
EXPLANATION-BASED NEURAL NETWORK LEARNING:

A Lifelong Learning Approach

Sebastian Thrun

foreword by Tom M. Mitchell



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Explanation Based Neural Network Learning A Lifelong Learning Approach

**Kelly Cohen, Nicholas Ernest, Barnabas
Bede, Vladik Kreinovich**



Explanation Based Neural Network Learning A Lifelong Learning Approach:

Explanation-Based Neural Network Learning Sebastian Thrun, 2012-12-06 Lifelong learning addresses situations in which a learner faces a series of different learning tasks providing the opportunity for synergy among them Explanation based neural network learning EBNN is a machine learning algorithm that transfers knowledge across multiple learning tasks When faced with a new learning task EBNN exploits domain knowledge accumulated in previous learning tasks to guide generalization in the new one As a result EBNN generalizes more accurately from less data than comparable methods Explanation Based Neural Network Learning A Lifelong Learning Approach describes the basic EBNN paradigm and investigates it in the context of supervised learning reinforcement learning robotics and chess The paradigm of lifelong learning using earlier learned knowledge to improve subsequent learning is a promising direction for a new generation of machine learning algorithms Given the need for more accurate learning methods it is difficult to imagine a future for machine learning that does not include this paradigm From the Foreword by Tom M Mitchell

Explanation-Based Neural Network Learning Sebastian Thrun, 2011-10-17 Lifelong learning addresses situations in which a learner faces a series of different learning tasks providing the opportunity for synergy among them Explanation based neural network learning EBNN is a machine learning algorithm that transfers knowledge across multiple learning tasks When faced with a new learning task EBNN exploits domain knowledge accumulated in previous learning tasks to guide generalization in the new one As a result EBNN generalizes more accurately from less data than comparable methods Explanation Based Neural Network Learning A Lifelong Learning Approach describes the basic EBNN paradigm and investigates it in the context of supervised learning reinforcement learning robotics and chess The paradigm of lifelong learning using earlier learned knowledge to improve subsequent learning is a promising direction for a new generation of machine learning algorithms Given the need for more accurate learning methods it is difficult to imagine a future for machine learning that does not include this paradigm From the Foreword by Tom M Mitchell

Interdisciplinary Approaches to Robot Learning John Demiris, 2000 This collection of papers explore the variety of techniques used to equip robots with the capacity to improve their behaviour over time based upon their incoming experiences The contributions are interdisciplinary in nature and combine research from the field of robotics computer science and biology

Knowledge-Free and Learning-Based Methods in Intelligent Game Playing Jacek Mandziuk, 2010-01-27 The book is focused on the developments and prospective challenging problems in the area of mind game playing i e playing games that require mental skills using Computational Intelligence CI methods mainly neural networks genetic evolutionary programming and reinforcement learning The majority of discussed game playing ideas were selected based on their functional similarity to human game playing These similarities include learning from scratch autonomous experience based improvement and example based learning The above features determine the major distinction between CI and traditional AI methods relying mostly on using

effective game tree search algorithms carefully tuned hand crafted evaluation functions or hardware based brute force methods On the other hand it should be noted that the aim of this book is by no means to underestimate the achievements of traditional AI methods in game playing domain On the contrary the accomplishments of AI approaches are undisputable and speak for themselves The goal is rather to express my belief that other alternative ways of developing mind game playing machines are possible and urgently needed

Learning to Learn Sebastian Thrun, Lorien Pratt, 2012-12-06 Over the past three decades or so research on machine learning and data mining has led to a wide variety of algorithms that learn general functions from experience As machine learning is maturing it has begun to make the successful transition from academic research to various practical applications Generic techniques such as decision trees and artificial neural networks for example are now being used in various commercial and industrial applications *Learning to Learn* is an exciting new research direction within machine learning Similar to traditional machine learning algorithms the methods described in *Learning to Learn* induce general functions from experience However the book investigates algorithms that can change the way they generalize i e practice the task of learning itself and improve on it To illustrate the utility of learning to learn it is worthwhile comparing machine learning with human learning Humans encounter a continual stream of learning tasks They do not just learn concepts or motor skills they also learn bias i e they learn how to generalize As a result humans are often able to generalize correctly from extremely few examples often just a single example suffices to teach us a new thing A deeper understanding of computer programs that improve their ability to learn can have a large practical impact on the field of machine learning and beyond In recent years the field has made significant progress towards a theory of learning to learn along with practical new algorithms some of which led to impressive results in real world applications *Learning to Learn* provides a survey of some of the most exciting new research approaches written by leading researchers in the field Its objective is to investigate the utility and feasibility of computer programs that can learn how to learn both from a practical and a theoretical point of view

