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Handbook of Brain Microcircuits Motor Cortex Microcircuits (Frontiers in Brain Microcircuits Series) Microcircuits Neurogastronomy The Brain in Motion Neuroenology Foundations of the Neuron Doctrine Handbook of Brain Microcircuits Diversity in the Neuronal Machine Dynamics in Neuronal Microcircuits Hippocampal Microcircuits The Physics of the Mind and Brain Disorders Analysis of Neuronal Microcircuits and Synaptic Interactions Exploring the Representation of Global Brain States in Cortical Microcircuits by All-optical Physiology The Synaptic Organization of the Brain Structure, function, and plasticity of hippocampal dentate gyrus microcircuits Computational Models of Brain and Behavior Hippocampal Microcircuits for Social Memory Specification Network Functions and Plasticity Goal-Directed Decision Making Visual Processing in Subcortical and Cortical Circuits Computational Modelling of the Brain Augmentation of Brain Function: Facts, Fiction and Controversy Functional Microcircuits and Development of Laminar Connectivity in Visual Cortex Mapping the Brain and Its Functions

The NEURON Book Computational Models of Brain and Behavior Conscious Mind, Resonant Brain Neuroscience Databases Rhythms of the Brain The Mammalian Auditory Pathways Network Neuroscience Handbook of Chemical Neuroanatomy: Analysis of neuronal microcircuits and synaptic interactions 2018 IEEE International Conference on Cyborg and Bionic Systems (CBS) Neural Communication and Control Adaptive Function and Brain Evolution Micro-, Meso- and Macro-Connectomics of the Brain Essence of Memory Inferior Colliculus Microcircuits Innate

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In order to focus on principles, each chapter in this work is brief, organized around 1-3 wiring diagrams of the key circuits, with several pages of text that distil the functional significance of each microcircuit This book has brought together leading investigators who work in the new arena of brain connectomics. This includes ‘macro-connectome’ efforts to comprehensively chart long-distance pathways and functional networks; ‘micro-connectome’ efforts to identify every neuron, axon, dendrite, synapse, and glial process within restricted brain regions; and ‘meso-

connectome’ efforts to systematically map both local and long-distance connections using anatomical tracers. This book highlights cutting-edge methods that can accelerate progress in elucidating static ‘hard-wired’ circuits of the brain as well as dynamic interactions that are vital for brain function. The power of connectomic approaches in characterizing abnormal circuits in the many brain disorders that afflict humankind is considered. Experts in computational neuroscience and network theory provide perspectives needed for synthesizing across different scales in space and time. Altogether, this book provides an integrated view of the challenges and opportunities in deciphering brain circuits in health and disease. During social interactions, humans and social animals can distinguish not only familiar and novel conspecifics (social recognition) but also between multiple familiar individuals (social specification). Recent studies have implicated hippocampal sub-region dorsal CA2 (dCA2) in social recognition and identified social recognition memory engram in downstream ventral CA1 (vCA1). However, the anatomical site for the storage of social specification memory and its underlying neuroscientific mechanisms are poorly known. Here, we report that social specification memory engrams are stored in vCA1 while social information encoded in dCA2 becomes sharpened as it travels from dCA2 to vCA1 microcircuits within CA2, thereby acquiring a progressive increase in specification through repeating motifs of feed-forward inhibition. Both the inhibition of GABAergic inhibitory neurons in CA2 and reduced activity of excitatory neurons by ablation of oxytocin receptors in the dCA2 to vCA1 microcircuits impair social memory specification. These results suggest that the vCA1 and the multiple feed-forward inhibition motifs in the dCA2 to vCA1 microcircuits are crucial for social memory specification. The auditory system is a

complex neural system composed of many types of neurons connected into networks. One feature that sets the auditory system apart from other sensory systems, such as somatosensory or visual systems, is the many stages of neural processing that occur between the ear in the periphery and the cerebral cortex. Each stage is composed of specialized types of neurons connected in specific microcircuits that perform computations on the information about sound. To understand this processing, all the tools of neuroscience must be employed. The proposed text integrates cell biology, synaptic physiology, and electrophysiology to fully develop the topic, presenting an overview of the functional anatomy of the central auditory system. It is organized based on the neuronal connectivity of the central auditory system, which emphasizes the neurons, their synaptic organization, and their formation of functional pathways and microcircuits. The goal of the book is to stimulate research into the cell biology of the central auditory system and the characteristics of the specific neurons and connections that are necessary for normal hearing. Future research on the development of the central auditory including that employing stem cells will require such information in order to engineer appropriate therapeutic approaches. ? This is the 2nd edition of a very well received and popular book that reflects the current state-of-the-art of the ongoing research avenues concerning the hippocampus and processing units bridging the gap between single cell activity, network activity and global brain function. It aims to provide a methodology to anyone interested in developing microcircuit level models of the hippocampus. The book is divided into two thematic areas: (I) Experimental background and (II) Computational analysis. In part I, leading experimental neuroscientists discuss the morphological, physiological and molecular characteristics as well as the connectivity and

