Robot Brains Circuits And Systems For Conscious Machines

Complex Systems are natural systems that science is unable to describe exhaustively. Examples of Complex Systems are both unicellular and multicellular living beings; human brains; human immune systems; ecosystems; human societies; the global economy; the climate and geology of our planet. This book is an account of a marvelous interdisciplinary journey the author made to understand properties of the Complex Systems. He has undertaken his trip, equipped with the fundamental principles of physical chemistry, in particular, the Second Law of Thermodynamics that describes the spontaneous evolution of our universe, and the tools of Non-linear dynamics. By dealing with many disciplines, in particular, chemistry, biology, physics, economy, and philosophy, the author demonstrates that Complex Systems are intertwined networks, working in out-of-equilibrium conditions, which exhibit emergent properties, such as self-organization phenomena and chaotic behaviors in time and space.

How do you know what works and what doesn't? This book contains case studies highlighting the power of polytope projects for complex problem solving. Any sort of combinational problem characterized by a large variety of possibly complex constructions and deconstructions based on simple building blocks can be studied in a similar way. Although the m

While embracing the now classical theories of McCulloch and Pitts, the neuroidal model also accommodates state information in the neurons, more flexible timing mechanisms, a variety of assumptions about interconnectivity, and the possibility that different brain areas perform specialized functions. Programmable so that a wide range of algorithmic theories can be described and evaluated, the model provides a concrete computational language and a unified framework in which diverse cognitive phenomena - such as memory, learning, and reasoning - can be systematically and concurrently analyzed. Requiring no specialized knowledge, Circuits of the Mind masterfully offers an exciting new approach to brain science for students and researchers in computer science, neurobiology, neuroscience, artificial intelligence, and cognitive science.

Discusses major aspects of content-based image retrieval (CBIR) using current technologies and applications within the artificial intelligence (AI) field.

This book demonstrates that not only is it possible to create entities with both consciousness and conscience, but that those entities demonstrate them in ways different from our own, thereby showing a new kind of consciousness.

Future robots are expected to work closely and interact safely with real-world objects and humans alike. Sense of touch is important in this context, as it helps estimate properties such as shape, texture, hardness, material type and many

more; provides action related information, such as slip detection; and helps carrying out actions such as rolling an object between fingers without dropping it. This book presents an in-depth description of the solutions available for gathering tactile data, obtaining aforementioned tactile information from the data and effectively using the same in various robotic tasks. The efforts during last four decades or so have yielded a wide spectrum of tactile sensing technologies and engineered solutions for both intrinsic and extrinsic touch sensors. Nowadays, new materials and structures are being explored for obtaining robotic skin with physical features like bendable, conformable, and stretchable. Such features are important for covering various body parts of robots or 3D surfaces. Nonetheless, there exist many more hardware, software and application related issues that must be considered to make tactile sensing an effective component of future robotic platforms. This book presents an in-depth analysis of various system related issues and presents the trade-offs one may face while developing an effective tactile sensing system. For this purpose, human touch sensing has also been explored. The design hints coming out of the investigations into human sense of touch can be useful in improving the effectiveness of tactile sensory modality in robotics and other machines. Better integration of tactile sensors on a robot's body is prerequisite for the effective utilization of tactile data. The concept of semiconductor devices based sensors is an interesting one, as it allows compact and fast tactile sensing systems with capabilities such as human-like spatio-temporal resolution. This book presents a comprehensive description of semiconductor devices based tactile sensing. In particular, novel Piezo Oxide Semiconductor Field Effect Transistor (POSFET) based approach for high resolution tactile sensing has been discussed in detail. Finally, the extension of semiconductors devices based sensors concept to large and flexile areas has been discussed for obtaining robotic or electronic skin. With its multidisciplinary scope, this book is suitable for graduate students and researchers coming from diverse areas such robotics (bio-robots, humanoids, rehabilitation etc.), applied materials, humans touch sensing, electronics, microsystems, and instrumentation. To better explain the concepts the text is supported by large number of figures.

