, programming exercises and a “diary problem” that a reader chooses at the beginning of the book, and which is used as a basis for questions throughout the rest of the book.

Advances in Power and Energy Engineering Yuanzhang Sun.2016-04-05 Energy and power are playing pivotal roles in social and economic developments of the modern world. Energy and power engineers and technologists have made our lives much more comfortable and affordable. However, due to the demands of the global population on resources and the environment, innovations of more reliable and sustainable energy res

Approximate Dynamic Programming Warren B. Powell.2007-10-05 A complete and accessible introduction to the real-world applications of approximate dynamic programming With the growing levels of sophistication in modern-day operations, it is vital for practitioners to understand how to approach, model, and solve complex industrial problems. Approximate Dynamic Programming is a result of the author's decades of experience working in large industrial settings to develop practical and high-quality solutions to problems that involve making decisions in the presence of uncertainty. This groundbreaking book uniquely integrates four distinct disciplines—Markov design processes, mathematical programming, simulation, and statistics—to demonstrate how to successfully model and solve a wide range of real-life problems using the techniques of approximate dynamic programming (ADP). The reader is introduced to the three curses of dimensionality that impact complex problems and is also shown how the post-decision state variable allows for the use of classical algorithmic strategies from operations research to treat complex stochastic optimization problems. Designed as an introduction and assuming no prior training in dynamic programming of any form, Approximate Dynamic Programming contains dozens of algorithms that are intended to serve as a starting point in the design of practical solutions for real problems. The book provides detailed coverage of implementation challenges including: modeling complex sequential decision processes under uncertainty, identifying robust policies, designing and estimating value function approximations, choosing effective stepsize rules, and resolving convergence issues. With a focus on modeling and algorithms in conjunction with the language of mainstream operations research, artificial intelligence, and control theory, Approximate Dynamic Programming: Models complex, high-dimensional problems in a natural and practical way, which draws on years of industrial projects Introduces and emphasizes the power of estimating a value function around the post-decision state, allowing solution algorithms to be broken down into three fundamental steps: classical simulation, classical optimization, and classical statistics Presents a thorough discussion of recursive estimation, including fundamental theory and a number of issues that arise in the development of practical algorithms Offers a variety of methods for approximating dynamic programs that have appeared in previous literature, but that have never been presented in the coherent format of a book Motivated by examples from modern-day operations research, Approximate Dynamic Programming is an accessible introduction to dynamic modeling and is also a valuable guide for the development of high-quality solutions to problems that exist in operations research and engineering. The clear and precise presentation of the material makes this an appropriate text for advanced undergraduate and beginning graduate courses, while also serving as a reference for researchers and practitioners. A companion Web site is available for readers, which includes additional exercises, solutions to exercises, and data sets to reinforce the book's main concepts.

Algorithms for Reinforcement Learning Csaba Szepesvari.2010 Reinforcement learning is a learning paradigm concerned with learning to control a system so as to maximize a numerical performance measure that expresses a long-term objective. What distinguishes reinforcement learning from supervised learning is that only partial feedback is given to the learner about the learner's predictions. Further, the predictions may have long term effects through influencing the future state of the controlled system. Thus, time plays a special role. The goal in reinforcement learning is to develop efficient learning algorithms, as well as to understand the algorithms' merits and limitations. Reinforcement learning is of great interest because of the large number of practical applications that it can be used to address, ranging from problems in artificial intelligence to operations research or control engineering. In this book, we focus on those algorithms of reinforcement learning that build on the powerful theory of dynamic programming. We give a fairly comprehensive catalog of learning problems, describe the core ideas, note a large number of state of the art

algorithms, followed by the discussion of their theoretical properties and limitations.

