Lukas König

COMPLEX BEHAVIOR IN EVOLUTIONARY ROBOTICS

Complex Behavior In Evolutionary Robotics De Gruyter Textbook

Patricia A. Vargas,Ezequiel A. Di Paolo,Inman Harvey,Phil Husbands

Complex Behavior In Evolutionary Robotics De Gruyter Textbook:

Complex Behavior in Evolutionary Robotics Lukas König,2015-03-30 Today autonomous robots are used in a rather limited range of applications such as exploration of inaccessible locations cleaning floors mowing lawns etc However ongoing hardware improvements and human fantasy steadily reveal new robotic applications of significantly higher sophistication For such applications the crucial bottleneck in the engineering process tends to shift from physical boundaries to controller generation As an attempt to automatize this process Evolutionary Robotics has successfully been used to generate robotic controllers of various types However a major challenge of the field remains the evolution of truly complex behavior Furthermore automatically created controllers often lack analyzability which makes them useless for safety critical applications In this book a simple controller model based on Finite State Machines is proposed which allows a straightforward analysis of evolved behaviors To increase the model s evolvability a procedure is introduced which by adapting the genotype phenotype mapping at runtime efficiently traverses both the behavioral search space as well as recursively the search space of genotype phenotype mappings Furthermore a data driven mathematical framework is proposed which can be used to calculate the expected success of evolution in complex environments **Vom Lehren zum Lernen** Friederike Pfeiffer-Bohnen,2017-10-23 Die fortschreitende Digitalisierung hat in den letzten Jahrzehnten nie dagewesene gesellschaftliche Umstrukturierungen herbeigef hrt In der Hochschullehre spiegeln sich diese Ver nderungen allerdings nur sehr zeitverz gert wider Im Rahmen des Shift from teaching to learning wird erst in den letzten Jahren die studierendenzentrierte Lehre durch die Gestaltung neuer Lehr und Lernbedingungen aktiv in den Mittelpunkt ger ckt Dieses Buch liefert Empfehlungen f r den intelligenten Einsatz digitaler Systeme in universit ren Lehrveranstaltungen sowie Hilfestellungen zu deren didaktischer Strukturierung Planung und Durchf hrung Zu diesem Zweck wird eine Metrik zur prozeduralen Qualit tsmessung einer Lehrveranstaltung vorgeschlagen und im Rahmen einer realen Gro vorlesung evaluiert Au erdem wird beispielhaft an drei digitalen Systemen dargelegt wie durch deren Einsatz die Entwicklung vom Lehren zum Lernen unterst tzt werden kann das Kommunikationswerkzeug nuKIT Tools der interaktive Aufgabenpool zur asynchronen kontextsensitiven Kommunikation sowie der XWizard zur Unterst tzung des Web Based Training Friederike Pfeifer Bohnen studierte Wirtschaftsingenieurwesen am Karlsruher Institut f r Technologie KIT Dort promovierte sie im Bereich Hochschuldidaktik mit Schwerpunkt eLearning am Institut f r Angewandte Informatik und Formale Beschreibungsverfahren AIFB Im Jahr 2013 erlangte sie das Baden W rttemberg Zertifi kat f r Hochschuldidaktik Im Jahr 2016 erhielt sie den Fakult tslehrpreis f r exzellente Lehre des KIT   The Significance of Complexity Kees van Kooten Niekerk,Hans Buhl,2023-01-06 Originally published in 2004 Thanks to computer simulations science is beginning to understand complex natural processes such as the weather earthquakes and the evolution of life The Significance of Complexity deals with the importance of the sciences of complexity for the humanities and theology First three scientists explain the science of complexity and illustrate it

with concrete examples Second two scholars consider the concept of complexity and possible applications of complexity theory within the humanities e g as a tool to understand the interplay between the artist the work of art and the user in interactive art Finally three theologians ask what can be learned from the science of complexity for a religious understanding of humankind and the world The Significance of Complexity is a pioneering work exploring the import of a fascinating new branch of science for human self understanding It caters for all those who are interested in relating science to the quest for the meaning of life   *Books in Series, 1876-1949* R.R. Bowker Company,1982   **Forthcoming Books** Rose Arny,1993

