Neuroinformatics

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Editorial

An Information Science Infrastructure for Neuroscience

A huge amount of data has been produced in all areas of neuroscience in the past few decades. As research in neuroscience continues to advance, the capacity of the individual investigator to retain all relevant information is severely taxed. This data, and the subsequent analytic results and conclusions that are generated, is derived from a myriad of diverse experiments that span scale, species, development, and pathology. This glut of information simultaneously provides a unique opportunity and a daunting challenge. The opportunity is to accumulate information on the structure, activity, and function of the brain, in health and disease: to actually solve the question "How does the brain work?" The challenge is to integrate and organize this wealth of information to create real knowledge and understanding that is greater than the sum of its parts. Examples of the diversity of information include: molecular data (from genes to cell specific expression), neuroanatomy (from the ultrastructure of synapses to systems level anatomy), electrophysiology (from single channels to scalp surface EEG), brain imaging (from structure to function using a wide variety of imaging techniques), behavior (from basic sensory operations to complex cognitive tasks), and neurochemistry (from neurotransmitters to receptor binding sites).

Integration across scales and species, validation and assessment of the variability among protocols, techniques, and laboratories, and the formulation of detailed models generally requires a re-analysis of the original data. Theory and computational modeling are essential for providing frameworks for integrating and understanding the important dynamics inherent to most neuroscience data. All these approaches require, of course, high quality software tools. Thus, the sharing, distribution, organization, and managing of data, models, and tools are essential elements in the path from sheer information to knowledge and understanding in neuroscience. Many neuroscientists now believe that the spectacular parallel advancement of computer science and technology can meet this challenge.

Informatics is the study of the application of computer and statistical techniques to the management of information. Informatics, in general, includes the development of databases to house information (and the methods to search them quickly), tools for analysis of information, and models that predict and synthesize information in order to formalize our understanding of information. "Neuroinformatics," by extension, is the information science infrastructure of neuroscience, and relates to the tools, databases, models, and mecha-

nisms of information flow that serve all of the clinical and research efforts in this field. The aim of this journal, *Neuroinformatics*, is to encourage, facilitate, and disseminate the use of software tools and databases in the neuroscience community to discover the key principles by which brains work. A complete understanding of brain mechanisms implies the subsequent possibility to implement the same principles in computational models and artificial systems that interact intelligently with the real world. If one accepts the premise that the task of understanding how the brain works will require the collective, community-wide integration of information, then one must begin to consider the ways in which information flow is optimized. These considerations will lead to an evolution in the way the information, upon which scientific discovery is made (and indeed the discoveries themselves), is presented, transmitted, and catalogued. However, community-wide participation and compliance in such efforts require the community-wide understanding of the technical, social, societal, and scientific implications of these efforts.

Neuroinformatics strives to publish original articles and reviews reporting on work in the field of neuroinformatics. The emphasis is on software, informatics tools, and databases for any area of neuroscience research. Useful tools include graphical interfaces and applications supporting: database operations (such as data querying, mining, and retrieval), image analysis functions (such as statistical characterization, segmentation, visualization, manipulation, and integration), simulations, and modeling. In particular, we invite papers in the following broad categories:

1. Theory and methodology, including proposals of formal definitions and ontologies, modeling approaches, discussions on database design and meta-analyses, and novel analytical methods to connect data across scales, protocols, or species.
2. Descriptions of actual developed databases and software tools, together with a discussion and examples of their utility for the neuroscience community, and the details of the methods for their distribution.
3. Experimental papers that are relevant to neuroinformatics, such as reports accompanied by the release of massive data sets, and original results deriving from the re-analysis of publicly available data.
4. Computational simulations pertaining to the testing and interaction of models and real world data. Authors are required to distribute the software code of their simulations upon publication in *Neuroinformatics*.
5. Papers reporting the use of information technology in neuroscience research, including hardware and robotics approaches, theoretical studies on information content, firing dynamics, and the neural code.

In addition, the journal publishes independent "tests and evaluations" of neuroscience databases and software tools. These reports are solicited or submitted by the users, and can either focus on a single software tool, or compare software tools with similar use in the community. In all aspects, the journal strives to foster a community-wide commitment to the principles and practice of tool and data sharing, as this will benefit and advance knowledge integration in neuroscience.

We hope *Neuroinformatics* will help further the necessary communication needed to enable these goals, and invite you to contribute to the success of this new journal.

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