Advances in Service Science Hui Yang, Robin Qiu. 2018-12-28 This volume offers the state-of-the-art research and developments in service science and related research, education and practice areas. It showcases emerging technology and applications in fields including healthcare, information technology, transportation, sports, logistics, and public services. Regardless of size and service, a service organization is a service system. Because of the socio-technical nature of a service system, a systems approach must be adopted to design, develop, and deliver services, aimed at meeting end users' both utilitarian and socio-psychological needs. Effective understanding of service and service systems often requires combining multiple methods to consider how interactions of people, technology, organizations, and information create value under various conditions. The papers in this volume highlight ways to approach such technical challenges in service science and are based on submissions from the 2018 INFORMS International Conference on Service Science.

Markov Decision Processes Martin L. Puterman. 2014-08-28 The Wiley-Interscience Paperback Series consists of selected books that have been made more accessible to consumers in an effort to increase global appeal and general circulation. With these new unabridged softcover volumes, Wiley hopes to extend the lives of these works by making them available to future generations of statisticians, mathematicians, and scientists. This text is unique in bringing together so many results hitherto found only in part in other texts and papers. . . . The text is fairly self-contained, inclusive of some basic mathematical results needed, and provides a rich diet of examples, applications, and exercises. The bibliographical material at the end of each chapter is excellent, not only from a historical perspective, but because it is valuable for researchers in acquiring a good perspective of the MDP research potential. —Zentralblatt für Mathematik . . . it is of great value to advanced-level students, researchers, and professional practitioners of this field to have now a complete volume (with more than 600 pages) devoted to this topic. . . . **Markov Decision Processes: Discrete Stochastic Dynamic Programming** represents an up-to-date, unified, and rigorous treatment of theoretical and computational aspects of discrete-time Markov decision processes. —Journal of the American Statistical Association

Reinforcement Learning and Approximate Dynamic Programming for Feedback Control Frank L. Lewis, Derong Liu. 2013-01-28 Reinforcement learning (RL) and adaptive dynamic programming (ADP) has been one of the most critical research fields in science and engineering for modern complex systems. This book describes the latest RL and ADP techniques for decision and control in human engineered systems, covering both single player decision and control and multi-player games. Edited by the pioneers of RL and ADP research, the book brings together ideas and methods from many fields and provides an important and timely guidance on controlling a wide variety of systems, such as robots, industrial processes, and economic decision-making.

Machine Learning, Optimization, and Big Data Giuseppe Nicosia, Panos Pardalos, Giovanni Giuffrida, Renato Umeton. 2017-12-19 This book constitutes the post-conference proceedings of the Third International Workshop on Machine Learning, Optimization, and Big Data, MOD 2017, held in Volterra, Italy, in September 2017. The 50 full papers presented were carefully reviewed and selected from 126 submissions. The papers cover topics in the field of machine learning, artificial intelligence, computational optimization and data science presenting a substantial array of ideas, technologies, algorithms, methods and applications.

Increasing Penetration of Renewable Sources in Power Systems: Opportunities and Challenges Xue Lyu, Minghao Wang, Siqi Bu, Tao Liu, Jiajia Yang. 2023-04-27

Markov Decision Processes in Practice Richard J. Boucherie, Nico M. van Dijk. 2017-03-10 This book presents classical Markov Decision Processes (MDP) for real-life applications and optimization. MDP allows users to develop and formally support approximate and simple decision rules, and this

book showcases state-of-the-art applications in which MDP was key to the solution approach. The book is divided into six parts. Part 1 is devoted to the state-of-the-art theoretical foundation of MDP, including approximate methods such as policy improvement, successive approximation and infinite state spaces as well as an instructive chapter on Approximate Dynamic Programming. It then continues with five parts of specific and non-exhaustive application areas. Part 2 covers MDP healthcare applications, which includes different screening procedures, appointment scheduling, ambulance scheduling and blood management. Part 3 explores MDP modeling within transportation. This ranges from public to private transportation, from airports and traffic lights to car parking or charging your electric car . Part 4 contains three chapters that illustrates the structure of approximate policies for production or manufacturing structures. In Part 5, communications is highlighted as an important application area for MDP. It includes Gittins indices, down-to-earth call centers and wireless sensor networks. Finally Part 6 is dedicated to financial modeling, offering an instructive review to account for financial portfolios and derivatives under proportional transactional costs. The MDP applications in this book illustrate a variety of both standard and non-standard aspects of MDP modeling and its practical use. This book should appeal to readers for practicing, academic research and educational purposes, with a background in, among others, operations research, mathematics, computer science, and industrial engineering.