   The Horizons of Evolutionary Robotics Patricia A. Vargas,Ezequiel A. Di Paolo,Inman Harvey,Phil Husbands,2014-03-28 An authoritative overview of current research in this exciting interdisciplinary field Evolutionary robotics ER aims to apply evolutionary computation techniques to the design of both real and simulated autonomous robots The Horizons of Evolutionary Robotics offers an authoritative overview of this rapidly developing field presenting state of the art research by leading scholars The result is a lively expansive survey that will be of interest to computer scientists robotics engineers neuroscientists and philosophers The contributors discuss incorporating principles from neuroscience into ER dynamical analysis of evolved agents constructing appropriate evolutionary pathways spatial cognition the coevolution of robot brains and bodies group behavior the evolution of communication translating evolved behavior into design principles the development of an evolutionary robotics based methodology for shedding light on neural processes an incremental approach to complex tasks and the notion of mindless intelligence complex processes from immune systems to social networks as a way forward for artificial intelligence Contributors Christos Ampatzis Randall D Beer Josh Bongard Joachim de Greeff Ezequiel A Di Paolo Marco Dorigo Dario Floreano Inman Harvey Sabine Hauert Phil Husbands Laurent Keller Michail Maniadakis Orazio Miglino Sara Mitri Renan Moioli Stefano Nolfi Michael O Shea Rainer W Paine Andy Philippides Jordan B Pollack Michela Ponticorvo Yoon Sik Shim Jun Tani Vito Trianni Elio Tuci Patricia A Vargas Eric D Vaughan   **Evolutionary Foundations of Human Behavior** ,19??   *From Animals to Animats 7* Bridget Hallam,Dario Floreano,John Hallam,Gillian M. Hayes,Jean-Arcady Meyer,2002 Proceedings of the Seventh International Conference on Simulation of Adaptive Behavior

   Darwin's Devices John Long,2012-04-03 What happens when we let robots play the game of life br Darwin s Devices Long tells the story of these evolving biorobots how they came to be and what they can teach us about the biology of living and extinct species Evolving biorobots can replicate creatures that disappeared from the earth long ago showing us in real time what happens in the face of unexpected environmental challenges Biomechanically correct models of backbones functioning as part of an autonomous robot for example can help us understand why the first vertebrates evolved them But the most impressive feature of these robots as Long shows is their ability to illustrate the power of evolution to solve difficult technological challenges autonomously without human input regarding what a workable solution might be Even a simple robot can create complex behavior often learning or evolving greater intelligence than humans could possibly program This

remarkable idea could forever alter the face of engineering design and even warfare An amazing tour through the workings of a fertile mind Darwin s Devices will make you rethink everything you thought you knew about evolution robot intelligence and life itself *Behavior Trees in Robotics and AI* Michele Colledanchise,Petter Ögren,2018-07-20 Behavior Trees BTs provide a way to structure the behavior of an artificial agent such as a robot or a non player character in a computer game Traditional design methods such as finite state machines are known to produce brittle behaviors when complexity increases making it very hard to add features without breaking existing functionality BTs were created to address this very problem and enables the creation of systems that are both modular and reactive Behavior Trees in Robotics and AI An Introduction provides a broad introduction as well as an in depth exploration of the topic and is the first comprehensive book on the use of BTs This book introduces the subject of BTs from simple topics such as semantics and design principles to complex topics such as learning and task planning For each topic the authors provide a set of examples ranging from simple illustrations to realistic complex behaviors to enable the reader to successfully combine theory with practice Starting with an introduction to BTs the book then describes how BTs relate to and in many cases generalize earlier switching structures or control architectures These ideas are then used as a foundation for a set of efficient and easy to use design principles The book then presents a set of important extensions and provides a set of tools for formally analyzing these extensions using a state space formulation of BTs With the new analysis tools the book then formalizes the descriptions of how BTs generalize earlier approaches and shows how BTs can be automatically generated using planning and learning The final part of the book provides an extended set of tools to capture the behavior of Stochastic BTs where the outcomes of actions are described by probabilities These tools enable the computation of both success probabilities and time to completion This book targets a broad audience including both students and professionals interested in modeling complex behaviors for robots game characters or other AI agents Readers can choose at which depth and pace they want to learn the subject depending on their needs and background **Intelligent Behavior in Animals and Robots** David McFarland,Tom Bösser,1993 This exciting study explores the novel insight based on well established ethological principles that animals humans and autonomous robots can all be analyzed as multi task autonomous control systems **Robot Shaping** Marco Dorigo,Marco Colombetti,1998 foreword by Lashon Booker To program an autonomous robot to act reliably in a dynamic environment is a complex task The dynamics of the environment are unpredictable and the robots sensors provide noisy input A learning autonomous robot one that can acquire knowledge through interaction with its environment and then adapt its behavior greatly simplifies the designer s work A learning robot need not be given all of the details of its environment and its sensors and actuators need not be finely tuned Robot Shaping is about designing and building learning autonomous robots The term shaping comes from experimental psychology where it describes the incremental training of animals The authors propose a new engineering discipline behavior engineering to provide the methodologies and tools for creating autonomous robots Their techniques are

