Fundamentals of Artificial Neural Networks

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Books Received

CUPS: Modern Physics Simulations

Doug Brandt, John R. Hiller, and Michael Moloney, Wiley, New York, 1995; ISBN 0-471-54882-0, 178 pp., paper, $32.75.

CUPS: Nuclear and Particle Simulations

Robert Bigelow, Michael Moloney, John Philpott, and Joseph Rothberg, Wiley, New York, 1995; ISBN 0-471-54883-9, 218 pp., paper, $32.75.

CUPS: Solid State Physics Simulations

Ian Johnston, Graham Keeler, Roger Rollins, and Steve Spicklemire, Wiley, New York, 1995; ISBN 0-471-54885-5, 173 pp., paper, $32.75.

CUPS: Waves and Optics Simulations

Andrew Antonelli, Wolfgang Christian, Susan L. Fischer, Robin Giles, Brian W. James, and Ronald Stoner, Wiley, New York, 1995; ISBN 0-471-54887-1, 257 pp., paper, $32.75.

Introduction to Programming with Mathematica

Richard Gaylord, Samuel N. Kamin, and Paul R. Wellin, Springer/TELOS, Santa Clara, CA, 1996; ISBN 0-387-94434-6, 452 pp., cloth, $44.95.

Numerical Solution of Initial Value Problems in Difference-Algebraic Equations

Kathryn Brenan, Stephen L. Campbell, and Linda Petzold, Society for Industrial and Applied Mathematics, Philadelphia, PA, 1996; ISBN 0-89871-353-6, 256 pp., paper, $44.95.

Quantum Mechanics II

Rubin Landau, Wiley, New York, 1996; ISBN 0-471-11608-4, 496 pp., paper, $79.75.

Real Computing Made Real

Forman Action, Princeton University Press, Princeton, NJ, 1996; ISBN 0-691-03663-2, 259 pp., cloth, $29.95.

The Science of Computer Benchmarking

Roger Hockney, Society for Industrial and Applied Mathematics, Philadelphia, PA, 1996; ISBN 0-89871-363-3, 129 pp., paper, $21.25.

Fundamentals of Artificial Neural Networks

Mohamad H. Hassoun

MIT Press, Cambridge, MA, 1995; ISBN 0-262-08239-X; 511 pp., cloth, $60.00.

Reviewed by Nathan Intrator

The subject of neural networks is currently drawing attention from diverse disciplines. Because neural-network applications are under development in various areas of pattern recognition, the subject is being taught and used in engineering schools. It is also being studied theoretically by physicists, mathematicians, and, more recently, statisticians who are interested in the mathematical properties of neural networks, their connections to other pattern-recognition and function-estimation techniques, and their connections to physical models such as the spin glass. Another expanding branch of study is the relevance of neural networks to computational neuroscience and related brain models.

Given the vastly different research areas related to neural networks, it is not surprising that a single book cannot be useful for a large majority of audiences. *Fundamentals of Artificial Neural Networks* presents, for the most part, introductory-level material related to engineering. It has little mathematical theory and is thus accessible to students and researchers with a limited mathematical background.

Chapter 3 discusses network-learning rules. In fewer than 80 pages, the author covers several methods in supervised and unsupervised learning, as well as reinforcement learning, competitive learning, and self-organizing maps. This collection of topics could easily fill an undergraduate course as well as a graduate course on the subject. Chapter 4 provides some mathematical theory of these learning rules. Unfortunately, one of the main topics in neural networks—the variance-bias dilemma—is not addressed. The variance-bias dilemma is of utmost importance for designing and using neural networks, as it deals with the tradeoff between network-architecture complexity and data overfitting. More generally, the relevant statistical learning theory is not discussed, and thus practical issues such as learning with a small training set, model selection, and confidence in the resulting model are not addressed. Taken together, these chapters provide a brief review on learning rules at an introductory level.

Applications are discussed throughout the book, especially in Chapter 5. They can be used to motivate students to apply these methods to the real world. There is some discussion on global optimization methods and a chapter on associative memories that briefly discusses the Hopfield networks.

In summary, the book introduces neural networks from an engineering viewpoint without getting into the statistical-mechanics-related theory and without discussing the relevant statistical learning theory. It is thus useful for students with limited mathematical background and to those who want to get a quick idea about the field without too many technical details.♦

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