synaptic properties of the various cell types found in the hippocampus. Behaviour-related ensemble activity patterns of morphologically identified neurons in anesthetized and freely moving animals provide insights on the function of the hippocampal areas. In part II, computational neuroscientists present models of the hippocampal microcircuits at various levels of detail (e.g. single cell level, network level, etc.). Synaptomics and connectomics models of hippocampal structures are initially discussed. Then, network models of memory, rhythm generation and spatial navigation are presented, followed by abstract and biophysical models of synaptic plasticity. Network models of hippocampal implicated disorders (epilepsy and schizophrenia) are then detailed and how their network topologies, connectivities and activities change in these diseases. Finally, two chapters are dedicated to describing simulator environments of single neurons and networks currently used by computational neuroscientists in developing their models and modelling tools to parametrically constrain them. This engaging volume is invaluable to experimental and computational neuroscientists, electrical engineers, physicists, mathematicians and others interested in developing microcircuit models of the hippocampus. Graduate level students and trainees in all of these fields can find this book a significant source of information. The main purpose of this workshop is to discuss frontier research and realistic applications on cyborg and bionic systems, which are concerned with hybrid fusion of organic and biomechatronic body parts with the integration of some artificial components or technology like bio hybrid actuators and sensors, sponsored by the new TC on Cyborg and Bionic Systems One of the primary goal is to make an organism restored or enhanced beyond its original biological characteristics In particular, the cyborg and bionic

systems is a promising research direction to meet the requirements for better life of human beings, such as regeneration medicine, neuro control, and rescue relief With rapid development of bionic technology and nanotechnology, we think that a cyborg and bionic system can assist human to conquer many limitations such as disease, speed, strength, as well as intelligence A comprehensive Introduction to the world of brain and behavior computational models This book provides a broad collection of articles covering different aspects of computational modeling efforts in psychology and neuroscience. Specifically, it discusses models that span different brain regions (hippocampus, amygdala, basal ganglia, visual cortex), different species (humans, rats, fruit flies), and different modeling methods (neural network, Bayesian, reinforcement learning, data fitting, and Hodgkin-Huxley models, among others). Computational Models of Brain and Behavior is divided into four sections: (a) Models of brain disorders; (b) Neural models of behavioral processes; (c) Models of neural processes, brain regions and neurotransmitters, and (d) Neural modeling approaches. It provides in-depth coverage of models of psychiatric disorders, including depression, posttraumatic stress disorder (PTSD), schizophrenia, and dyslexia; models of neurological disorders, including Alzheimer’s disease, Parkinson’s disease, and epilepsy; early sensory and perceptual processes; models of olfaction; higher/systems level models and low-level models; Pavlovian and instrumental conditioning; linking information theory to neurobiology; and more. Covers computational approximations to intellectual disability in down syndrome Discusses computational models of pharmacological and immunological treatment in Alzheimer's disease Examines neural circuit models of serotonergic system (from microcircuits to cognition) Educates on information theory, memory, prediction, and timing in

