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Edited by Rudolph Groner
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Heuristics are general methods that serve to improve problem solving. This book contains the first interdisciplinary and comprehensive treatment of developments in heuristics, written by specialists from computer science, psychology, and mathematics. From their own perspective these writers answer such central questions as: What are heuristics, the methods and rules guiding discovery and problem solving in a variety of different fields? How did they develop in individual human beings and in the history of science? Is it possible to arrive at a commonly accepted definition of heuristics as the field unifying all these efforts, and, if yes, what are its basic characteristics?

0-89859-251-8, 1983, 416 pp., $49.95.

METHODS AND TACTICS IN COGNITIVE SCIENCE

Edited by Walter Kintsch
James R. Miller and
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What are the promises, the challenges, and the problems of cognitive science? Does cognitive science require a common methodological orientation - or can it thrive on diversity? How can the various subdisciplines contribute to the common goal of understanding intelligence behavior and computation? Specifically designed as an introduction to cognitive science, this book features chapters on original research. Scientists from the disciplines of linguistics, cognitive psychology, and artificial intelligence discuss in detail their approaches to research, along with their latest results. Methodological issues are considered with respect to concrete, substantive problems, making them clear to readers in various field, including psychology, linguistics, and computer science.

BOOK REVIEWS

THE HEDONISTIC NEURON: A Theory of Memory, Learning & Intelligence

Reviewed by:
David M.W. Powers
Dept. of Computer Science
University of New South Wales

(A. Harry Klopf, Hemisphere Publishing Corporation, Washington, 1982, 14+xvii pages, paper, ISBN 0-89116-202-X)

Another reviewer of this work has questioned "whether hedonism is an appropriate metaphor for brain research" [1, p24]. For Klopf however, hedonism is clearly much more than a metaphor. On the contrary, he sees hedonism as a phenomenon which is exhibited by systems - both social structures and individual organisms - as a direct result of their construction from hedonistic building blocks. The hedonistic neuron is hypothesized as being the most elementary such component of living systems.

For the bulk of his discussion, Klopf prefers a slightly different term to characterize his hedonistic neurons. By contrast with homeostatic systems seeking to maintain homeostasis, neurons and the systems they compose are envisaged as "heterostats", which seek to achieve "heterostasis". A "homeostat" seeks to maintain a steady state (Greek, "similar" state) whilst a "heterostatic" system seeks to achieve a better or optimal state (Greek, "other/different" state). Personally, this reviewer considers the coinage ill-chosen and suggests the term "eustatic" (Greek, "good/better" state).

Klopf opens (pp 3-4) with a progression of "equivalences" which culminate in the hedonistic hypothesis:

Nervous systems ≓ social systems
Neuron ≓ whole organism
Whole organism ≡ hedonist
Neuron ≡ hedonist
Depolarization ≓ pleasure
Hyperpolarization ≡ pain

Klopf then proceeds to relate these to a number of physiological and psychological paradigms and thence to develop his heterostatic theory.

His arguments in favour of the characterization of living systems as heterostatic are quite convincing; his discussion of the psychological ramifications of his hedonistic model are most plausible; but his insistence that these equivalences are more than analogues, and that his characterization is no mere model, is less compelling. The thesis of this book is that social systems are hedonistic precisely because nervous systems are, and they precisely because neurons are!

A relatively small proportion of the book is couched at the technical neurophysiological level, since the author is quite satisfied in this respect to pinpoint the position of his theory in relation to the Hebbian legacy of plasticity and self-organization. A simple mathematical formulation of the model is given, but virtually no reference is made to sub-neural mechanisms, and the application of the model to various brain formations is couched in rather general terms. As the author points out, it is clear that further experimental research is necessary to flesh out the theory and establish its validity at each level. The work of Sutton and Barto has been influenced considerably by Klopf's theories, and an antecedent paper of theirs [2] expounds the theoretical advantages of a particular mathematical formulation of the hedonistic hypothesis and presents the results of a computer simulation.

Major sections of the book are dedicated to examination of the implications of the hedonistic neuron for related disciplines:

Lest one be concerned that Hedonism has not proven successful as an ethical theory, Klopf addresses this in part and elaborates on the implications of his theory for social structures. If one is interested in the macroscopic ramifications of the theory, Klopf demonstrates its explicative power in respect of both Classical and Operant Conditioning, as well as other Psychologically observed phenomena. Lest one be concerned about the seat of consciousness, or the "Mind-Body" problem, Klopf discusses this at length. If, as is likely the case for SIGART readers, one's interests centre on the pragmatic Artificial Intelligence goals of Computer Science, then Klopf provides a chapter offering some words of wisdom - advice and criticism.

