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Spiking Neuron Models - Wulfgram Gerstner - 2002-08-15

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Memory serves to process and store information about experiences such that this information can be used in future situations. The transfer from transient storage into long-term memory, which retains information for hours, days, and even years, is called consolidation. In brains, information is primarily stored via alteration of synaptic connections, which is referred to as long-term potentiation (LTP) and long-term depression (LTD), and the resulting changes are transcribed into memory. LTP is the phenomenon that stabilizes the synapses between neurons. This stabilization has been explained by so-called synaptic tagging and capture (STC) mechanisms. To store and recall memory representations, emergent dynamics arise from the synaptic structure of recurrent networks of neurons. This happens through so-called cell assemblies, which are groups of neurons that interact strongly within and not with distant areas. The STC mechanisms are usually unknowns which influence STC mechanisms but are often found to be consistent with cell assemblies. On timescales of minutes to hours, the interactions between the cell assembles are used to store memory. In the present work, we investigate how STC mechanisms are used to store memory. The results show that STC mechanisms can enable the network to learn firing patterns that are not possible to learn. The resulting networks can, in theory, store information in a way that is not possible in typical applications of learning. This is shown experimentally that, in very specific circumstances, STC mechanisms can be considered to be approximately equivalent processes. A summary of the results shows that STC mechanisms can enable the network to learn firing patterns that are not possible to learn. The resulting networks can, in theory, store information in a way that is not possible in typical applications of learning.
Neural Engineering - Chris Eliasmith - 2003

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Integration in Neural Networks - Shih-Chii Liu - 2015-02-16

Networks that operate in the real world. The book also provides historical context that helps relate the architectures and circuits to each other and that guides readers to

Learning Deep Architectures for AI - Yoshua Bengio - 2009

A synthesis of approaches to adapting engineering tools to the study of neurological systems.

Event-Based Neuromorphic Systems - Shih-Chii Liu - 2015-02-16

Neural Engineering - Chris Eliasmith - 2003

A network model for direction selectivity: the second one is a generalized network of Winner-Take-All; the third one is a model for
domains of research associated with spiking neural systems, such as biologically plausible recall strategies and network configurations which suggests the role of inhibition and
cellular dynamics are pivotal in learning and memory.

Improving Associative Memory in a Network of Spiking Neurons - Russell J. Hunter - 2011

In this thesis we use computational neural network models to examine the dynamics and functionality of the CA3 region of the mammalian hippocampus. The emphasis is put on the biological interpretation of the computational models. Architectures and algorithms of previously studied hardware systems are extensively reviewed and compared with the computational models.

Models of Neuronal Networks - Eric Darmont - 2015-11-11

On the other hand, a biological plausible model of the hippocampus is presented, based on the physiological integration of the network. The model is validated against physiological data and can be extended to other conditions, including age-related deterioration.

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The biological nervous system, the device which has a similar function to the human smell sensing system, can be realized by combining the olfactory cells or receptors with nanotechnology. In the last two decades, much has been learned about the smell sensing mechanism in biological systems. With knowledge about the biological olfactory system now available, we can now consider wider applications of olfactory sensors in the field of biotechnology including new applications in the field of electronic nose technology. In addition to the advances in biological and biotechnological areas, nanotechnology has progressed to a great degree. The biological nose is a good example of the integration of biotechnology and nanotechnology. This book describes basic biological sciences of the olfactory system, biotechnology for the production of relevant components and systems, and monitoring of the developed system. The purpose of this book is to provide the reader with a concept of the basic sciences, fundamental technologies, applications, and perspectives of the biological nose.

Bioelectronic Nose - Tai Hyun Park - 2014-04-25

The biological nose, which has a similar function to the human smell sensing system, can be realized by combining the olfactory cells or receptors with nanotechnology. In the last two decades, much has been learned about the smell sensing mechanism in biological systems. With knowledge about the biological olfactory system now available, we can now consider wider applications of olfactory sensors in the field of biotechnology including new applications in the field of electronic nose technology. In addition to the advances in biological and biotechnological areas, nanotechnology has progressed to a great degree. The biological nose is a good example of the integration of biotechnology and nanotechnology. This book describes basic biological sciences of the olfactory system, biotechnology for the production of relevant components and systems, and monitoring of the developed system. The purpose of this book is to provide the reader with a concept of the basic sciences, fundamental technologies, applications, and perspectives of the biological nose.