associative learning Computational Models of Brain and Behavior is written for advanced undergraduate, Master's and PhD-level students—as well as researchers involved in computational neuroscience modeling research. Studying brain networks has become a truly interdisciplinary endeavor, attracting students and seasoned researchers alike from a wide variety of academic backgrounds. What has been lacking is an introductory textbook that brings together the different fields and provides a gentle introduction to the major concepts and findings in the emerging field of network neuroscience. Network Neuroscience is a one-stop-shop that is of equal use to the neurobiologist, who is interested in understanding the quantitative methods employed in network neuroscience, and to the physicist or engineer, who is interested in neuroscience applications of mathematical and engineering tools. The book spans 27 chapters that cover everything from individual cells all the way to complex network disorders such as depression and autism spectrum disorders. An additional 12 toolboxes provide the necessary background for making network neuroscience accessible independent of the reader’s background. Dr. Flavio Frohlich (www.networkneuroscientist.org) wrote this book based on his experience of mentoring dozens of trainees in the Frohlich Lab, from undergraduate students to senior researchers. The Frohlich lab (www.frohlichlab.org) pursues a unique and integrated vision that combines computer simulations, animal model studies, human studies, and clinical trials with the goal of developing novel brain stimulation treatments for psychiatric disorders. The book is based on a course he teaches at UNC that has attracted trainees from many different departments, including neuroscience, biomedical engineering, psychology, cell biology, physiology, neurology, and psychiatry. Dr. Frohlich has consistently received rave reviews for

his teaching. With this book he hopes to make his integrated view of neuroscience available to trainees and researchers on a global scale. His goal is to make the book the training manual for the next generation of (network) neuroscientists, who will be fusing biology, engineering, and medicine to unravel the big questions about the brain and to revolutionize psychiatry and neurology. Easy-to-read, comprehensive introduction to the emerging field of network neuroscience Includes 27 chapters packed with information on topics from single neurons to complex network disorders such as depression and autism Features 12 toolboxes serve as primers to provide essential background knowledge in the fields of biology, mathematics, engineering, and physics Goal-Directed Decision Making: Computations and Neural Circuits examines the role of goal-directed choice. It begins with an examination of the computations performed by associated circuits, but then moves on to in-depth examinations on how goal-directed learning interacts with other forms of choice and response selection. This is the only book that embraces the multidisciplinary nature of this area of decision-making, integrating our knowledge of goal-directed decision-making from basic, computational, clinical, and ethology research into a single resource that is invaluable for neuroscientists, psychologists and computer scientists alike. The book presents discussions on the broader field of decision-making and how it has expanded to incorporate ideas related to flexible behaviors, such as cognitive control, economic choice, and Bayesian inference, as well as the influences that motivation, context and cues have on behavior and decision-making. Details the neural circuits functionally involved in goal-directed decision-making and the computations these circuits perform Discusses changes in goal-directed decision-making spurred by development and disorders, and within real-world applications, including

social contexts and addiction Synthesizes neuroscience, psychology and computer science research to offer a unique perspective on the central and emerging issues in goal-directed decision-making The hippocampus mediates several higher brain functions, such as learning, memory, and spatial coding. The input region of the hippocampus, the dentate gyrus, plays a critical role in these processes. Several lines of evidence suggest that the dentate gyrus acts as a preprocessor of incoming information, preparing it for subsequent processing in CA3. For example, the dentate gyrus converts input from the entorhinal cortex, where cells have multiple spatial fields, into the spatially more specific place cell activity characteristic of the CA3 region. Furthermore, the dentate gyrus is involved in pattern separation, transforming relatively similar input patterns into substantially different output patterns. Finally, the dentate gyrus produces a very sparse coding scheme in which only a very small fraction of neurons are active at any one time. How are these unique functions implemented at the level of cells and synapses? Dentate gyrus granule cells receive excitatory neuron input from the entorhinal cortex and send excitatory output to the hippocampal CA3 region via the mossy fibers. Furthermore, several types of GABAergic interneurons are present in this region, providing inhibitory control over granule cell activity via feedback and feedforward inhibition. Additionally, hilar mossy cells mediate an excitatory loop, receiving powerful input from a small number of granule cells and providing highly distributed excitatory output to a large number of granule cells. Finally, the dentate gyrus is one of the few brain regions exhibiting adult neurogenesis. Thus, new neurons are generated and functionally integrated throughout life. How these specific cellular and synaptic properties contribute to higher brain functions remains unclear. One way to understand these properties of