Reinforcement Learning, second edition Richard S. Sutton, Andrew G. Barto. 2018-11-13 The significantly expanded and updated new edition of a widely used text on reinforcement learning, one of the most active research areas in artificial intelligence. Reinforcement learning, one of the most active research areas in artificial intelligence, is a computational approach to learning whereby an agent tries to maximize the total amount of reward it receives while interacting with a complex, uncertain environment. In Reinforcement Learning, Richard Sutton and Andrew Barto provide a clear and simple account of the field's key ideas and algorithms. This second edition has been significantly expanded and updated, presenting new topics and updating coverage of other topics. Like the first edition, this second edition focuses on core online learning algorithms, with the more mathematical material set off in shaded boxes. Part I covers as much of reinforcement learning as possible without going beyond the tabular case for which exact solutions can be found. Many algorithms presented in this part are new to the second edition, including UCB, Expected Sarsa, and Double Learning. Part II extends these ideas to function approximation, with new sections on such topics as artificial neural networks and the Fourier basis, and offers expanded treatment of off-policy learning and policy-gradient methods. Part III has new chapters on reinforcement learning's relationships to psychology and neuroscience, as well as an updated case-studies chapter including AlphaGo and AlphaGo Zero, Atari game playing, and IBM Watson's wagering strategy. The final chapter discusses the future societal impacts of reinforcement learning.

Simulation-Based Optimization Abhijit Gosavi. 2014-10-30 Simulation-Based Optimization: Parametric Optimization Techniques and Reinforcement Learning introduce the evolving area of static and dynamic simulation-based optimization. Covered in detail are model-free optimization techniques - especially designed for those discrete-event, stochastic systems which can be simulated but whose analytical models are difficult to find in closed mathematical forms. Key features of this revised and improved Second Edition include: · Extensive coverage, via step-by-step recipes, of powerful new algorithms for static simulation optimization, including simultaneous perturbation, backtracking adaptive search and nested partitions, in addition to traditional methods, such as response surfaces, Nelder-Mead search and meta-heuristics (simulated annealing, tabu search, and genetic algorithms) · Detailed coverage of the Bellman equation framework for Markov Decision Processes (MDPs), along with dynamic programming (value and policy iteration) for discounted, average, and total reward performance metrics · An in-depth consideration of dynamic simulation optimization via temporal differences and Reinforcement Learning: Q-Learning, SARSA, and R-SMART algorithms, and policy search, via API, Q-P-Learning, actor-critics, and learning automata · A special examination of neural-network-based function approximation for Reinforcement Learning, semi-Markov

decision processes (SMDPs), finite-horizon problems, two time scales, case studies for industrial tasks, computer codes (placed online) and convergence proofs, via Banach fixed point theory and Ordinary Differential Equations Themed around three areas in separate sets of chapters - Static Simulation Optimization, Reinforcement Learning and Convergence Analysis - this book is written for researchers and students in the fields of engineering (industrial, systems, electrical and computer), operations research, computer science and applied mathematics.

Reinforcement Learning for Optimal Feedback Control Rushikesh Kamalapurkar,Patrick Walters,Joel Rosenfeld,Warren Dixon.2018-05-10