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natural-computing paradigms are molecular computing and quantum computing, where the goal is to replace traditional electronic hardware, e.g., by biomolecules in molecular computing. In molecular computing, data are encoded as biomolecules and then molecular biology tools are used to transform the data, thus performing the operations. In quantum computing, one exploits quantum-mechanical phenomena to perform computations and secure communications more efficiently than classical physics and, hence, traditional hardware allows. The second strand of research covered by the handbook, computation taking place in nature, is represented by investigations into, among others, the computational nature of self-assembly, which lies at the core of nanoscience, the computational nature of developmental processes, the computational nature of biochemical reactions, the computational nature of brain processes, and the systems biology approach to bioworks where cellular processes are treated in terms of communication and interaction, and, hence, in terms of computation. We are now witnessing exciting interaction between computer science and the natural sciences. While the natural sciences are rapidly absorbing informatics, techniques and methodologies intrinsic to information processing, computer science is adapting and extending its traditional notion of computation, and computational techniques, to account for computation taking place in nature around us. Natural Computing is an important catalyst for this two-way interaction, and this handbook is a major record of this important development.

Handbook of Natural Computing - Grzegorz Rozenberg - 2012-07-09
Natural Computing is the field of research that investigates both human-designed computing inspired by nature and computing taking place in nature, i.e., it investigates models and computational techniques inspired by nature and it also investigates phenomena taking place in nature also in terms of information processing. The examples of the first strand of research covered by the handbook include neural computation inspired by the functioning of the brain, evolutionary computation inspired by Darwinian evolution of species, cellular automata inspired by intercellular communication, image intelligence inspired by the behavior of groups of insects, quantum-computing-inspired molecular algebras and associated information processing and systems biology. The second strand of research covered by the handbook, computation taking place in nature, is represented by investigations into, among others, the computational nature of self-assembly, which lies at the core of nanoscience, the computational nature of developmental processes, the computational nature of biochemical reactions, the computational nature of bacterial communication, the computational nature of brain processes, and the systems biology approach to bioworks where cellular processes are treated in terms of communication and interaction, and, hence, in terms of computation. We are now witnessing exciting interaction between computer science and the natural sciences. While the natural sciences are rapidly absorbing informatics, techniques and methodologies intrinsic to information processing, computer science is adapting and extending its traditional notion of computation, and computational techniques, to account for computation taking place in nature around us. Natural Computing is an important catalyst for this two-way interaction, and this handbook is a major record of this important development.

Spiking Neural Networks Encoding and Decoding Algorithms for Time Series Estimation and System Identification - Shinchun Buchholzreuther - 2012
"Artificial Neural Networks (ANNs) have increasingly been applied to different system identification, pattern recognition and function approximation problems. The predominantly used neural network architectures are the feedforward and feedback networks. Multilayer perceptrons and radial basis function networks are among the most commonly used feedforward architecture neural networks and the Elman and Jordan networks are the most widely used recurrent neural networks. These recurrent networks are trained using gradient decent methods. This handbook shows that the understanding and use of recurrent network architectures stem from the principles as the living neurons. These are also known as biologically inspired artificial neural networks (BIANNs). Spiking neural networks (SNNs) and polychronous spiking neural networks (PSNs) are among the most researched BIANNs. The advantage of BIANNs over traditional ANNs is their ability to scale up. But encoding and decoding information in and out of a SN is a big challenge. This thesis addresses both the challenges. This book presents a PSN model for the experimental simulation purposes in this thesis. Gaussian receptive field (GRF) encoding is used to convert real world data into spike streams which can be used by the SNs. A novel decoding method is presented to extract the required encoded information from the PSN spikes. The MLP is trained using particle swarm optimization (PSO). The performance of SNNs and the proposed decoding technique in time series estimation is tested on various benchmark time series functions and neurophysiology data. A major success of these algorithms is the development of a two-sector machine power system for identifying generator dynamics." Abstract, iii.

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Emerging Intelligent Computing Technology and Applications. With Aspects of Artificial Intelligence - De-Shuang Huang - 2009-08-20
The International Conference on Intelligent Computing (ICIC) was formed to provide an annual forum dedicated to the emerging and challenging topics in artificial intelligence, machine learning, bioinformatics, and computational biology, etc. It aims to bring together researchers and practitioners from both academia and industry to share ideas, problems, and solutions related to the multifaceted aspects of artificial intelligence. ICIC 2009, held in Ulsan, Korea, September 16-19, 2009, constituted the 5th International Conference on Intelligent Computing. It built upon the success of ICIC 2008, ICIC 2007, ICIC 2006, and ICIC 2005 held in Shanghai, Guangzhou, Hangzhou, and Nanjing, respectively. This conference focused mainly on the theories and methodologies as well as the emerging applications of intelligent computing. Its aim was to unify the p-ture of contemporary intelligent computing techniques as an integral concept that is to establish a forum where the trends in advanced computational intelligence and bridges theoretical research with applications. Therefore, the theme for this conference was “Emerging Intelligent Computing Technology and Applications.” Papers focusing on this theme were solicited, addressing theories, methodologies, and applications in science and technology.

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