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Tasks and Methods in Applied Artificial Intelligence

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Preface

Nowadays, it is generally accepted that the aim of Applied Artificial Intelligence is to render computational a large portion of non-analytical human knowledge. To attain this end, we need first to build knowledge-level models of analysis and synthesis tasks in scientific and technical domains, such as those performed daily by human experts in fields such as medical diagnosis, design in civil or telecommunication engineering, architecture, flexible manufacturing, or tutoring. Then, these models have to be transformed in such a way that their entities and relations can be linked to the primitives of a programming language and, finally, produce a program and continue with the usual phases in software engineering (validation, evaluation, and maintenance).

This purpose, that seems to be clear, has suffered since its origins in 1956, from a lack of methodology and foundations. That is, there has been an excessive hurry to develop applications (*expert* systems) without the technical and methodological support available to other engineering disciplines —those dealing with matter or energy— having been established. This is the reason why the advancement of Knowledge Engineering has not been as robust as expected.

Fortunately, interest in methodology and foundations has grown in recent years, commencing by Clancey and Chandrasekaran's proposals about generic tasks aiming at capturing recurrent abstractions in human knowledge modeling. Then, efforts have been made to build libraries of problem-solving methods to develop these tasks by decomposing them up to primitive level and completing these tasks and methods with ontologies and domain knowledge models together with a set of assumptions about implicit representations for each method and about the method's assumptions which are implicit in each domain model. These three basic concepts —tasks, method, and domain—, along with the underlying pursuit of designing reusable components, have characterized most of methodological developments around KADS, CommonKADS, and PROTÉGÉ, for instance.

The scope and topics included in the Call for Papers of the *Eleventh International Conference on Industrial and Engineering Applications of Artificial Intelligence and Expert Systems* (IEA/AIE-98) were compiled within this spirit of concern about sound foundations and methodology, as well as with the explicit acknowledgment of the necessity of developing efficient procedures to make the models operational. As a result of this call, 291 contributed and invited papers were submitted from 41 countries; the program committee selected 187 among them, after conscientiously considering the reviews provided by at least two referees per paper. We believe that the significant increase in the number of submitted papers, with respect to recent conferences, is a symptom of a maturing interest within the AI community towards fundamental issues relevant to well-founded and robust applications in the real world.

We are pleased to present, as program chairs and editors of these two volumes, a final version of the accepted papers incorporating the reviewers' comments. We have arranged their contents basically following the topic list included in the Call for Papers, adding some additional topics which received special attention as a result of being the subject of invited sessions. The first volume entitled *Methodology and Tools in Knowledge-Based Systems*, is divided into four main parts and includes the

contributions having a basic and methodological nature, along with those concerning knowledge modeling, formal tools, and generic tasks of analysis in applied AI. There are sections on fuzzy knowledge representation and inference, qualitative reasoning, evolutionary computing, and multiagent systems, among others.

One of the most frequent deficiencies in the majority of methodological developments lies in ignoring the conclusive step about how to render the models operational with the final result of an implemented system. We believe that this fact accounts for a considerable lack of credibility towards AI among researches on the outside, who feel that it has failed in that it has not made enough inroads into real-world applications. Consequently, AI researchers are sometimes seen as *just blowing smoke*. It is still common to find journal articles that do not support claims on rigorous experimental evidence or that only show solutions to toy problems by way of validation.

In the second volume, with the title *Tasks and Methods in Applied Artificial Intelligence*, we have included the contributions dealing with aspects that are more directly relevant to application development. These contributions are grouped into five parts: generic tasks of synthesis and modification, machine learning, applied AI and Knowledge-Based Systems in specific domains, and validation and evaluation criteria.

The editors are also aware of the grand challenges for AI concerning artificial behavior for agents that have to deal with the real world through perception and motor actions. Nowadays, there is an enormous lack of balance between existing AI systems in some aspects of their competence. Whereas in some formal microworlds AI systems have reached the highest human level of competence —the recent success of chess-playing systems being a paradigmatic example—, or there are knowledge-based systems exhibiting human expert competence in narrow technical domains such as medical diagnosis, etc., few systems exist surpassing the competence of a cockroach, for instance, in moving around pursuing a goal in an unstructured world. This enormous distance between pure abstract intellectual tasks at one end, and those that involve sensorimotor interaction with the physical world at the other, calls for an emphasis on research on robotic agents.

Since the current state of affairs is partly due to the Turing vision of a disembodied, abstract, symbol-processing intelligence, new proposals —such as those put forward by Harnad or Brooks— are worth consideration. Robotic capacities including the ability to see, grasp, manipulate, or move have been added to an extended version of the Turing test. The symbol grounding problem has been approached by the physical grounding hypothesis: grounding a system's representations in the physical world via sensory devices with the result of emergent functionalities. Taking the biological paradigm seriously implies building on top of an integrated and distributed sensorimotor system, since the coordination of our movement is done mainly in an unconscious way, relying on perception without central processors coming into play. Neural networks have proven to be an adequate paradigm for approaching this kind of problem as well as others at the subsymbolic level. We believe that the connectionist and symbolic perspectives to AI should be taken as mutually supporting approaches to the same problems, rather than as competitive areas, as is often the case. Hybrid systems integrating both perspectives appear to be the right track to follow.