the dentate gyrus is to try to integrate experimental data into models, following the famous Hopfield quote: “Build it, and you understand it.” However, when trying this, one faces two major challenges. First, hard quantitative data about cellular properties, structural connectivity, and functional properties of synapses are lacking. Second, the number of individual neurons and synapses to be represented in the model is huge. For example, the dentate gyrus contains ~1 million granule cells in rodents, and ~10 million in humans. Thus, full scale models will be complex and computationally demanding. In this Frontiers Research Topic, we collect important information about cells, synapses, and microcircuit elements of the dentate gyrus. We have put together a combination of original research articles, review articles, and a methods article. We hope that the collected information will be useful for both experimentalists and modelers. We also hope that the papers will be interesting beyond the small world of “dentology,” i.e., for scientists working on other brain areas. Ideally, the dentate gyrus may serve as a blueprint, helping neuroscientists to define strategies to analyze network organization of other brain regions. A comprehensive Introduction to the world of brain and behavior computational models This book provides a broad collection of articles covering different aspects of computational modeling efforts in psychology and neuroscience. Specifically, it discusses models that span different brain regions (hippocampus, amygdala, basal ganglia, visual cortex), different species (humans, rats, fruit flies), and different modeling methods (neural network, Bayesian, reinforcement learning, data fitting, and Hodgkin-Huxley models, among others). Computational Models of Brain and Behavior is divided into four sections: (a) Models of brain disorders; (b) Neural models of behavioral processes; (c) Models of neural processes, brain regions and

neurotransmitters, and (d) Neural modeling approaches. It provides in-depth coverage of models of psychiatric disorders, including depression, posttraumatic stress disorder (PTSD), schizophrenia, and dyslexia; models of neurological disorders, including Alzheimer's disease, Parkinson's disease, and epilepsy; early sensory and perceptual processes; models of olfaction; higher/systems level models and low-level models; Pavlovian and instrumental conditioning; linking information theory to neurobiology; and more. Covers computational approximations to intellectual disability in down syndrome Discusses computational models of pharmacological and immunological treatment in Alzheimer's disease Examines neural circuit models of serotonergic system (from microcircuits to cognition) Educates on information theory, memory, prediction, and timing in associative learning Computational Models of Brain and Behavior is written for advanced undergraduate, Master's and PhD-level students—as well as researchers involved in computational neuroscience modeling research. The brain of each animal shows specific traits that reflect its phylogenetic history and its particular lifestyle. Therefore, comparing brains is not just a mere intellectual exercise, but it helps understanding how the brain allows adaptive behavioural strategies to face an ever-changing world and how this complex organ has evolved during phylogeny, giving rise to complex mental processes in humans and other animals. These questions attracted scientists since the times of Santiago Ramon y Cajal one of the founders of comparative neurobiology. In the last decade, this discipline has undergone a true revolution due to the analysis of expression patterns of morphogenetic genes in embryos of different animals. The papers of this e-book are good examples of modern comparative neurobiology, which mainly focuses on the following four Grand Questions: a) How are different

brains built during ontogeny? b) What is the anatomical organization of mature brains and how can they be compared? c) How do brains work to accomplish their function of ensuring survival and, ultimately, reproductive success? d) How have brains evolved during phylogeny? The title of this e-book, Adaptive Function and Brain Evolution, stresses the importance of comparative studies to understand brain function and, the reverse, of considering brain function to properly understand brain evolution. These issues should be taken into account when using animals in the research of mental function and dysfunction, and are fundamental to understand the origins of the human mind. This is a thorough revision of the standard text on local circuits in the different regions of the brain. In this fifth edition, the results of the mouse and human genome projects are incorporated for the first time. Also for the first time, the reader is oriented to supporting neuroscience databases. Among the new advances covered are 2-photon confocal laser microscopy of dendrites and dendritic spines, biochemical analyses, and dual patch and multielectrode recordings, applied together with an increasing range of behavioral and gene-targeting methods. Neuroscience Databases: A Practical Guide is the first book providing a comprehensive overview of these increasingly important databases. This volume makes the results of the Human Genome Project and other recent large-scale initiatives in the neurosciences available to a wider community. It extends the scope of bioinformatics from the molecular to the cellular, microcircuitry and systems levels, dealing for the first time with complex neuroscientific issues and leading the way to a new culture of data sharing and data mining necessary to successfully tackle neuroscience questions. Aimed at the novice user who wants to access the data, it provides clear and concise instructions on how to download the available data sets and