Reinforcement Learning for Optimal Feedback Control develops model-based and data-driven reinforcement learning methods for solving optimal control problems in nonlinear deterministic dynamical systems. In order to achieve learning under uncertainty, data-driven methods for identifying system models in real-time are also developed. The book illustrates the advantages gained from the use of a model and the use of previous experience in the form of recorded data through simulations and experiments. The book's focus on deterministic systems allows for an in-depth Lyapunov-based analysis of the performance of the methods described during the learning phase and during execution. To yield an approximate optimal controller, the authors focus on theories and methods that fall under the umbrella of actor-critic methods for machine learning. They concentrate on establishing stability during the learning phase and the execution phase, and adaptive model-based and data-driven reinforcement learning, to assist readers in the learning process, which typically relies on instantaneous input-output measurements. This monograph provides academic researchers with backgrounds in diverse disciplines from aerospace engineering to computer science, who are interested in optimal reinforcement learning functional analysis and functional approximation theory, with a good introduction to the use of model-based methods. The thorough treatment of an advanced treatment to control will also interest practitioners working in the chemical-process and power-supply industry.

Handbook of Learning and Approximate Dynamic Programming Jennie Si,Andrew G. Barto,Warren B. Powell,Don Wunsch.2004-08-02 A complete resource to Approximate Dynamic Programming (ADP), including on-line simulation code Provides a tutorial that readers can use to start implementing the learning algorithms provided in the book Includes ideas, directions, and recent results on current research issues and addresses applications where ADP has been successfully implemented The contributors are leading researchers in the field

Approximate Dynamic Programming for Dynamic Vehicle Routing Marlin Wolf Ulmer.2017-04-19 This book provides a straightforward overview for every researcher interested in stochastic dynamic vehicle routing problems (SDVRPs). The book is written for both the applied researcher looking for suitable solution approaches for particular problems as well as for the theoretical researcher looking for effective and efficient methods of stochastic dynamic optimization and approximate dynamic programming (ADP). To this end, the book contains two parts. In the first part, the general methodology required for modeling and approaching SDVRPs is presented. It presents adapted and new, general anticipatory methods of ADP tailored to the needs of dynamic vehicle routing. Since stochastic dynamic optimization is often complex and may not always be intuitive on first glance, the author accompanies the ADP-methodology with illustrative examples from the field of SDVRPs. The second part of this book then depicts the application of the theory to a specific SDVRP. The process starts from the real-world application. The author describes a SDVRP with stochastic customer requests often addressed in the literature, and then shows in detail how this problem can be modeled as a Markov decision process and presents several anticipatory solution approaches based on ADP. In an extensive computational study, he shows the advantages of the presented approaches compared to conventional heuristics. To allow deep insights in the functionality of ADP, he presents a comprehensive analysis of the ADP approaches.

Approximate Iterative Algorithms Anthony Louis Almudevar.2014-02-18 Iterative algorithms often rely on approximate evaluation techniques, which may include statistical estimation, computer simulation or functional approximation. This volume presents methods for the study of approximate

iterative algorithms, providing tools for the derivation of error bounds and convergence rates, and for the optimal design of such algorithms. Techniques of functional analysis are used to derive analytical relationships between approximation methods and convergence properties for general classes of algorithms. This work provides the necessary background in functional analysis and probability theory. Extensive applications to Markov decision processes are presented. This volume is intended for mathematicians, engineers and computer scientists, who work on learning processes in numerical analysis and are involved with optimization, optimal control, decision analysis and machine learning.

Simulation-Based Algorithms for Markov Decision Processes Hyeong Soo Chang, Jiaqiao Hu, Michael C. Fu, Steven I. Marcus. 2013-02-26 Markov decision process (MDP) models are widely used for modeling sequential decision-making problems that arise in engineering, economics, computer science, and the social sciences. Many real-world problems modeled by MDPs have huge state and/or action spaces, giving an opening to the curse of dimensionality and so making practical solution of the resulting models intractable. In other cases, the system of interest is too complex to allow explicit specification of some of the MDP model parameters, but simulation samples are readily available (e.g., for random transitions and costs). For these settings, various sampling and population-based algorithms have been developed to overcome the difficulties of computing an optimal solution in terms of a policy and/or value function. Specific approaches include adaptive sampling, evolutionary policy iteration, evolutionary random policy search, and model reference adaptive search. This substantially enlarged new edition reflects the latest developments in novel algorithms and their underpinning theories, and presents an updated account of the topics that have emerged since the publication of the first edition. Includes: innovative material on MDPs, both in constrained settings and with uncertain transition properties; game-theoretic method for solving MDPs; theories for developing roll-out based algorithms; and details of approximation stochastic annealing, a population-based on-line simulation-based algorithm. The self-contained approach of this book will appeal not only to researchers in MDPs, stochastic modeling, and control, and simulation but will be a valuable source of tuition and reference for students of control and operations research.