This volume is part of the two-volume proceedings of the 19th International Conf- ence on Artificial Neural Networks (ICANN 2009), which was held in Cyprus during September 14–17, 2009. The ICANN conference is an annual meeting sp- sored by the European Neural Network Society (ENNS), in cooperation with the - ternational Neural Network Society (INNS) and the Japanese Neural Network Society (JNNS). ICANN 2009 was technically sponsored by the IEEE Computational Intel- gence Society. This series of conferences has been held annually since 1991 in various European countries and covers the field of neurocomputing, learning systems and related areas. Artificial neural networks provide an information-processing structure inspired by biological nervous systems. They consist of a large number of highly interconnected processing elements, with the capability of learning by example. The field of artificial neural networks has

evolved significantly in the last two decades, with active partici- tion from diverse fields, such as engineering, computer science, mathematics, artificial intelligence, system theory, biology, operations research, and neuroscience. Artificial neural networks have been widely applied for pattern recognition, control, optimization, image processing, classification, signal processing, etc.

Impossible Minds: My Neurons, My Consciousness has been written to satisfy the curiosity each and every one of us has about our own consciousness. It takes the view that the neurons in our heads are the source of consciousness and attempts to explain how this happens. Although it talks of neural networks, it explains what they are and what they do in such a way that anyone may understand. While the topic is partly philosophical, the text makes no assumptions of prior knowledge of philosophy; and so contains easy excursions into the important ideas of philosophy that may be missing in the education of a computer scientist. The approach is pragmatic throughout; there are many references to material on experiments that were done in our laboratories.The first edition of the book was written to introduce curious readers to the way that the consciousness we all enjoy might depend on the networks of neurons that make up the brain. In this second edition, it is recognized that these arguments still stand, but that they have been taken much further by an increasing number of researchers. A post-script has now been written for each chapter to inform the reader of these developments and provide an up-to-date bibliography. A new epilogue has been written to summarize the state-of-the art of the search for consciousness in neural automata, for researchers in computation, students of philosophy, and anyone who is fascinated by what is one of the most engaging scientific endeavours of the day.This book also tells a story. A story of a land where people think that they are automata without much in the way of consciousness, a story of cormorants and cliffs by the sea, a story of what it might be like to be a conscious machine …

For the last decades, as the computer technology has been developing, the importance of human-computer systems interaction problems was growing. This is not only because the computer systems performance characteristics have been im-proved but also due to the growing number of computer users and of their expectations about general computer systems capabilities as universal tools for human work and life facilitation. The early technological problems of man-computer information exchange – which led to a progress in computer programming languages and input/output devices construction – have been step by step dominated by the more general ones of human interaction with-and-through computer systems, shortly denoted as H-CSI problems. The interest of scientists and of any sort specialists to the H-CSI problems is very high as it follows from an increasing number of scientific conferences and publications devoted to these topics. The present book contains selected papers concerning various aspects of H-CSI. They have been grouped into five Parts: I. General H-CSI problems (7 papers), II. Disabled persons helping and medical H-CSI applications (9 papers), III. Psychological and linguistic H-CSI aspects (9 papers), IV. Robots and training systems (8 papers), V. Various H-CSI applications (11 papers).

THIS BOOK is the fully revised and updated second edition of 'Consciousness and Robot Sentience'. With lots of new material, it will provide

new insights into artificial intelligence (AI) and machine consciousness, beyond materials published in the first edition. The organization of this book has been streamlined for better clarity and continuity of the lines of arguments.The perspective of AI has been added to this edition. It is shown that contemporary AI has a hidden problem, which prevents it from becoming a true intelligent agent. A self-evident solution to this problem is given in this book.This solution is surprisingly connected with the concepts of qualia, the mind-body problem and consciousness. These are the hard problems of consciousness that so far have been without viable solution. Unfortunately, the solution to the hidden problem of AI cannot be satisfactorily implemented, unless the phenomena of qualia and consciousness are first understood. In this book an explanation of consciousness is presented, one that rejects material and immaterial substances, dualism, panpsychism, emergence and metaphysics. What remains is obvious. This explanation excludes consciousness in digital computers, but allows the artificial creation of consciousness in one natural-like way, by associative non-computational neural networks.The proof of a theory calls for empirical verification. In this case, the proof could be in the form of a sentient robot. This book describes a step towards this in the form of the author's small experimental robot XCR-1. This robot has evolved through the years, and has now new cognitive abilities, which are described.