Lifelong Machine Learning Zhiyuan Chaudhri, Bing Liu, 2022-11-10 *Lifelong Machine Learning* or *Lifelong Learning* is an advanced machine learning paradigm that learns continuously accumulates the knowledge learned in previous tasks and uses it to help future learning In the process the learner becomes more and more knowledgeable and effective at learning This learning ability is one of the hallmarks of human intelligence However 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 It makes no attempt to retain the learned knowledge and use it in future learning Although this isolated learning paradigm has been very successful it requires a large number of training examples and is only suitable for well defined and narrow tasks In comparison we humans can learn effectively with a few examples because we have accumulated so much knowledge in the past which enables us to learn with little data or effort *Lifelong learning* aims to achieve this capability As statistical machine learning matures it is time to make a major effort to break the isolated learning

tradition and to study lifelong learning to bring machine learning to new heights Applications such as intelligent assistants chatbots and physical robots that interact with humans and systems in real life environments are also calling for such lifelong learning capabilities Without the ability to accumulate the learned knowledge and use it to learn more knowledge incrementally a system will probably never be truly intelligent This book serves as an introductory text and survey to lifelong learning Handbook of Natural Language Processing Robert Dale,Hermann Moisl,Harold Somers,2000-07-25 This study explores the design and application of natural language text based processing systems based on generative linguistics empirical corpus analysis and artificial neural networks It emphasizes the practical tools to accommodate the selected system

Rule-Based Programming Thaddeus J. Kowalski,Leon S. Levy,2012-12-06 Rule Based Programming is a broad presentation of the rule based programming method with many example programs showing the strengths of the rule based approach The rule based approach has been used extensively in the development of artificial intelligence systems such as expert systems and machine learning This rule based programming technique has been applied in such diverse fields as medical diagnostic systems insurance and banking systems as well as automated design and configuration systems Rule based programming is also helpful in bridging the semantic gap between an application and a program allowing domain specialists to understand programs and participate more closely in their development Over sixty programs are presented and all programs are available from an ftp site Many of these programs are presented in several versions allowing the reader to see how realistic programs are elaborated from back of envelope models Metaprogramming is also presented as a technique for bridging the semantic gap Rule Based Programming will be of interest to programmers systems analysts and other developers of expert systems as well as to researchers and practitioners in artificial intelligence computer science professionals and educators Advances in Robot Learning Jeremy Wyatt,John Demiris,2003-06-29 This book constitutes the thoroughly refereed post workshop proceedings of the 8th European Workshop on Learning Robots EWLRL 99 held in Lausanne Switzerland in September 1999 The seven revised full workshop papers presented were carefully reviewed and selected for inclusion in the book Also included are two invited full papers Among the topics addressed are map building for robot navigation multi task reinforcement learning neural network approaches example based learning situated agents planning maps for mobile robots path finding autonomous robots and biologically inspired approaches Neural-Symbolic Cognitive Reasoning Artur S. D'Avila Garcez,Luís C. Lamb,Dov M. Gabbay,2009 This book explores why regarding practical reasoning humans are sometimes still faster than artificial intelligence systems It is the first to offer a self contained presentation of neural network models for many computer science logics **Fuzzy Information Processing 2023** Kelly

Cohen,Nicholas Ernest,Barnabas Bede,Vladik Kreinovich,2023-11-24 This book is an overview of latest successes and applications of fuzzy techniques techniques that use expert knowledge formulated by natural language words like small Engineering applications deal with aerospace control of spacecrafts and unmanned aerial vehicles air traffic control airport

passenger flow predictions materials designing gold nano structures for medicine catalysis and sensors and robot navigation and manipulation Other application areas include cosmology demographics finances wine production medicine diagnostics epidemics control and predicting human behavior In many cases fuzzy techniques are combined with machine learning AI Due to natural language origin of fuzzy techniques such combination adds explainability X to AI This book is recommended to students and practitioners interested in the state of the art fuzzy related XAI and to researchers willing to take on numerous remaining challenges

Strength or Accuracy: Credit Assignment in Learning Classifier Systems Tim Kovacs, 2012-12-06