how to use the software with a minimum of technical detail with most chapters written by the database creators themselves. The neocortex is the most computationally advanced portion of the brain. It is currently assumed to be composed of a large number of "cortical columns" intricate arrangements of cortical neurons approximately 300-500µm in diameter and 2-5 mm in height in humans that might serve as the elementary computational unit of the neocortex. Understanding the computation performed by this microcircuit is one of the keys to our comprehension of the brain. The so-called cortical column is not a static entity as it evolves throughout a lifetime and continually adapts to the information from its cortical environment. Despite the differences between cortical columns across the cortex, a number of common features have been identified such as a laminar structure, the dynamics of connections between identified neurons or the mechanisms for these connections to be modified. This book presents the description of the differential connectivity and synaptic dynamics across two cell populations and the long term neuronal rewiring in a particular neuronal population within the cortical column. These results were obtained during a PhD work done at the Swiss Federal Institute of Technology in Lausanne. This volume offers an up-to-date overview of essential concepts and modern approaches to computational modelling, including the use of experimental techniques related to or directly inspired by them. The book introduces, at increasing levels of complexity and with the non-specialist in mind, state-of-the-art topics ranging from single-cell and molecular descriptions to circuits and networks. Four major themes are covered, including subcellular modelling of ion channels and signalling pathways at the molecular level, single-cell modelling at different levels of spatial complexity, network modelling from local microcircuits to large-scale simulations of

entire brain areas and practical examples. Each chapter presents a systematic overview of a specific topic and provides the reader with the fundamental tools needed to understand the computational modelling of neural dynamics. This book is aimed at experimenters and graduate students with little or no prior knowledge of modelling who are interested in learning about computational models from the single molecule to the inter-areal communication of brain structures. The book will appeal to computational neuroscientists, engineers, physicists and mathematicians interested in contributing to the field of neuroscience. Chapters 6, 10 and 11 are available open access under a Creative Commons Attribution 4.0 International License via link.springer.com. Leading neuroscientists discuss the function of microcircuits, functional modules that act as elementary processing units bridging single cells to systems and behavior. Microcircuits, functional modules that act as elementary processing units bridging single cells to systems and behavior, could provide the link between neurons and global brain function. Microcircuits are designed to serve particular functions; examples of these functional modules include the cortical columns in sensory cortici, glomeruli in the olfactory systems of insects and vertebrates, and networks generating different aspects of motor behavior. In this Dahlem Workshop volume, leading neuroscientists discuss how microcircuits work to bridge the single cell and systems levels and compare the intrinsic function of microcircuits with their ion channel subtypes, connectivity, and receptors, in order to understand the design principles and function of the microcircuits. The chapters cover the four major areas of microcircuit research: motor systems, including locomotion, respiration, and the saccadic eye movements; the striatum, the largest input station of the basal ganglia; olfactory systems and the neural organization of the

glomeruli; and the neocortex. Each chapter is followed by a group report, a collaborative discussion among senior scientists. Contributors Lidia Alonso-Nanclares, Hagai Bergman, Maria Blatow, J. Paul Bolam, Ansgar Büschges, Antonio Caputi, Jean-Pierre Changeux, Javier DeFelipe, Carsten Duch, Paul Feinstein, Stuart Firestein, Yves Frégnac, Rainer W. Friedrich, C. Giovanni Galizia, Ann M. Graybiel, Charles A. Greer, Sten Grillner, Tadashi Isa, Ole Kiehn, Minoru Kimura, Anders Lanser, Gilles Laurent, Pierre-Marie Lledo, Wolfgang Maass, Henry Markram, David A. McCormick, Christoph M. Michel, Peter Mombaerts, Hannah Monyer, Hans-Joachim Pflüger, Dietmar Plenz, Diethelm W. Richter, Silke Sachse, H. Sebastian Seung, Keith T. Sillar, Jeffrey C. Smith, David L. Sparks, D. James Surmeier, Eörs Szathmáry, James M. Tepper, Jeff R. Wickens, Rafael Yuste This selection of reviews gives an up-to-date picture of memory research. Great progress has been made in identifying the memory trace at the molecular and cellular level and individual reviews address the major mechanisms by which changes in synaptic strength can persist. Exciting research at the systems level is also reviewed including the growing importance of changes in inhibitory interneurons and how they play a role in memory formation. Finally, reviews present cognitive and neurobiological models of human memory that explain, characterize and organize the act of memory within a coherent framework. * Provides an unique overview that covers all perspectives and methodological approaches to memory * Broad coverage of memory research from molecular to human studies in one source * Up-to-date reviews give the latest important ideas on memory formation How does your mind work? How does your brain give rise to your mind? These are questions that all of us have wondered about at some point in our lives, if only because everything that we know is