An investigation into the assignment of moral responsibilities and rights to intelligent and autonomous machines of our own making. One of the enduring concerns of moral philosophy is deciding who or what is deserving of ethical consideration. Much recent attention has been devoted to the "animal question"—consideration of the moral status of nonhuman animals. In this book, David Gunkel takes up the "machine question": whether and to what extent intelligent and autonomous machines of our own making can be considered to have legitimate moral responsibilities and any legitimate claim to moral consideration. The machine question poses a fundamental challenge to moral thinking, questioning the traditional philosophical conceptualization of technology as a tool or instrument to be used by human agents. Gunkel begins by addressing the question of machine moral agency: whether a machine might be considered a legitimate moral agent that could be held responsible for decisions and actions. He then approaches the machine question from the other side, considering whether a machine might be a moral patient due legitimate moral consideration. Finally, Gunkel considers some recent innovations in moral philosophy and critical theory that complicate the machine question, deconstructing the binary agent–patient opposition itself. Technological advances may prompt us to wonder if the science fiction of computers and robots whose actions affect their human companions (think of HAL in 2001: A Space Odyssey) could become science fact. Gunkel's argument promises to influence future considerations of ethics, ourselves, and the other entities who inhabit this world.

The theme of Aesthetics in Present Future concerns the new chances the arts have and the deep changes they are undergoing, due to the new media, and the digital world in which we are growingly immersed. That this world is to be understood from an aesthetic point of view, become clear if we think of how much of what we produce, and observe and study is offered through images in particular and perceptual means in general.

This book presents compact and informative descriptions of the most promising new projects in brain-computer interface (BCI) research. As in earlier volumes in this series, the contributions come from many of the best-known groups in BCI research. Each of these chapters provides an overview of a project that was nominated for the most prestigious award in the BCI community: the Annual BCI Research Award. The book also contains an introduction and discussion with a review of major trends reflected in the awards. This volume also introduces a new type of contribution, namely a chapter"Trends in BCI Research" that summarizes a top trend in the BCI research community. This year's "Trends in BCI Research" addresses BCI technology to help patients with disorders of consciousness (DOC) and related conditions, including

new work that goes beyond communication to diagnosis and even prediction.

No longer the clunky characters of science fiction novels and old movies, robots are dynamic and vital agents in modern life. This book introduces readers to current technologies and transports them to a future where the sky is truly the limit when it comes to how advanced and helpful robotics may prove to be. It provides them a glimpse at the myriad possible roles robots may play in medicine, services, military, and law enforcement applications. In addition, it asks how human beings themselves and their civilization may adapt to a future world of advanced robotics.

For thousands of years, humans have used machines to accomplish tasks more efficiently and often to complete tasks people simply can't do on their own. Now, modern technology allows inventors to design robots capable of amazing feats that used to seem unthinkable. This cool book examines how automation revolutionized the world in the 1940s and has grown and changed over time. Readers learn how cutting-edge factories use robots, and the latest information about self-driving cars and drones. They'll evaluate the problems that robots solve, like disaster cleanup and exploring uninhabitable areas in outer space. This book also looks at what's next in the field of robotics, including lifelike social robots and advanced machine learning.

A rigorous case for the primacy of mind in nature, from philosophy to neuroscience, psychology and physics. The Idea of the World offers a grounded alternative to the frenzy of unrestrained abstractions and unexamined assumptions in philosophy and science today. This book examines what can be learned about the nature of reality based on conceptual parsimony, straightforward logic and empirical evidence from fields as diverse as physics and neuroscience. It compiles an overarching case for idealism - the notion that reality is essentially mental - from ten original articles the author has previously published in leading academic journals. The case begins with an exposition of the logical fallacies and internal contradictions of the reigning physicalist ontology and its popular alternatives, such as bottom-up panpsychism. It then advances a compelling formulation of idealism that elegantly makes sense of - and reconciles - classical and quantum worlds. The main objections to idealism are systematically refuted and empirical evidence is reviewed that corroborates the formulation presented here. The book closes with an analysis of the hidden psychological motivations behind mainstream physicalism and the implications of idealism for the way we relate to the world.