based on classifier systems a reinforcement learning architecture originated by John Holland to which they have added several new ideas such as mutespec classifier system energy and dynamic population size In the book they present Behavior Analysis and Training BAT as an example of a behavior engineering methodology **Living with Robots** Richard Pak,Ewart J. de Visser,Ericka Rovira,2019-11-30 Living with Robots Emerging Issues on the Psychological and Social Implications of Robotics focuses on the issues that come to bear when humans interact and collaborate with robots The book dives deeply into critical factors that impact how individuals interact with robots at home work and play It includes topics ranging from robot anthropomorphic design degree of autonomy trust individual differences and machine learning While other books focus on engineering capabilities or the highly conceptual philosophical issues of human robot interaction this resource tackles the human elements at play in these interactions which are essential if humans and robots are to coexist and collaborate effectively Authored by key psychology robotics researchers the book limits its focus to specifically those robots who are intended to interact with people including technology such as drones self driving cars and humanoid robots Forward looking the book examines robots not as the novelty they used to be but rather the practical idea of robots participating in our everyday lives Explores how individual differences in cognitive abilities and personality influence human robot interaction Examines the human response to robot autonomy Includes tools and methods for the measurement of social emotion with robots Delves into a broad range of domains military caregiving toys surgery and more Anticipates the issues we will encountering with robots in the next ten years Foreword by Maggie Jackson author of Distracted From Animals to Animats 3 Dave Cliff,1994 August 8 12 1994 Brighton England From Animals to Animats 3 brings together research intended to advance the fron tier of an exciting new approach to understanding intelligence The contributors represent a broad range of interests from artificial intelligence and robotics to ethology and the neurosciences Unifying these approaches is the notion of animat an artificial animal either simulated by a computer or embodied in a robot which must survive and adapt in progressively more challenging environments The 58 contributions focus particularly on well defined models computer simulations and built robots in order to help characterize and compare various principles and architectures capable of inducing adaptive behavior in real or artificial animals Topics include Individual and collective behavior Neural correlates of behavior Perception and motor control Motivation and emotion Action selection and behavioral sequences Ontogeny learning and evolution Internal world models and cognitive processes Applied adaptive behavior Autonomous robots Heirarchical and parallel organizations Emergent structures and behaviors Problem solving and planning Goal directed behavior Neural networks and evolutionary computation Characterization of environments A Bradford Book **Behavioral and Cognitive Robotics: An adaptive perspective** Stefano Nolfi,2021-01-15 This book describes how to create robots capable to develop the behavioral and cognitive skills required to perform a task through machine learning methods It focuses on model free approaches with minimal human intervention in which the behavior used by the robots to solve their task and the way in