From Shortest Paths to Reinforcement Learning Paolo Brandimarte. 2021-01-11 Dynamic programming (DP) has a relevant history as a powerful and flexible optimization principle, but has a bad reputation as a computationally impractical tool. This book fills a gap between the statement of DP principles and their actual software implementation. Using MATLAB throughout, this tutorial gently gets the reader acquainted with DP and its potential applications, offering the possibility of actual experimentation and hands-on experience. The book assumes basic familiarity with probability and optimization, and is suitable to both practitioners and graduate students in engineering, applied mathematics, management, finance and economics.

Introduction to Stochastic Dynamic Programming Sheldon M. Ross. 2014-07-10 Introduction to Stochastic Dynamic Programming presents the basic theory and examines the scope of applications of stochastic dynamic programming. The book begins with a chapter on various finite-stage models, illustrating the wide range of applications of stochastic dynamic programming. Subsequent chapters study infinite-stage models: discounting future returns, minimizing nonnegative costs, maximizing nonnegative returns, and maximizing the long-run average return. Each of these chapters first considers whether an optimal policy need exist—providing counterexamples where appropriate—and then presents methods for obtaining such policies when they do. In addition, general areas of application are presented. The final two chapters are concerned with more specialized models. These include stochastic scheduling models and a type of process known as a multiproject bandit. The mathematical prerequisites for this text are relatively few. No prior knowledge of dynamic programming is assumed and only a moderate familiarity with probability— including the use of conditional expectation—is necessary.

Introduction to Methods of Optimization Leon Cooper, David Steinberg. 1970

Handbook of Industrial Organization .2021-12-09 Handbook of Industrial Organization, Volume Four highlights new advances in the field, with this new volume presenting interesting chapters written by an international board of expert authors. Presents authoritative surveys and reviews of advances in theory and econometrics Reviews recent research on capital raising methods and institutions Includes discussions on developing countries

Multi-UAV Planning and Task Allocation Yasmina Bestaoui Sebbane.2020-03-27 Multi-robot systems are a major research topic in robotics. Designing, testing, and deploying aerial robots in the real world is a possibility due to recent technological advances. This book explores different aspects of cooperation in multiagent systems. It covers the team approach as well as deterministic decision-making. It also presents distributed receding horizon control, as well as conflict resolution, artificial potentials, and symbolic planning. The book also covers association with limited communications, as well as genetic algorithms and game theory reasoning. Multiagent decision-making and algorithms for optimal planning are also covered along with case studies. Key features: Provides a comprehensive introduction to multi-robot systems planning and task allocation Explores multi-robot aerial planning; flight planning; orienteering and coverage; and deployment, patrolling, and foraging Includes real-world case studies Treats different aspects of cooperation in multiagent systems Both scientists and practitioners in the field of robotics will find this text valuable.

Iterative Dynamic Programming Rein Luus.2019-09-17 Dynamic programming is a powerful method for solving optimization problems, but has a number of drawbacks that limit its use to solving problems of very low dimension. To overcome these limitations, author Rein Luus suggested using it in an iterative fashion. Although this method required vast computer resources, modifications to his original schem

Advances in Neural Computation, Machine Learning, and Cognitive Research VII Boris Kryzhanovsky,Witali Dunin-Barkowski,Vladimir Redko,Yury Tiumentsev,Valentin Klimov.2023-11-12 This book describes new theories and applications of artificial neural networks, with a special focus on answering questions in neuroscience, biology and biophysics and cognitive research. It covers a wide range of methods and technologies, including deep neural networks, large-scale neural models, brain-computer interface, signal processing methods, as well as models of perception, studies on emotion recognition, self-organization and many more. The book includes both selected and invited papers presented at the XXV International Conference on Neuroinformatics, held on October 23-27, 2023, in Moscow, Russia.