Classifier systems are an intriguing approach to a broad range of machine learning problems based on automated generation and evaluation of condition action rules In reinforcement learning tasks they simultaneously address the two major problems of learning a policy and generalising over it and related objects such as value functions Despite over 20 years of research however classifier systems have met with mixed success for reasons which were often unclear Finally in 1995 Stewart Wilson claimed a long awaited breakthrough with his XCS system which differs from earlier classifier systems in a number of respects the most significant of which is the way in which it calculates the value of rules for use by the rule generation system Specifically XCS like most classifier systems employs a genetic algorithm for rule generation and the way in which it calculates rule fitness differs from earlier systems Wilson described XCS as an accuracy based classifier system and earlier systems as strength based The two differ in that in strength based systems the fitness of a rule is proportional to the return reward payoff it receives whereas in XCS it is a function of the accuracy with which return is predicted The difference is thus one of credit assignment that is of how a rule's contribution to the system's performance is estimated XCS is a Q learning system in fact it is a proper generalisation of tabular Q learning in which rules aggregate states and actions In XCS as in other Q learners Q values are used to weight action selection

Symbol Grounding Tony Belpaeme, Stephen John

Cowley, Karl F. MacDorman, 2009 When explaining cognition one must explain how representations in the mind or symbols become meaningful by connecting to the external world This process of connecting symbols with sensorimotor experiences is known as symbol grounding The classical view of symbol grounding is that it is an individual process a person or machine interacts with the environment and associates symbols with external experiences This volume contains views from different disciplines ranging from psychology to robotics on how this view can be extended by first extending symbol grounding to encompass semiotics and by showing how the classical view exaggerates the importance of written language grounding does not necessarily involve written notations but rather language is an external cognitive resource that allows us to acquire categories and concepts Secondly as symbol grounding relies on language to acquire and coordinate the process and language is a dynamical process rooted in both culture and biology symbol grounding by extension is also sensitive to culture emotion and embodiment The contributions to this volume were previously published in Interaction Studies 8 1 2007

Learning to Play Aske Plaat, 2020-11-21 In this textbook the author takes as inspiration recent breakthroughs in game

playing to explain how and why deep reinforcement learning works In particular he shows why two person games of tactics and strategy fascinate scientists programmers and game enthusiasts and unite them in a common goal to create artificial intelligence AI After an introduction to the core concepts environment and communities of intelligence and games the book is organized into chapters on reinforcement learning heuristic planning adaptive sampling function approximation and self play The author takes a hands on approach throughout with Python code examples and exercises that help the reader understand how AI learns to play He also supports the main text with detailed pointers to online machine learning frameworks technical details for AlphaGo notes on how to play and program Go and chess and a comprehensive bibliography The content is class tested and suitable for advanced undergraduate and graduate courses on artificial intelligence and games It s also appropriate for self study by professionals engaged with applications of machine learning and with games development Finally it s valuable for any reader engaged with the philosophical implications of artificial and general intelligence games represent a modern Turing test of the power and limitations of AI

Recent Advances in Robot Learning Judy A. Franklin, Tom M. Mitchell, Sebastian Thrun, 1996-06-30 Recent Advances in Robot Learning contains seven papers on robot learning written by leading researchers in the field As the selection of papers illustrates the field of robot learning is both active and diverse A variety of machine learning methods ranging from inductive logic programming to reinforcement learning is being applied to many subproblems in robot perception and control often with objectives as diverse as parameter calibration and concept formulation While no unified robot learning framework has yet emerged to cover the variety of problems and approaches described in these papers and other publications a clear set of shared issues underlies many robot learning problems Machine learning when applied to robotics is situated it is embedded into a real world system that tightly integrates perception decision making and execution Since robot learning involves decision making there is an inherent active learning issue Robotic domains are usually complex yet the expense of using actual robotic hardware often prohibits the collection of large amounts of training data Most robotic systems are real time systems Decisions must be made within critical or practical time constraints These characteristics present challenges and constraints to the learning system Since these characteristics are shared by other important real world application domains robotics is a highly attractive area for research on machine learning On the other hand machine learning is also highly attractive to robotics There is a great variety of open problems in robotics that defy a static hand coded solution Recent Advances in Robot Learning is an edited volume of peer reviewed original research comprising seven invited contributions by leading researchers This research work has also been published as a special issue of Machine Learning Volume 23 Numbers 2 and 3