experienced in our minds. They are also very hard questions to answer. After all, how can a mind understand itself? How can you understand something as complex as the tool that is being used to understand it? This book provides an introductory and self-contained description of some of the exciting answers to these questions that modern theories of mind and brain have recently proposed. Stephen Grossberg is broadly acknowledged to be the most important pioneer and current research leader who has, for the past 50 years, modelled how brains give rise to minds, notably how neural circuits in multiple brain regions interact together to generate psychological functions. This research has led to a unified understanding of how, where, and why our brains can consciously see, hear, feel, and know about the world, and effectively plan and act within it. The work embodies revolutionary Principia of Mind that clarify how autonomous adaptive intelligence is achieved. It provides mechanistic explanations of multiple mental disorders, including symptoms of Alzheimer's disease, autism, amnesia, and sleep disorders; biological bases of morality and religion, including why our brains are biased towards the good so that values are not purely relative; perplexing aspects of the human condition, including why many decisions are irrational and self-defeating despite evolution's selection of adaptive behaviors; and solutions to large-scale problems in machine learning, technology, and Artificial Intelligence that provide a blueprint for autonomously intelligent algorithms and robots. Because brains embody a universal developmental code, unifying insights also emerge about shared laws that are found in all living cellular tissues, from the most primitive to the most advanced, notably how the laws governing networks of interacting cells support developmental and learning processes in all species. The fundamental brain design principles of complementarity, uncertainty, and resonance

that Grossberg has discovered also reflect laws of the physical world with which our brains ceaselessly interact, and which enable our brains to incrementally learn to understand those laws, thereby enabling humans to understand the world scientifically. Accessibly written, and lavishly illustrated, Conscious Mind/Resonant Brain is the magnum opus of one of the most influential scientists of the past 50 years, and will appeal to a broad readership across the sciences and humanities. Network Functions and Plasticity: Perspectives from Studying Neuronal Electrical Coupling in Microcircuits focuses on the specific roles of electrical coupling in tractable, well-defined circuits, highlighting current research that offers novel insights for electrical coupling‘s roles in sensory and motor functions, neural computations, decision-making, regulation of network activity, circuit development, and learning and memory. Bringing together a diverse group of international experts and their contributions using a variety of approaches to study different invertebrate and vertebrate model systems with a focus on the role of electrical coupling/gap junctions in microcircuits, this book presents a timely contribution for students and researchers alike. Provides an easy-to-read introduction on neural circuits of the model system Focuses on the specific roles of electrical coupling in tractable, well-defined circuits Includes recent discoveries and findings that are presented in the context of historical background Outlines outstanding issues and future research in the field The authoritative reference on NEURON, the simulation environment for modeling biological neurons and neural networks that enjoys wide use in the experimental and computational neuroscience communities. This book shows how to use NEURON to construct and apply empirically based models. Written primarily for neuroscience investigators, teachers, and students, it assumes no previous knowledge of

computer programming or numerical methods. Readers with a background in the physical sciences or mathematics, who have some knowledge about brain cells and circuits and are interested in computational modeling, will also find it helpful. The NEURON Book covers material that ranges from the inner workings of this program, to practical considerations involved in specifying the anatomical and biophysical properties that are to be represented in models. It uses a problem-solving approach, with many working examples that readers can try for themselves. This book provides eloquent support for the idea that spontaneous neuron activity, far from being mere noise, is actually the source of our cognitive abilities. In a sequence of "cycles," György Buzsáki guides the reader from the physics of oscillations through neuronal assembly organization to complex cognitive processing and memory storage. His clear, fluid writing-accessible to any reader with some scientific knowledge-is supplemented by extensive footnotes and references that make it just as gratifying and instructive a read for the specialist. The coherent view of a single author who has been at the forefront of research in this exciting field, this volume is essential reading for anyone interested in our rapidly evolving understanding of the brain. Significant advances in brain research have been made, but investigators who face the resulting explosion of data need new methods to integrate the pieces of the "brain puzzle." Based on the expertise of more than 100 neuroscientists and computer specialists, this new volume examines how computer technology can meet that need. Featuring outstanding color photography, the book presents an overview of the complexity of brain research, which covers the spectrum from human behavior to genetic mechanisms. Advances in vision, substance abuse, pain, and schizophrenia are highlighted. The committee explores the potential benefits of

