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Preface

From Intelligence Models to Intelligent Systems

Natural intelligent agents depend on a variety of crucial features, among them the ability

- **to act in domains only partially observable and to learn from exploring their environment**
- **to exhibit robust behavior, often handling erroneous situations without even noticing them**
- **to perform quick logical inferencing and cope with limited memory**
- **to master signal and symbol transformation and integration**
- **to organize and optimize their knowledge and reuse heterogeneous resources**
- **to reason about action and change and revise their beliefs**
- **to perform efficient qualitative spatial reasoning**
- **to integrate vision and language capabilities**

To better understand the functions of intelligence, researchers in Artificial Intelligence have studied well-founded operational models of many aspects of intelligent functioning. From a research perspective, it is indispensable to investigate intelligence models systematically and reach for principled solutions, not necessarily meticulously mimicking their natural counterparts. But research in artificial intelligence has also given rise to a great potential for applications. Thus it is important to assess, and improve, principled findings in the light of above-mentioned features, to make them better workable in practical intelligent systems.

In this spirit, this book compiles *Advances in Artificial Intelligence* that were prepared for the 19th Annual German Conference on Artificial Intelligence *KI-95*, held at the University of Bielefeld, 11-13 September, 1995. Appearing in the Springer LNAI series for the second time, the *KI* conference proceedings are widely available for international distribution. A second proceedings volume, published by the German Informatics Society (GI), presents descriptions and extended abstracts of the activity parts embedded in the conference, workshops, posters, and system demonstrations.

As a novelty, this year's Annual German AI Conference, for the first time, is held together with the Annual Symposium of the German Working Group on Pattern Recognition (DAGM), publishing their own proceedings volume via Springer-Verlag. The scientific organizers of the two conferences hope that discourse across the two related disciplines is encouraged, and deepened, by having them convene in one setting.

The present volume has six sections. The first section contains four invited papers, devoted to the general conference theme, *From Intelligence Models to Intelligent Systems.*

The paper by *Leslie Pack Kaelbling et al., Brown University* illustrates that, in general, intelligent agents act in domains that are only partially observable; thus they must learn from exploring their environment and select appropriate actions when their effects are only apparent in the future. Developing new ways of viewing the problem that are more consistent with the AI perspective than previous work, the paper exploits techniques from operations research and presents some recent research results on acting in partially observable stochastic domains.

The paper by *Wolfgang Menzel, University of Hamburg* addresses the topic that many systems able to process natural language have shown themselves to be fragile; thus ways are needed to cope with robustness more naturally and which will eventually be suited to accommodate quite different aspects of robust behavior within a single framework. The paper analyses the necessary preconditions for achieving a higher level of robustness in natural language processing and suggests a quite different approach based on a procedure for structural disambiguation.

The paper by *William Bricken, Oz...International* observes that intelligent systems call for organizationally closed networks of interacting processes. To this end, logic itself is approached as a system of autonomous elementary processes. The paper introduces so-called distinction networks (dnets) which represent logical expressions as directed graphs of nodes and links. The entire dnet operates in parallel to arrive at valid logical conclusions and reduced boolean functions. It is demonstrated that dnets are conceptually simpler than propositional logic.

The paper by *Ruzena Bajcsy and Jana Košecká, University of Pennsylvania* deals with the problem of signal and symbol integration, an outstanding problem in Robotics and AI. To capture the dynamic nature of individual processes and interactions, the systematic partition of signals into symbols and analysis of the composition of more complex behaviors is required. Within the framework of a task description language, a variety of cooperative behaviors for mobile autonomous agents is specified, and ways of coupling between multiple agents are investigated in scenarios of navigation and manipulation.

A total of 17 papers, accepted for presentation at the conference in a rigorous reviewing process, are presented in five further sections.

The section on *Knowledge Organization and Optimization* deals with issues important for practical knowledge systems. The four papers in this section are concerned with: enhancing expressiveness in knowledge bases while trying to meet requirements of operationality, sufficiency, and correctness; inducing compact integrity constraints, in order to speed up query-response time and detect irregularities in "noisy" knowledge bases; the reuse of heterogeneous lexical resources by dynamic knowledge structuring; and finally, heuristic search under restricted memory.

In four papers in the section on *Logic and Reasoning* work is presented on: reasoning about statements in a terminological representation language; automating support for task acquisition by guiding the user through an object-centered domain model; parallelizing description logics to reduce efficiency problems faced in large-scale applications, expressive dialects, or complete inference algorithms;

and finally, introducing more advanced calculi for automated reasoning.

The two papers in the section on *Nonmonotony* deal with skeptical proof and defeasible inference; the first one considers skeptical reasoning in extension-based, nonmonotonic logics and shows a formal correspondence between two notions of skeptical provability, allowing adoption of the general definition of a skeptical proof into default logic; the second introduces a powerful new plausible inference relation, preferential construction entailment.

The section on *Action and Change* has four papers dealing with: the dynamics of belief from an agent-oriented, semantics-based view, defining belief revisions as sequential compositions of contractions and expansions; a formalization of a preferential strategy applicable for reasoning about action and change; a logic-based method for reasoning about action and change which admits actions with abnormal effects; and finally, an approach to temporal knowledge representation based on reified propositional logic.

In contrast to qualitative temporal reasoning, the computational properties of qualitative spatial reasoning are not yet well investigated, nor have they been subject to empirical validation. The first paper in the final section on *Spatial Reasoning* addresses the problem of efficient consistency checking for topological base relations, and the second presents an attempt to reach for empirically validated models for computing spatial relations in 2D and 3D space.

Selected Paper

As a culminating highlight in the conference and its proceedings volume, the last paper of this final section deals with integrating vision and natural language in the context of automatic description of human movements. Because of its excellent approach and quality, this paper, by Gerd Herzog and Karl Rohr, was selected, in the unanimous vote of all program committee members, for the Springer Best Paper Award KI-95.

The editors of this proceedings volume are grateful to the paper authors, the program committee, many auxiliary reviewers, and, last but not least, the local organizing committee for their hard work which is the basis for a successful conference. A special thank-you goes to Britta Lenzmann, Bielefeld for her assistance in preparing this proceedings volume. The editors hope that the result constitutes a very good step forward toward developing intelligent systems and that it will be of advantage to many readers.

July, 1995

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Second KI-95 proceedings volume:

KI-95 Activities: Workshops - Posters - Demos
Extended Abstracts
L. Dreschler-Fischer, S. Pribbenow (Eds.)
Bonn: Gesellschaft für Informatik e.V., 1995

DAGM proceedings volume:

Mustererkennung 95: 17. DAGM-Symposium, Bielefeld
G. Sagerer, S. Posch, F. Kummert (Eds.)
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