A comprehensive, integrated, and accessible textbook presenting core neuroscientific topics from a computational perspective, tracing a path from cells and circuits to behavior and cognition. This textbook presents a wide range of subjects in neuroscience from a computational perspective. It offers a comprehensive, integrated introduction to core topics, using computational tools to trace a path from neurons and circuits to behavior and cognition. Moreover, the chapters show how computational neuroscience—methods for modeling the causal interactions underlying neural systems—complements empirical research in advancing the understanding of brain and behavior. The chapters—all by leaders in the field, and carefully integrated by the editors—cover such subjects as action and motor control; neuroplasticity, neuromodulation, and reinforcement learning; vision; and language—the core of human cognition. The book can be used for advanced undergraduate or graduate level courses. It presents all necessary background in neuroscience beyond basic facts about neurons and synapses and general ideas about the structure and function of the human brain. Students should be familiar with differential equations and probability theory, and be able to pick up the basics of programming in MATLAB and/or Python. Slides, exercises, and other ancillary materials are freely available

online, and many of the models described in the chapters are documented in the brain operation database, BODB (which is also described in a book chapter). Contributors Michael A. Arbib, Joseph Ayers, James Bednar, Andrej Bicanski, James J. Bonaiuto, Nicolas Brunel, Jean-Marie Cabelguen, Carmen Canavier, Angelo Cangelosi, Richard P. Cooper, Carlos R. Cortes, Nathaniel Daw, Paul Dean, Peter Ford Dominey, Pierre Enel, Jean-Marc Fellous, Stefano Fusi, Wulfram Gerstner, Frank Grasso, Jacqueline A. Griego, Ziad M. Hafed, Michael E. Hasselmo, Auke Ijspeert, Stephanie Jones, Daniel Kersten, Jeremie Knuesel, Owen Lewis, William W. Lytton, Tomaso Poggio, John Porrill, Tony J. Prescott, John Rinzel, Edmund Rolls, Jonathan Rubin, Nicolas Schweighofer, Mohamed A. Sherif, Malle A. Tagamets, Paul F. M. J. Verschure, Nathan Vierling-Claasen, Xiao-Jing Wang, Christopher Williams, Ransom Winder, Alan L. Yuille

The Routledge Companion to Embodied Music Interaction captures a new paradigm in the study of music interaction, as a wave of recent research focuses on the role of the human body in musical experiences. This volume brings together a broad collection of work that explores all aspects of this new approach to understanding how we interact with music, addressing the issues that have roused the curiosities of scientists for ages: to understand the complex and multi-faceted way in which music manifests itself not just as sound but also as a variety of cultural styles, not just as experience but also as awareness of that experience. With contributions from an interdisciplinary and international array of scholars, including both empirical and theoretical perspectives, the Companion explores an equally impressive array of topics, including: Dynamical music interaction theories and concepts Expressive gestural interaction Social music interaction Sociological and anthropological approaches Empowering health and well-being Modeling music interaction Music-based interaction technologies and applications This book is a vital resource for anyone seeking to understand human interaction with music from an embodied perspective.

Examines the brains inside of a robot.

The ?eld of robotics continues to ?ourish and develop. In common with general scienti?c investigation, new ideas and implementations emerge quite spontaneously and these are discussed, used, discarded or subsumed at c- ferences, in the reference journals, as well as through the Internet. After a little more maturity has been acquired by the new concepts, then archival publication as a scienti?c or engineering monograph may occur. The goal of the Springer Tracts in Advanced Robotics is to publish new developments and advances in the ?elds of robotics research – rapidly and informally but with a high quality. It is hoped that prospective authors will welcome the opportunity to publish a structured presentation of some of the emerging robotics methodologies and technologies. The edited volume by Antonio Bicchi, Henrik Christensen and Domenico Prattichizzo is the outcome of the second edition of a workshop jointly sponsored by the IEEE Control Systems Society and the IEEE Robotics and Automation Society. Noticeably, the previous volume was published in the Springer Lecture Notes on Control and Information Sciences. The authors are recognised as leading scholars internationally. A n- ber of challenging control problems on the forefront of today’s research in robotics and automation are covered, with special emphasis on vision, sensory-feedback control, human-centered robotics, manipulation, planning, ?exible and cooperative robots, assembly systems.

