Encyclopedia of Computational Neuroscience

Dieter Jaeger • Ranu Jung
Editors

Encyclopedia of Computational Neuroscience

Second Edition

With 316 Figures and 18 Tables

Springer

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Preface to the Second Edition

Computational neuroscience offers multi-scale models that span complexity from the gene to the whole living system levels, and can span different time and spatial scales. Such models offer hypotheses for testing in biological systems. Computational neuroscience also offers advanced statistical and data analysis techniques and approaches to interpret and analyze complex data. Collaborative effort among several disciplines and a convergence of diversity of approaches to knowledge inquiry and seeking of solutions are hallmarks of the field. Data sharing and model sharing based on modern markup language syntax and semantics shore up this effort.

In the 7 years since the print publication of the first edition of Springer's *Encyclopedia for Computational Neuroscience* in 2015, computational neuroscience has advanced significantly. In keeping with the rapid advancement of the field, as a live document, the online encyclopedia is continuously undergoing change, and over 120,000 downloads have occurred. This second print edition offers 46 new entries covering growing areas such as modeling of disease states, neural-glial interactions, and advances in applying information theory to computational neuroscience.

Several international conferences in this field of study, such as the annual meeting of the Organization of Computational Neuroscience http://www.cnsorg.org/ and COSYNE http://cosyne.org, continue to bring the global community together, and standard-setting organizations, such as the International Neuroinformatics Coordinating Facility http://incf.org/, assure open and fair data exchange.

The growing allocation of research funding for computational neuroscience reflects the importance for understanding complex neurobiological systems in health and disease and translating that knowledge for clinical applications as well as design and development of neurobiology-inspired engineered systems. In the USA, the National Science Foundation, the National Institutes of Health, and the Department of Energy support collaborative research in computational neuroscience. Bilateral funding commitments to these agencies have been made by national research grant supporting agencies in France, Germany, Israel, Japan, and Spain. Support for multilateral projects and collaborations is also available. Thus, a global community of computational neuroscientists engage in "collaboratories."

The encyclopedia highlights achievements and approaches to describe basic neural function and major brain systems as well as biomedical applications in 579 entries and 42 overviews over distinct research areas in

computational neuroscience. In-depth articles, written by subject-matter experts from around the globe, provide comprehensive coverage of important topics, whereas short articles summarize individual concepts and key terms. The interplay between computational and theoretical approaches and experimental data is highlighted at all levels from molecular to cognitive. Available shared database resources are also covered. While overall alphabetically sorted, an introduction of each section of topics covered is presented in entries denoted "Overview," which also provide organized links to section entries.

The level of description in the encyclopedia is aimed to make the material accessible to graduate students in the many disciplines that contribute to computational neuroscience while also providing a valuable reference to advanced researchers. Cited website links allow the access to a more detailed level of information when needed. For those with institutional access to the online SpringerReference enterprise, a hot-linked version of this encyclopedia is available under springerlink.com.

The editors in chief are pleased to present this second edition of the *Encyclopedia of Computational Neuroscience* and are looking forward to readers' comments that will be taken to further improve and complete future updates of this work.

Atlanta, USA   Dieter Jaeger
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