This emphasis on perception and robotics has obtained a satisfactory response in terms of the number of submitted papers, as compared with previous conferences.

Consequently, a section on perception is included in Volume I, and in Volume II more than 20 papers can be found in sections devoted to perceptual robotics, robot motion planning, and neurofuzzy approaches to robot control.

The papers included in this volume were presented at IEA/AIE-98 which was held in Benicàssim, Castellón, Spain on June 1-4, 1998. The event was sponsored by the *International Society of Applied Intelligence* —which promotes this conference series—, Universidad Jaume I de Castellón —the hosting institution— and Universidad Nacional de Educación a Distancia, in cooperation with several international associations such as AAAI, ACM/SIGART, ECCAI, and AEPIA, among others. Support for this event has been provided by Fundació Caixa Castelló-Bancaixa, Ministerio de Educación y Ciencia, Fundació Universitat Empresa of the Universidad Jaume I, and Silicon Graphics Computer Systems.

We would like to express our sincere gratitude to the members of the organizing and program committees, to the reviewers, and to the organizers of invited sessions for their invaluable effort in helping with the preparation of this event. Thanks also to the invited speakers, Michael Brady and Bob J. Wielinga, with particular gratitude to Roberto Moreno-Díaz, for their original papers given as plenary lectures and appearing in this book. Thanks also to Moonis Ali, president of ISAI and IEA/AIE-98 general chair, for his constant support. The collaboration of the Technical Committee on Robot Motion and Path Planning of the *IEEE Robotics and Automation Society* deserves a special mention, as well as Toshio Fukuda, president of this society, for his help in the review process. Also, thanks to Springer-Verlag and particularly to Alfred Hofmann for an already long and fruitful collaboration with us. We sincerely thank all authors for making the conference and this book possible with their contributions and participation.

Finally, the editors would like to dedicate this book to the memory of Núria Piera, who promoted research on qualitative reasoning across Spain and Europe and could not see by herself the success of her last organized session, since she had to move to her definitive dwelling.

The theme for the 1998 conference was *New Methodologies, Knowledge Modeling and Hybrid Techniques*. Our focus has been on methodological aspects in the development of KBS's, knowledge modeling, and hybrid techniques that integrate the symbolic and connectionist perspectives in AI applications. The global assessment of the contributions contained in these two volumes is reasonably positive. They give a representative sample of the current state of the art in the field of Applied Artificial Intelligence and Knowledge Engineering and they clearly illustrate which problems have already been solved or are on the way to being solved and which still present a challenge in the serious enterprise of making Applied Artificial Intelligence a science and an engineering discipline as unequivocal and robust as physics or matter and energy engineering. We hope that these volumes will contribute to a better understanding of these problems and to expedite the way to their solution for the well-being of humankind with the advent of the third millennium.

Angel Pasqual del Pobil
José Mira Mira

March 1998

Table of Contents, Vol. II

1 Synthesis Tasks

Spatial, Temporal and Spatio-Temporal Planning and Scheduling

Motion Planning for Robots

System Configuration

2 Modification Tasks

Knowledge-Based Control Systems

Dynamic Systems Supervision

Intelligent Supervision

Predictive Control Systems

Perceptual Robotics

Fuzzy and Neurofuzzy Approaches to Robot Control

Program Reuse

3 Machine Learning

Machine Learning Applications: Tools and Methods

Inductive and Deductive Strategies

Case-Based Reasoning

Learning Advances in Neural Networks

4 Applied Artificial Intelligence and Knowledge-Based Systems in Specific Domains

Multimedia

Human-Computer Interaction

Decision Support Systems

Tutoring Systems

Connectionist and Hybrid AI Approaches to Manufacturing

Modeling and Simulation of Ecological/Environmental Systems

Reports on Real Applications with Significant Findings

5 Validation and Evaluation Criteria

Simulation

Table of Contents, Vol. I

1 Methodological Aspects

2 Knowledge Modeling

3 Formal Tools

Fuzzy Knowledge Representation and Inference

Uncertainty, Causal Reasoning and Bayesian Networks

Qualitative Reasoning

Neural Networks

Evolutionary Computing

Object-Oriented Formulations

Hybridization Techniques

Context-Sensitive Reasoning

Multi-Agent Systems

Divisible Problems

4 Generic Tasks of Analysis

Perception

Natural Language Understanding

System Identification

Monitoring

Fault Diagnosis

Predictive Models