Optimal Learning Warren B. Powell,Ilya O. Ryzhov.2013-07-09 Learn the science of collecting information to make effective decisions Everyday decisions are made without the benefit of accurate information. Optimal Learning develops the needed principles for gathering information to make decisions, especially when collecting information is time-consuming and expensive. Designed for readers with an elementary background in probability and statistics, the book presents effective and practical policies illustrated in a wide range of applications, from energy, homeland security, and transportation to engineering, health, and business. This book covers the fundamental dimensions of a learning problem and presents a simple method for testing and comparing policies for learning. Special attention is given to the knowledge gradient policy and its use with a wide range of belief models, including lookup table and parametric and for online and offline problems. Three sections develop ideas with increasing levels of sophistication: Fundamentals explores fundamental topics, including adaptive learning, ranking and selection, the knowledge gradient, and bandit problems Extensions and Applications features coverage of linear belief models, subset selection models, scalar function optimization, optimal bidding, and stopping problems Advanced Topics explores complex methods including simulation optimization, active learning in mathematical programming, and optimal continuous measurements Each chapter identifies a specific learning problem, presents the related, practical algorithms for implementation, and concludes with numerous exercises. A related website features additional applications and downloadable software, including MATLAB and the Optimal Learning Calculator, a spreadsheet-based package that provides an introduction to learning and a variety of policies for

learning.

Approximate Dynamic Programming Warren B. Powell. 2007-11-09 A complete and accessible introduction to the real-world applications of approximate dynamic programming. With the growing levels of sophistication in modern-day operations, it is vital for practitioners to understand how to approach, model, and solve complex industrial problems. Approximate Dynamic Programming is a result of the author's decades of experience working in large industrial settings to develop practical and high-quality solutions to problems that involve making decisions in the presence of uncertainty. This groundbreaking book uniquely integrates four distinct disciplines—Markov design processes, mathematical programming, simulation, and statistics—to demonstrate how to successfully model and solve a wide range of real-life problems using the techniques of approximate dynamic programming (ADP). The reader is introduced to the three curses of dimensionality that impact complex problems and is also shown how the post-decision state variable allows for the use of classical algorithmic strategies from operations research to treat complex stochastic optimization problems. Designed as an introduction and assuming no prior training in dynamic programming of any form, Approximate Dynamic Programming contains dozens of algorithms that are intended to serve as a starting point in the design of practical solutions for real problems. The book provides detailed coverage of implementation challenges including: modeling complex sequential decision processes under uncertainty, identifying robust policies, designing and estimating value function approximations, choosing effective stepsize rules, and resolving convergence issues. With a focus on modeling and algorithms in conjunction with the language of mainstream operations research, artificial intelligence, and control theory, Approximate Dynamic Programming: Models complex, high-dimensional problems in a natural and practical way, which draws on years of industrial projects. Introduces and emphasizes the power of estimating a value function around the post-decision state, allowing solution algorithms to be broken down into three fundamental steps: classical simulation, classical optimization, and classical statistics. Presents a thorough discussion of recursive estimation, including fundamental theory and a number of issues that arise in the development of practical algorithms. Offers a variety of methods for approximating dynamic programs that have appeared in previous literature, but that have never been presented in the coherent format of a book. Motivated by examples from modern-day operations research, Approximate Dynamic Programming is an accessible introduction to dynamic modeling and is also a valuable guide for the development of high-quality solutions to problems that exist in operations research and engineering. The clear and precise presentation of the material makes this an appropriate text for advanced undergraduate and beginning graduate courses, while also serving as a reference for researchers and practitioners. A companion Web site is available for readers, which includes additional exercises, solutions to exercises, and data sets to reinforce the book's main concepts.