which such behavior is produced is discovered by the adaptive process automatically i e it is not specified by the experimenter The book which is targeted toward researchers PhD and Master students with an interest in machine learning and robotics i introduces autonomous robots evolutionary algorithms reinforcement learning algorithms and learning by demonstration methods ii uses concrete experiments to illustrate the fundamental aspects of embodied intelligence iii provides theoretical and practical knowledge including tutorials and exercises and iv provides an integrated review of recent research in this area carried within partially separated research communities **From Animals to Animats 5** Rolf Pfeifer,1998 The Animals to Animats Conference brings together researchers fromethology psychology ecology artificial intelligence artificiallife robotics engineering and related fields to furtherunderstanding of the behaviors and underlying mechanisms that allownatural and synthetic agents animats to adapt and survive inuncertain environments The Animals to Animats Conference brings together researchers from ethology psychology ecology artificial intelligence artificial life robotics engineering and related fields to further understanding of the behaviors and underlying mechanisms that allow natural and synthetic agents animats to adapt and survive in uncertain environments The work presented focuses on well defined models robotic computer simulation and mathematical that help to characterize and compare various organizational principles or architectures underlying adaptive behavior in both natural animals and animats *ENACTION, EMBODIMENT, EVOLUTIONARY ROBOTICS* Marieke Rohde,2010-03-01 This is an unusual book It launches a new style of research into the nature of the mind a style that pro ciently uncovers explores and exploits the synergies between complex systems thinking sophisticated theoretical critique synthetic modeling technologies and experimental work Rather than adopting a grandiose programmatic approach Marieke Rohde presents us with a pragmatic conjunction of elements each of them strongly feeding off the others and making it impossible to shelf her work strictly under any one rubric such as psychology robotics arti cial intelligence or philosophy of mind Perhaps the least unjust choice is to call this a work of new cognitive science It is yesterday s news to remark on how our conceptual framework for understanding c plex systems is changing There is a recognized need to supplement the scienti c categories of mechanistic XIX century thought for new ways of thinking about non linear forms of interaction and inter relation between events and processes at multiple scales Since the times of cybernetics and in parallel to the development of the computer as a scienti c tool we have witnessed several proposals for revolutionary ways of dealing with complexity catastrophe theory general systems theory chaos self organized criticality complex n works etc Despite not always ful lling their stated potential these ideas have helped us increase our capability to understand complex systems and have in general left us with new concepts new tools and new ways of formulating questions This conceptual change however has not been homogeneous From Animals to Animats : ,2002 **From Animals to Animats 2** Jean-Arcady Meyer,H. L. Roitblat,Stewart W. Wilson,1993 More than sixty contributions in From Animals to Animats 2 byresearchers in ethology ecology cybernetics artificial intelligence robotics and related

fieldsinvestigate behaviors and the underlying mechanisms that allow animals and potentially robots toadapt and survive in uncertain environments Jean Arcady Meyer is Director of Research CNRS Paris Herbert L Roitblat is Professor of Psychology at the University of Hawaii at Manoa Stewart W Wilson is a scientist at The Rowland Institute for Science Cambridge Massachusetts Topics covered The Animat Approach to Adaptive Behavior Perception and Motor Control Action Selection and Behavioral Sequences Cognitive Maps and InternalWorld Models Learning Evolution Collective Behavior

Developmental Robotics Angelo Cangelosi,Matthew Schlesinger,2015-01-23 A comprehensive overview of an interdisciplinary approach to robotics that takes direct inspiration from the developmental and learning phenomena observed in children s cognitive development Developmental robotics is a collaborative and interdisciplinary approach to robotics that is directly inspired by the developmental principles and mechanisms observed in children s cognitive development It builds on the idea that the robot using a set of intrinsic developmental principles regulating the real time interaction of its body brain and environment can autonomously acquire an increasingly complex set of sensorimotor and mental capabilities This volume drawing on insights from psychology computer science linguistics neuroscience and robotics offers the first comprehensive overview of a rapidly growing field After providing some essential background information on robotics and developmental psychology the book looks in detail at how developmental robotics models and experiments have attempted to realize a range of behavioral and cognitive capabilities The examples in these chapters were chosen because of their direct correspondence with specific issues in child psychology research each chapter begins with a concise and accessible overview of relevant empirical and theoretical findings in developmental psychology The chapters cover intrinsic motivation and curiosity motor development examining both manipulation and locomotion perceptual development including face recognition and perception of space social learning emphasizing such phenomena as joint attention and cooperation language from phonetic babbling to syntactic processing and abstract knowledge including models of number learning and reasoning strategies Boxed text offers technical and methodological details for both psychology and robotics experiments

Reviewing **Complex Behavior In Evolutionary Robotics De Gruyter Textbook**: Unlocking the Spellbinding Force of Linguistics

In a fast-paced world fueled by information and interconnectivity, the spellbinding force of linguistics has acquired newfound prominence. Its capacity to evoke emotions, stimulate contemplation, and stimulate metamorphosis is really astonishing. Within the pages of "**Complex Behavior In Evolutionary Robotics De Gruyter Textbook**," an enthralling opus penned by a very acclaimed wordsmith, readers embark on an immersive expedition to unravel the intricate significance of language and its indelible imprint on our lives. Throughout this assessment, we shall delve into the book is central motifs, appraise its distinctive narrative style, and gauge its overarching influence on the minds of its readers.

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