"This book presents the proceedings of the First International Conference on Biologically Inspired Cognitive Architectures (BICA 2010), which is also the First Annual Meeting of the BICA Society. A cognitive architecture is a computational framework for the design of intelligent, even conscious, agents. It may draw inspiration from many sources, such as pure mathematics, physics or abstract theories of cognition. A biologically inspired cognitive architecture (BICA) is one which incorporates formal mechanisms from computational models of human and animal cognition, which currently provide the only physical examples with the robustness, flexibility, scalability and consciousness that artificial intelligence aspires to achieve. The BICA approach has several different goals: the broad aim of creating intelligent software systems without focusing on any one area of application; attempting to accurately simulate human behavior or gain an understanding of how the human mind works, either for purely scientific reasons or for applications in a variety of domains; understanding how the brain works at a neuronal and sub-neuronal level; or designing artificial systems which can perform the cognitive tasks important to practical applications in human society, and which at present only humans are capable of. The papers presented in this volume reflect the cross-disciplinarity and integrative nature of the BICA approach and will be of interest to anyone developing their own approach to cognitive architectures. Many insights can be found here for inspiration or to import into one's own architecture, directly or in modified form."--Publisher description.

Includes full-length papers, short position statements and also the papers presented in the post conference workshop on the sociocultural, ethical and futurological implications of Artificial General Intelligence (AGI).

This volume explores the ethical questions that arise in the development, creation and use of robots that are capable of semiautonomous or autonomous decision making and human-like action. It examines how ethical and moral theories can and must be applied to address the complex and critical issues of the application of these intelligent robots in society. Coverage first presents fundamental concepts and provides a general overview of ethics, artificial intelligence and robotics. Next, the book studies all principal ethical applications of robots, namely medical, assistive, socialized and war roboethics. It looks at such issues as robotic surgery, children-robot and elderly-robot therapeutical/social interactions and the use of robots, especially autonomous lethal ones, in warfare. In addition, a chapter also considers Japanese roboethics as well as key intercultural and robot legislation issues. Overall, readers are provided with a thorough investigation into the moral responsibility (if any) of autonomous robots when doing harm. This volume will serve as an ideal educational source in engineering and robotics courses as well as an introductory reference for researchers in the field.

This monograph presents key method to successfully manage the growing complexity of systems where conventional engineering and scientific methodologies and technologies based on learning and adaptability come to their limits and new ways are nowadays required. The transition from adaptable to evolvable and finally to self-evolvable systems is highlighted, self-properties such as self-organization, self-configuration, and self-repairing are introduced and challenges and limitations of the self-evolvable engineering systems are evaluated.

Cognitive Systems - Information Processing Meets Brain Science presents an overview of the exciting, truly multidisciplinary research by

neuroscientists and systems engineers in the emerging field of cognitive systems, providing a cross-disciplinary examination of this cutting-edge area of scientific research. This is a great example of where research in very different disciplines touches to create a new emerging area of research. The book illustrates some of the technical developments that could arise from our growing understanding of how living cognitive systems behave, and the ability to use that knowledge in the design of artificial systems. This unique book is of considerable interest to researchers and students in information science, neuroscience, psychology, engineering and adjacent fields. Represents a remarkable collection of relevant experts from both the life sciences and computer science Includes state-of-the-art reviews of topics in cognitive systems from both a life sciences and a computer science perspective Discusses the impact of this research on our lives in the near future

The book focuses on original approaches intended to support the development of biologically inspired cognitive architectures. It bridges together different disciplines, from classical artificial intelligence to linguistics, from neuro- and social sciences to design and creativity, among others. The chapters, based on contributions presented at the Ninth Annual Meeting of the BICA Society, held in on August 23-24, 2018, in Prague, Czech Republic, discuss emerging methods, theories and ideas towards the realization of general-purpose humanlike artificial intelligence or fostering a better understanding of the ways the human mind works. All in all, the book provides engineers, mathematicians, psychologists, computer scientists and other experts with a timely snapshot of recent research and a source of inspiration for future developments in the broadly intended areas of artificial intelligence and biological inspiration.