Intelligent Information and Database Systems Ngoc Thanh Nguyen, Duong Hung Hoang, Tzung-Pei Hong, Hoang Pham, Bogdan Trawiński, 2018-03-03 The two volume set LNAI 10751 and 10752 constitutes the refereed proceedings of the 10th Asian Conference on Intelligent Information and Database Systems ACIIDS 2018 held in Dong Hoi City Vietnam in March 2018 The total of 133 full papers

accepted for publication in these proceedings was carefully reviewed and selected from 423 submissions They were organized in topical sections named Knowledge Engineering and Semantic Web Social Networks and Recommender Systems Text Processing and Information Retrieval Machine Learning and Data Mining Decision Support and Control Systems Computer Vision Techniques Advanced Data Mining Techniques and Applications Multiple Model Approach to Machine Learning Sensor Networks and Internet of Things Intelligent Information Systems Data Structures Modeling for Knowledge Representation Modeling Storing and Querying of Graph Data Data Science and Computational Intelligence Design Thinking Based R Intelligent and Contextual Systems Intelligent Systems and Algorithms in Information Sciences Intelligent Applications of Internet of Thing and Data Analysis Technologies Intelligent Systems and Methods in Biomedicine Intelligent Biomarkers of Neurodegenerative Processes in Brain Analysis of Image Video and Motion Data in Life Sciences Computational Imaging and Vision Computer Vision and Robotics Intelligent Computer Vision Systems and Applications Intelligent Systems for Optimization of Logistics and Industrial Applications

Deep Reinforcement Learning Aske
 Plaat,2022-06-10 Deep reinforcement learning has attracted considerable attention recently Impressive results have been achieved in such diverse fields as autonomous driving game playing molecular recombination and robotics In all these fields computer programs have taught themselves to understand problems that were previously considered to be very difficult In the game of Go the program AlphaGo has even learned to outmatch three of the world s leading players Deep reinforcement learning takes its inspiration from the fields of biology and psychology Biology has inspired the creation of artificial neural networks and deep learning while psychology studies how animals and humans learn and how subjects desired behavior can be reinforced with positive and negative stimuli When we see how reinforcement learning teaches a simulated robot to walk we are reminded of how children learn through playful exploration Techniques that are inspired by biology and psychology work amazingly well in computers animal behavior and the structure of the brain as new blueprints for science and engineering In fact computers truly seem to possess aspects of human behavior as such this field goes to the heart of the dream of artificial intelligence These research advances have not gone unnoticed by educators Many universities have begun offering courses on the subject of deep reinforcement learning The aim of this book is to provide an overview of the field at the proper level of detail for a graduate course in artificial intelligence It covers the complete field from the basic algorithms of Deep Q learning to advanced topics such as multi agent reinforcement learning and meta learning

The Logic of Adaptive Behavior Martijn van Otterlo,2009 Markov decision processes have become the de facto standard in modeling and solving sequential decision making problems under uncertainty This book studies lifting Markov decision processes reinforcement learning and dynamic programming to the first order or relational setting

Activity Learning Diane J. Cook,Narayanan C. Krishnan,2015-02-19 Defines the notion of an activity model learned from sensor data and presents key algorithms that form the core of the field Activity Learning Discovering Recognizing and Predicting Human Behavior from

Sensor Data provides an in depth look at computational approaches to activity learning from sensor data Each chapter is constructed to provide practical step by step information on how to analyze and process sensor data The book discusses techniques for activity learning that include the following Discovering activity patterns that emerge from behavior based sensor data Recognizing occurrences of predefined or discovered activities in real time Predicting the occurrences of activities The techniques covered can be applied to numerous fields including security telecommunications healthcare smart grids and home automation An online companion site enables readers to experiment with the techniques described in the book and to adapt or enhance the techniques for their own use With an emphasis on computational approaches Activity Learning Discovering Recognizing and Predicting Human Behavior from Sensor Data provides graduate students and researchers with an algorithmic perspective to activity learning Foundations of Data Science Avrim Blum,John Hopcroft,Ravindran Kannan,2020-01-23 Covers mathematical and algorithmic foundations of data science machine learning high dimensional geometry and analysis of large networks

Enjoying the Song of Expression: An Psychological Symphony within **Explanation Based Neural Network Learning A Lifelong Learning Approach**

In some sort of consumed by screens and the ceaseless chatter of instant interaction, the melodic splendor and emotional symphony developed by the published word usually diminish in to the background, eclipsed by the persistent noise and disturbances that permeate our lives. However, situated within the pages of **Explanation Based Neural Network Learning A Lifelong Learning Approach** a stunning literary value overflowing with organic emotions, lies an immersive symphony waiting to be embraced. Constructed by an outstanding composer of language, that charming masterpiece conducts readers on a psychological journey, skillfully unraveling the concealed tunes and profound affect resonating within each carefully crafted phrase. Within the depths with this moving evaluation, we can discover the book is main harmonies, analyze their enthralling writing style, and submit ourselves to the profound resonance that echoes in the depths of readers souls.

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