computer graphics, database systems, and communications networks in neuroscience and reviews the available technology. Recommendations center on a proposed Brain Mapping Initiative, with an agenda for implementation and a look at issues such as privacy and accessibility. In his new book, Gordon M. Shepherd expands on the startling discovery that the brain creates the taste of wine. This approach to understanding wine's sensory experience draws on findings in neuroscience, biomechanics, human physiology, and traditional enology. Shepherd shows, just as he did in Neurogastronomy: How the Brain Creates Flavor and Why It Matters, that creating the taste of wine engages more of the brain than does any other human behavior. He clearly illustrates the scientific underpinnings of this process, along the way enhancing our enjoyment of wine. Neuroenology is the first book on wine tasting by a neuroscientist. It begins with the movements of wine through the mouth and then consults recent research to explain the function of retronasal smell and its extraordinary power in creating wine taste. Shepherd comprehensively explains how the specific sensory pathways in the cerebral cortex create the memory of wine and how language is used to identify and imprint wine characteristics. Intended for a broad audience of readers—from amateur wine drinkers to sommeliers, from casual foodies to seasoned chefs—Neuroenology shows how the emotion of pleasure is the final judge of the wine experience. It includes practical tips for a scientifically informed wine tasting and closes with a delightful account of Shepherd's experience tasting classic Bordeaux vintages with French winemaker Jean-Claude Berrouet of the Chateau Petrus and Dominus Estate. "What makes you the way you are--and what makes each of us different from everyone else? In Innate, leading neuroscientist and popular science blogger Kevin Mitchell traces human diversity and individual

differences to their deepest level: in the wiring of our brains. Deftly guiding us through important new research, including his own groundbreaking work, he explains how variations in the way our brains develop before birth strongly influence our psychology and behavior throughout our lives, shaping our personality, intelligence, sexuality, and even the way we perceive the world. We all share a genetic program for making a human brain, and the program for making a brain like yours is specifically encoded in your DNA. But, as Mitchell explains, the way that program plays out is affected by random processes of development that manifest uniquely in each person, even identical twins. The key insight of Innate is that the combination of these developmental and genetic variations creates innate differences in how our brains are wired--differences that impact all aspects of our psychology--and this insight promises to transform the way we see the interplay of nature and nurture. Innate also explores the genetic and neural underpinnings of disorders such as autism, schizophrenia, and epilepsy, and how our understanding of these conditions is being revolutionized. In addition, the book examines the social and ethical implications of these ideas and of new technologies that may soon offer the means to predict or manipulate human traits. Compelling and original, Innate will change the way you think about why and how we are who we are."--Provided by the publisher. This book covers recent advances in the understanding of brain structure, function and disorders based on the fundamental principles of physics. It covers a broad range of physical phenomena occurring in the brain circuits for perception, cognition, emotion and action, representing the building blocks of the mind. It provides novel insights into the devastating brain disorders of the mind such as schizophrenia, dementia, autism, aging or addictions, as well as into the new devices for brain

repair. The book is aimed at basic researchers in the fields of neuroscience, physics, biophysics and clinicians in the fields of neurology, neurosurgery, psychology, psychiatry. Advances in Physiological Sciences, Volume 30: Neural Communication and Control is a collection of papers presented at the 1980 satellite symposium of the 28th International Congress of Physiological Science, held in Visegrá Hungary. This volume is composed of 26 chapters and begins with a description of nervous elements and systems on the phylogenetic scale. The succeeding chapters review studies on the excitable membrane, the properties of a single neuron, of small and large neuronal ensembles and of systems of increasing complexity, considering physiological and anatomical aspects, as well as experimenting and modeling. Other chapters explore the whole-brain function based on a conscious experience. The remaining chapters examine the understanding the neural basis of cognitive experience through experiment on evaluative cognitive agency in "split-brain" patients. This book is of value to physiologists, neurologists, and researchers. Challenging the belief that the sense of smell diminished during human evolution, Shepherd argues that this sense, which constitutes the main component of flavor, is far more powerful and essential than previously believed. --from publisher description. Aims to provide insights into the striking degree of cellular diversity found in the interneuronal microcircuits in the brain's neocortex and hippocampus. This book elaborates on different ideas about interneuronal diversity that rest upon theoretical and experimental results and is useful for neuroscientists. Cover -- Foundations of the Neuron Doctrine -- Copyright -- Dedication -- Contents -- Preface to the 25th Anniversary Edition -- Preface to the Original Publication -- Commentaries on the "Neuron Doctrine"--Cajal, Golgi, and Ariadne's Thread-Marina