This book guides readers along a path that proceeds from neurobiology to nonlinear-dynamical circuits, to nonlinear neuro-controllers and to bio-inspired robots. It provides a concise exploration of the essence of neural processing in simple animal brains and its adaptation and extrapolation to modeling, implementation, and realization of the analogous emergent features in artificial but bio-inspired robots: an emerging research field. The book starts with a short presentation of the main areas of the Drosophila brain. These are modeled as nonlinear dynamical structures, which are then used to showcase key features like locomotion, motor learning, memory formation, and exploitation. It also discusses additional complex behaviors, such as sequence learning and perception, which have recently been discovered to exist in insects. Much of the material presented has been tested in biorobotics classes for the Master’s degree in Automation Engineering and Control of Complex Systems at the University of Catania. Reporting on the work fostered by several national and international research projects, the book offers researchers novel ideas on how neuro-inspired dynamics can be used in developing the autonomous machines of the future.

"This encyclopedia, magnificently edited by Byron Kaldis, will become a valuable source both of reference and inspiration for all those who are interested in the interrelation between philosophy and the many facets of the social sciences. A must read for every student of the humanities." Wulf Gaertner, University of Osnabrueck, Germany "Like all good works of reference this Encyclopedia of Philosophy and the Social Sciences is not to be treated passively: it provides clear and sometimes controversial material for constructive confrontation. It is a rich resource for critical engagement. The Encyclopedia conceived and edited by Byron Kaldis is a work of impressive scope and I am delighted to have it on my bookshelf." David Bloor, Edinburgh University "This splendid and possibly unique work steers a skilful course between narrower conceptions of philosophy and the social sciences. It will be an invaluable resource for students and researchers in either or both fields, and to anyone working on the interrelations between them." William Outhwaite, Newcastle University The Encyclopedia of Philosophy and the Social Sciences is the first of its kind in bringing the subjects of philosophy and the social sciences together. It is not only about the

philosophy of the social sciences but, going beyond that, it is also about the relationship between philosophy and the social sciences. The subject of the Encyclopedia is purposefully multi- and inter-disciplinary. Knowledge boundaries are both delineated and crossed over. The goal is to convey a clear sense of how philosophy looks at the social sciences and to mark out a detailed picture of how the two are interrelated: interwoven at certain times but also differentiated and contrasted at others. The Entries cover topics of central significance but also those that are both controversial and on the cutting-edge, underlining the unique mark of this Encyclopedia: the interrelationship between philosophy and the social sciences, especially as it is found in fresh ideas and unprecedented hybrid disciplinary areas. The Encyclopedia serves a further dual purpose: it contributes to the renewal of the philosophy of the social sciences and helps to promote novel modes of thinking about some of its classic problems.

Research on natural and artificial brains is proceeding at a rapid pace. However, the understanding of the essence of consciousness has changed slightly over the millennia, and only the last decade has brought some progress to the area. Scientific ideas emerged that the soul could be a product of the material body and that calculating machines could imitate brain processes. However, the authors of this book reject the previously common dualism—the view that the material and spiritual-psychic processes are separate and require a completely different substance as their foundation. Reductive Model of the Conscious Mind is a forward-thinking book wherein the authors identify processes that are the essence of conscious thinking and place them in the imagined, simplified structure of cells able to memorize and transmit information in the form of impulses, which they call neurons. The purpose of the study is to explain the essence of consciousness to the degree of development of natural sciences, because only the latter can find a way to embed the concept of the conscious mind in material brains. The book is divided into three parts. Part 1 works to convince readers that the emergence of consciousness does not require detailed knowledge of the structure and morphology of the brain, with the exception of some specific properties of the neural network structure that the authors attempt to point out. Part 2 proves that the biological structure of many natural brains fulfills the necessary conditions for consciousness and intelligent thinking. Similarly, Part 3 shows the ways in which artificial creatures imitating natural brains can meet these conditions, which gives great hopes for building artificially intelligent beings endowed with consciousness. Covering topics that include cognitive architecture, the embodied mind, and machine learning, this book is ideal for cognitive scientists, philosophers of mind, neuroscientists, psychologists, researchers, academicians, and advanced-level students. The book can also help to focus the research of linguists, neurologists, and biophysicists on the biophysical basis of postulated information processing into knowledge structures.

