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Methia
and
Tyoga

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MACHINE INTELLIGENCE 12

Towards an automated logic of human thought

edited by

J. E. HAYES

Research Associate, Turing Institute

D. MICHIE

Chief Scientist, Turing Institute

and

É. TYUGU

*Head of Software,
Institute of Cybernetics,
Estonian Academy of Sciences*

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FOREWORD

Evgeni Velikhov

Vice President of the Academy of Sciences of the USSR

It is a pleasure to contribute an introduction to this twelfth volume of the international *Machine Intelligence* series. My own work has, at times, cast me in the scientific roles of experimenter, instrumentation designer, and administrator. In all these roles I have seen the growing pervasiveness of the new tools of information technology. As a visitor to the 1987 meeting in Milan of the International Joint Conference on Artificial Intelligence I received a vivid impression of the role that machine intelligence in particular seems destined to play in this, the final decade of this century. Economic growth is increasingly dependent on new technologies in which the intelligence of machines plays a leading role. The concept of machine intelligence itself acquires a new semantic content. This is demonstrated by the evolution of new disciplines such as mechatronics as well as by the increasing importance of intelligent tools in manufacturing. It seems extremely important for the future of the human species that the mind that machines develop grows faster than the muscles, that is the energy parameters.

Looking at the eleven previous impressive volumes of *Machine Intelligence* one observes that the MI conferences have covered a significant part of the world including the Soviet Union where, before MI-12, the ninth MI conference was also held in 1977. I believe that the style and the content of the *Machine Intelligence* series will continue to reflect the much needed dialogue between various societies.



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For almost twenty-five years I have, as editor of these volumes, presided over the inquisitiveness of the newly arrived. The young delight to get their noses into everything. But unbounded promise must sooner or later confront the emergence of what in ecology and in entrepreneurial commerce are known as 'niches'. Possibly, machine intelligence has, during all this time, been sleepwalking towards its own true niche. In any case, the series must now select one. Along what line do we see the future commitment of the *Machine Intelligence* series?

In 1986 a Steering Committee was formed to set a direction and to initiate the formation of an international editorial board with an executive editor and two associate editors to support the work and to organize the workshops themselves. These will resume their initial annual tempo. As editor-in-chief I am privileged to welcome our future executive editor Dr Stephen Muggleton. With regard to directions, the central theme will be the design of automated support for intellectual discovery and its application. Sophistication of computing aids is a conspicuous feature of today's scientific scene. From the astrophysicist's super-computer to the field worker's pocket machine, the race has been to automate every function but one. That one is scientific reasoning itself, whilst AI has been the laggard.

More than a quarter of a century ago, the Nobel Prize-winning chemical microbiologist Joshua Lederberg had a vision of intelligent machines as partners in the scientific quest. In Stanford's DENDRAL project he initiated the first inroad into organized empirical enquiry. The tools of that time were too weak to accomplish more than the planting of a series of signposts, some of which appear in earlier MI volumes. Among these the MetaDENDRAL module set a crucial pointer to the need, reflected in this volume, to mechanize the inductive as well as the deductive component of the cycle of scientific inference.

A modern scientist can fairly be described as an inductive agent loaded to breaking point by complexity. Reporting from a sector where the strain is especially severe, Ross King describes in this volume an application of computer induction to the prediction of protein folding. Elsewhere he has written that 'it was once possible to discover the meaning of new data by carefully examining it by eye'. That time is, of course, long past. Today, decision supports from statistical data analysis are pressed into service. But now even these impressive constructions are proving inadequate to such complex requirements as those of biotechnology for empirical theories of structure-activity relationships,

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and the requirement for better models of our planet as a basis of rational plans for the next century.

At some stage in the mechanized analysis of any sufficiently complex problem, further progress (as indicated for example in the chapter by Mozetič, Bratko, and Urbančič) has to await intelligible mechanization of the underlying relations of cause and effect. The wheel here comes full circle. John McCarthy's paper of just 30 years ago, 'Programs with common sense', placed at the core of AI's coming tasks the need for a machine-oriented logic capable of expressing causality in everyday life. Progress has subsequently been made, but in its unrestricted form McCarthy's plan remains ambitious. By restricting the aim of mechanizing causal reasoning to defined domains of scientific study we may find both a measure of tractability and also uncommon rewards.

Not the least reward must surely be the sense of mutual usefulness among disciplines, which forms the living cement of our invisible college.

June 1990

Donald Michie
Editor-in-Chief

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