Bentivoglio -- Reflections on the Neuron Doctrine-Javier DeFelipe -- The Neuron Doctrine Revisited: A Personal Account-Sten Grillner -- Camillo Golgi, Foundations of the Neuron Doctrine, and the History of Neuroscience-Paolo Mazzarello -- Some Reflections on the Neuron Doctrine-Larry Swanson -- Back to Golgi? Neural Networks as a New Paradigm for Brain Circuits-Rafael Yuste -- 1. Introduction -- 2. From the Beginnings to the Cell Theory -- 3. Do Nerve Cells Belong in the Cell Theory? -- 4. Nerve Cells or Nerve Nets? -- 5. KÖlliker Gives In -- 6. Support Builds for Networks -- 7. The Nerve Cell Studies of Freud -- 8. The Revolutionary Method of Golgi -- 9. A Neuron Theory Begins to Take Form: His, Forel, Nansen -- 10. Ramón y Cajal: The Shock of Recognition -- 11. The Early Discoveries of Cajal -- 12. The Laws of Cajal -- 13. Joining the Mainstream -- 14. The Neuron Doctrine -- 15. The Law of Dynamic Polarization -- 16. Controversy -- 17. The Synapse and the Growth Cone -- 18. Forging a Consensus -- 19. Confrontation in Stockholm -- 20. Modern Revisions of the Neuron Doctrine -- References -- Index. Nothing provided Volume I, entitled “Augmentation of Brain Functions: Brain-Machine Interfaces”, is a collection of articles on neuroprosthetic technologies that utilize brain-machine interfaces (BMIs). BMIs strive to augment the brain by linking neural activity, recorded invasively or noninvasively, to external devices, such as arm prostheses, exoskeletons that enable bipedal walking, means of communication and technologies that augment attention. In addition to many practical applications, BMIs provide useful research tools for basic science. Several articles cover challenges and controversies in this rapidly developing field, such as ways to improve information transfer rate. BMIs can be applied to the awake state of the brain and to the sleep state, as well. BMIs can augment action planning and decision making. Importantly,

BMI operations evoke brain plasticity, which can have long-lasting effects. Advanced neural decoding algorithms that utilize optimal feedback controllers are key to the BMI performance. BMI approach can be combined with the other augmentation methods; such systems are called hybrid BMIs. Overall, it appears that BMI will lead to many powerful and practical brain-augmenting technologies in the future. How does the motor cortex enable mammals to generate accurate, complex, and purposeful movements? A cubic millimeter of motor cortex contains roughly ?10?5 cells, an amazing ?4 Km of axons and ?0.4 Km of dendrites, somehow wired together with ?10?9 synapses. Corticospinal neurons (a.k.a. Betz cells, upper motor neurons) are a key cell type, monosynaptically conveying the output of the cortical circuit to the spinal cord circuits and lower motor neurons. But corticospinal neurons are greatly outnumbered by all the other kinds of neurons in motor cortex, which presumably also contribute crucially to the computational operations carried out for planning, executing, and guiding actions. Determining the wiring patterns, the dynamics of signaling, and how these relate to movement at the level of specific excitatory and inhibitory cell types is critically important for a mechanistic understanding of the input-output organization of motor cortex. While there is a predictive microcircuit hypothesis that relates motor learning to the operation of the cerebellar cortex, we lack such a microcircuit understanding in motor cortex and we consider microcircuits as a central research topic in the field. This Research Topic covers any issues relating to the microcircuit-level analysis of motor cortex. Contributions are welcomed from neuroscientists at all levels of investigation, from in vivo physiology and imaging in humans and monkeys, to rodent models, in vitro anatomy, electrophysiology, electroanatomy, cellular imaging, molecular biology, disease

models, computational modeling, and more. Microcircuits are the specific arrangements of cells and their connections that carry out the operations unique to each brain region. This resource summarizes succinctly these circuits in over 40 regions - enabling comparisons of principles across both vertebrates and invertebrates. It provides a new foundation for understanding brain function that will be of interest to all neuroscientists. Oxford Clinical Neuroscience is a comprehensive, cross-searchable collection of resources offering quick and easy access to eleven of Oxford University Press's prestigious neuroscience texts. Joining Oxford Medicine Online these resources offer students, specialists and clinical researchers the best quality content in an easy-to-access format.