Millions of people worldwide are affected by neurological disorders which disrupt the connections within the brain and between brain and body causing impairments of primary functions and paralysis. Such a number is likely to increase in the next years and current assistive technology is yet limited. A possible response to such disabilities, offered by the neuroscience community, is given by Brain-Machine Interfaces (BMIs) and neuroprostheses. The latter field of research is highly multidisciplinary, since it involves very different and disperse scientific communities, making it fundamental to create connections and to join research efforts. Indeed, the design and development of neuroprosthetic devices span/involve different research topics such as: interfacing of neural systems at different levels of architectural complexity (from in vitro neuronal ensembles to human brain), bio-artificial interfaces for stimulation (e.g. micro-stimulation, DBS: Deep Brain Stimulation) and recording (e.g. EMG: Electromyography, EEG: Electroencephalography, LFP: Local Field Potential), innovative signal processing tools for coding and decoding of neural activity, biomimetic artificial Spiking Neural Networks (SNN) and neural network modeling. In order to develop functional communication with the nervous system and to create a new generation of neuroprostheses, the study of

closed-loop systems is mandatory. It has been widely recognized that closed-loop neuroprosthetic systems achieve more favorable outcomes for users then equivalent open-loop devices. Improvements in task performance, usability, and embodiment have all been reported in systems utilizing some form of feedback. The bi-directional communication between living neurons and artificial devices is the main final goal of those studies. However, closed-loop systems are still uncommon in the literature, mostly due to requirement of multidisciplinary effort. Therefore, through eBook on closed-loop systems for next-generation neuroprostheses, we encourage an active discussion among neurobiologists, electrophysiologists, bioengineers, computational neuroscientists and neuromorphic engineers. This eBook aims to facilitate this process by ordering the 25 contributions of this research in which we highlighted in three different parts: (A) Optimization of different blocks composing the closed-loop system, (B) Systems for neuromodulation based on DBS, EMG and SNN and (C) Closed-loop BMIs for rehabilitation.

Annotation Robots are being used in increasingly complicated and demanding tasks, often in environments that are complex or even hostile. Underwater, space and volcano exploration are just some of the activities that robots are taking part in, mainly because the environments that are being explored are dangerous for humans. Robots can also inhabit dynamic environments, for example to operate among humans, not just in factories, but also taking on more active roles. Recently, for instance, they have made their way into the home entertainment market. Given the variety of situations that robots will be placed in, learning becomes increasingly important. Robot learning is essentially about equipping robots with the capacity to improve their behaviour over time, based on their incoming experiences. The papers in this volume present a variety of techniques. Each paper provides a mini-introduction to a subfield of robot learning. Some also give a fine introduction to the field of robot learning as a whole. Thereis one unifying aspect to the work reported in the book, namely its interdisciplinary nature, especially in the combination of robotics, computer science and biology. This approach has two important benefits: first, the study of learning in biological systems can provide robot learning scientists and engineers with valuable insights into learning mechanisms of proven functionality and versatility; second, computational models of learning in biological systems, and their implementation in simulated agents and robots, can provide researchers of biological systems with a powerful platform for the development and testing of learning theories.

Modern robots have arrived at a very matured state both in their mechanical / control aspects and their mental aspects. An Introduction to Robophilosophy explores the philosophical questions that arise in the development, creation, and use of mental – anthropomorphic and zoomorphic- robots that are capable of semiautonomous / autonomous operation, decision making and human-like action, being able to socially interact with humans and exhibit behavior similar to human beings or animals. Coverage first presents fundamental concepts, and an overview of philosophy, philosophy of science, and philosophy of technology. The six principal mental capabilities of modern robots, namely cognition, intelligence, autonomy, consciousness, conscience, and ethics are then studied from a philosophical point of view. They actually represent the product of technological embodiment of cognitive features to robots. Overall, readers are provided a consolidated thorough investigation of the philosophical aspects of these mental capabilities when embedded to robots. This book will serve as an ideal educational source in engineering and robotics courses as well as an introductory reference for researchers in the field of robotics, and it includes a rich bibliography.