Neural Approximations for Optimal Control and Decision Riccardo Zoppoli, Marcello Sanguineti, Giorgio Gnecco, Thomas Parisini. 2019-12-17 Neural Approximations for Optimal Control and Decision provides a comprehensive methodology for the approximate solution of functional optimization problems using neural networks and other nonlinear approximators where the use of traditional optimal control tools is prohibited by complicating factors like non-Gaussian noise, strong nonlinearities, large dimension of state and control vectors, etc. Features of the text include: • a general functional optimization framework; • thorough illustration of recent theoretical insights into the approximate solutions of complex functional optimization problems; • comparison of classical and neural-network based methods of approximate solution; • bounds to the errors of approximate solutions; • solution algorithms for optimal control and decision in deterministic or stochastic environments with perfect or imperfect state measurements over a finite or infinite time horizon and with one decision maker or several; • applications of current interest: routing in communications networks, traffic control, water resource management, etc.; and • numerous, numerically detailed examples. The authors' diverse backgrounds in systems and control theory, approximation theory, machine learning, and operations research lend the book a range of expertise and

subject matter appealing to academics and graduate students in any of those disciplines together with computer science and other areas of engineering.

Approximate Dynamic Programming Dimitri P. Bertsekas.2012

Constrained Markov Decision Processes Eitan Altman.1999-03-30 This book provides a unified approach for the study of constrained Markov decision processes with a finite state space and unbounded costs. Unlike the single controller case considered in many other books, the author considers a single controller with several objectives, such as minimizing delays and loss, probabilities, and maximization of throughputs. It is desirable to design a controller that minimizes one cost objective, subject to inequality constraints on other cost objectives. This framework describes dynamic decision problems arising frequently in many engineering fields. A thorough overview of these applications is presented in the introduction. The book is then divided into three sections that build upon each other. The first part explains the theory for the finite state space. The author characterizes the set of achievable expected occupation measures as well as performance vectors, and identifies simple classes of policies among which optimal policies exist. This allows the reduction of the original dynamic into a linear program. A Lagrangian approach is then used to derive the dual linear program using dynamic programming techniques. In the second part, these results are extended to the infinite state space and action spaces. The author provides two frameworks: the case where costs are bounded below and the contracting framework. The third part builds upon the results of the first two parts and examines asymptotical results of the convergence of both the value and the policies in the time horizon and in the discount factor. Finally, several state truncation algorithms that enable the approximation of the solution of the original control problem via finite linear programs are given.

Stochastic Decomposition Julia L. Higle,S. Sen.2013-11-27 Motivation Stochastic Linear Programming with recourse represents one of the more widely applicable models for incorporating uncertainty within in which the SLP optimization models. There are several arenas model is appropriate, and such models have found applications in air line yield management, capacity planning, electric power generation planning, financial planning, logistics, telecommunications network planning, and many more. In some of these applications, modelers represent uncertainty in terms of only a few scenarios and formulate a large scale linear program which is then solved using LP software. However, there are many applications, such as the telecommunications planning problem discussed in this book, where a handful of scenarios do not capture variability well enough to provide a reasonable model of the actual decision-making problem. Problems of this type easily exceed the capabilities of LP software by several orders of magnitude. Their solution requires the use of algorithmic methods that exploit the structure of the SLP model in a manner that will accommodate large scale applications.

Approximate Dynamic Programming Solving The Curse Book Review: Unveiling the Power of Words

In some sort of driven by information and connectivity, the energy of words has been evident than ever. They have the ability to inspire, provoke, and ignite change. Such may be the essence of the book **Approximate Dynamic Programming Solving The Curse**, a literary masterpiece that delves deep to the significance of words and their affect our lives. Compiled by a renowned author, this captivating work takes readers on a transformative journey, unraveling the secrets and potential behind every word. In this review, we will explore the book's key themes, examine its writing style, and analyze its overall impact on readers.

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