To meet the objection that man's behaviour "appears to be truly altruistic at times" and thus not purely hedonistic, Klopf (p87) introduces another hypothesis - that the capacity of the Limbic System and Hypothalumus to distinguish between self and other is "severely limited". He cites a variety of support for the supposition, but nonetheless it would seem somewhat more counterintuitive than the original hedonistic hypothesis.

In an attempt to characterize consciousness, Klopf relates it to wave phenomena and suggests the further general equivalences of pleasure with "entropic processes", and pain with "anti-entropic processes". It will be interesting to see whether any empirical support can be adduced for these hypotheses - it would certainly appear difficult to design experiments to test them!

With respect to AI, Klopf decries the deliberate choice of AI researchers in ignoring physiological evidence and the peculiar nature of the neuron - he asserts the fallacy of classing them with digital components. He questions (p105) whether AI researchers are premature in addressing the higher level organizational problems before developing "an inherently self-organizing substrate". He does however acknowledge the systems approach to the extent that (p113) a model comprising "a set of nested heterostats" may usefully be researched at levels appropriate to the various disciplines, the emphasis being on the goal oriented behaviour of the subsystems and the existence of positive and negative reinforcing inputs to each subsystem.

Klopf further points out the central role of learning in man, and contrasts it with the unnatural role it has traditionally had in AI - there is certainly a need for more emphasis on learning from the environment, and such an emphasis is only recently beginning to emerge in AI.

Considering the book as a whole, it is most pleasing to be able to read a serious scientific work couched in readable language, written in an enjoyable style, addressed to a wide audience and offering fresh insights deriving from a well rounded interdisciplinary reading and research background. In a world of increasingly sectarian disciplines, it is most refreshing to encounter an author who feels free to meander across the bounds of philosophy, psychology, neurology, sociology and computer science. Computer Science is a service science, and Artificial Intelligence ought to be a multidisciplinary field whose practitioners are aware of research in related fields.

Thus, quite irrespective of the validity of the novel theory presented in this book, "The Hedonistic Neuron" is to be recommended to any AI researcher who acknowledges the relevance of the processes of Human Intelligence - and some such

book should be compulsory reading for those who don't!

References:

[1] Smoliar, S. W. (1983), Book Review: "The Hedonistic Neuron", SIGART #84, April 1983.

[2] Sutton, R. S., Barto, A. G. (1981), "Towards a modern theory of adaptive networks: expectation and prediction", Psych. Rev. V88, No 2, 135-170. (Also available as COINS TR 79-17, Comp. & Inf Sci. Dept., U. Mass. Amherst.)

WHAT CAN BE AUTOMATED
Editor: Bruce W. Arden
Reviewed by: Keith Price

(MIT Press, 1983, paper=$15.00, ISBN 0-262-51026-x)

What Can be Automated is a massive tome that reports on the Computer Science and Engineering Research Study (COSERS). In about 1K pages, it presents a record of research in computer science with some evaluation of the past results and projections of the future directions for research. The title comes from the fact that most of Computer Science is concerned with the problems of automating various manual tasks, be it numerical computations, database management, weather forecasting, industrial processes, or language understanding.

Artificial Intelligence as a whole and some of its subareasi by themselves receive considerable attention. This reflects the fact that AI is the subarea of computer science that pushes at the limits of what is possible more than any other (numerical computation pushes at the limits of computer technology to a greater degree - 10^{18} operations are expected for some 3-D problems).

This book reviews the past developments in: numerical computation, operating systems, databases, software methodology, artificial intelligence, and assorted special topics and applications.

The review of AI is only meant to give the flavor of what has been done to indicate what can be done in the future. Thus, the survey is not as detailed or complete as is found in the three volumes of the Handbook of Artificial Intelligence and it concentrates on what has been accomplished in different areas rather than a description of individual systems. Reading the survey of work in such areas as natural language understanding or vision and speech perception, it is clear that there has been some progress - we can now do something useful, but many of the same problems remain. The progress in numerical computation is easier to measure, for example, a study is referenced which describes a $12x10^9$ speed-up in algorithmic efficiency (over 30 years) for a class of useful three dimensional problems. This speed-up exceeds that of going from paper and pencil to a large scientific computer, and the solution is still barely feasible. AI does not have these kinds of measures to apply to indicate progress; we are not concerned with finding an efficient algorithm as much as finding the first algorithm to solve our problems.

Overall, What Can be Automated provides a good survey of computer science and engineering, though some material is becoming dated (the study was finished in 1979). It provides a good reference for what was possible then and what were the major problems and thus can be more useful for learning about the state of research in areas other than your own.

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