This book presents an interpretation of pharmaceutical, surgical and psychotherapeutic interventions based on a univalent metalanguage: biosemiotics. It proposes that a metalanguage for the physical, mental, social, and cultural aspects of health and

medicine could bring all parts and aspects of human life together and thus shape a picture of the human being as a whole, made up from the heterogeneous images of the vast variety of sciences and technologies in medicine discourse. The book adopts a biosemiotics clinical model of thinking because, similar to the ancient principle of alchemy, tam ethice quam physice, everything in this model is physical as much as it is mental. Signs in the forms of vibrations, molecules, cells, words, images, reflections and rites conform cultural, mental, physical, and social phenomena. The book decodes healing, dealing with health, illness and therapy by emphasizing the first-person experience as well as objective events. It allows readers to follow the energy-information flows through and between embodied minds and to see how they form physiological functions such as our emotions and narratives.
Building a conscious robot is a scientific and technological challenge. Debates about the possibility of conscious robots and the related positive outcomes and hazards for human beings are today no longer confined to philosophical circles. Robot consciousness is a research field aimed at a two-part goal: on the one hand, scholars working in robot consciousness take inspiration from biological consciousness to build robots that present forms of experiential and functional consciousness. On the other hand, scholars employ robots as tools to better understand biological consciousness. Thus, part one of the goal concerns the replication of aspects of biological consciousness in robots, by unifying a variety of approaches from AI and robotics, cognitive robotics, epigenetic and affective robotics, situated and embodied robotics, developmental robotics, anticipatory systems, and biomimetic robotics. Part two of the goal is pursued by employing robots to advance and mark progress in the study of consciousness in humans and animals. Notably, neuroscientists involved in the study of consciousness do not exclude the possibility that robots may be conscious. This eBook comprises a collection of thirteen manuscripts and an Editorial published by Frontiers in Robotics and Artificial Intelligence, under the section Humanoid Robotics, and Frontiers in Neurorobotics, on the topic “Consciousness in Humanoid Robots.” This compendium aims at collating the most recent theoretical studies, models, and case studies of machine consciousness that take the humanoid robot as a frame of reference. The content in the articles may be applied to many different kinds of robots, and to software agents as well.
Haikonen envisions autonomous robots that perceive and understand the world directly, acting in it in a natural human-like way without the need of programs and numerical representation of information. By developing higher-level cognitive functions through the power of artificial associative neuron architectures, the author approaches the issues of machine consciousness. Robot Brains expertly outlines a complete system approach to cognitive machines, offering practical design guidelines for the creation of non-numeric autonomous creative machines. It details topics such as component parts and realization principles, so that different pieces may be implemented in hardware or software. Real-world examples for designers and researchers are provided, including circuit and systems examples that few books on this topic give. In novel technical and practical detail, this book also considers: the limitations and remedies of traditional neural associators in creating true machine cognition; basic circuit assemblies cognitive neural architectures; how motors can be interfaced with the associative neural system in order for fluent motion to be achieved without numeric computations; memorization, imagination, planning and reasoning in the machine; the concept of machine

emotions for motivation and value systems; an approach towards the use and understanding of natural language in robots. The methods presented in this book have important implications for computer vision, signal processing, speech recognition and other information technology fields. Systematic and thoroughly logical, it will appeal to practising engineers involved in the development and design of robots and cognitive machines, also researchers in Artificial Intelligence. Postgraduate students in computational neuroscience and robotics, and neuromorphic engineers will find it an exciting source of information.

This book focuses on the importance of human factors in the development of safe and reliable unmanned systems. It discusses current challenges such as how to improve the perceptual and cognitive abilities of robots, develop suitable synthetic vision systems, cope with degraded reliability in unmanned systems, predict robotic behavior in case of a loss of communication, the vision for future soldier–robot teams, human–agent teaming, real-world implications for human–robot interaction, and approaches to standardize both the display and control of technologies across unmanned systems. Based on the AHFE 2019 International Conference on Human Factors in Robots and Unmanned Systems, held on July 24–28, 2019, Washington D.C., USA, this book fosters new discussions and stimulates new advances in the development of more reliable, safer, and highly functional devices for carrying out automated and concurrent tasks.

Neuromorphic and brain-based robotics have enormous potential for furthering our understanding of the brain. By embodying models of the brain on robotic platforms, researchers can investigate the roots of biological intelligence and work towards the development of truly intelligent machines. This book provides a broad introduction to this groundbreaking area for researchers from a wide range of fields, from engineering to neuroscience. Case studies explore how robots are being used in current research, including a whisker system that allows a robot to sense its environment and neurally inspired navigation systems that show impressive mapping results. Looking to the future, several chapters consider the development of cognitive, or even conscious robots that display the adaptability and intelligence of biological organisms. Finally, the ethical implications of intelligent robots are explored, from morality and Asimov's three laws to the question of whether robots have rights.