The pagens appearing in this book comprise the proceedings of the meeting mentioned on the power and title page. They reflect the sulhors' opinions and are published as presented and without change. In the in enests of timely dissemination. Their inclusion in this postication does not recruitarily opnatifular endorsement by the advocations. IEEE Computer Society Press, on the Institute of Electronics and Electronics.

ISBN 0-8186-0668-6 IEEE CATALOG NUMBER 85CH2215-2 LIBRARY OF CONGRESS NUMBER 85-62321 IEEE COMPUTER SOCIETY ORDER NUMBER 688

The Second Conference on Artificial Intelligence Applications

THE ENGINEERING OF KNOWLEDGE-BASED SYSTEMS

Sponsored by IEEE Computer Society Fontainebleau Hilton, Miami Beach, Florida

December 11-13, 1985





IEEE COMPUTER SOCIETY



THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC. COMPUTER SOCIETY (PRESS

79

8850079

The papers appearing in this book comprise the proceedings of the meeting mentioned on the cover and title page. They reflect the authors' opinions and are published as presented and without change, in the interests of timely dissemination. Their inclusion in this publication does not necessarily constitute endorsement by the editors, IEEE Computer Society Press, or the Institute of Electrical and Electronics Engineers, Inc.

Published by IEEE Computer Society Press 1730 Massachusetts Avenue, N.W. Washington, D.C. 20036-1903

COVER DESIGNED BY JACK I. BALLESTERO

Copyright and Reprint Permissions: Abstracting is permitted/with credit to the source. Libraries are permitted to photocopy beyond the limits of U.S. copyright law for private use of patrons those articles in this volume that carry a code at the bottom of the first page, provided the per-copy fee indicated in the code is paid through the Copyright Clearance Center, 29 Congress Street, Salem, MA 01970. Instructors are permitted to photocopy isolated articles for noncommercial classroom use without fee. For other copying, reprint or republication permission, write to Director, Publishing Services, IEEE, 345 E. 47 St., New York, NY 10017. All rights reserved. Copyright © 1985 by The Institute of Electrical and Electronics Engineers, Inc.

lÉEE Catalog Number 85CH2215-2 Library of Congress Number 85-62321 IEEE Computer Society Order Number 688 ISBN 0-8186-0688-6 (Paper) ISBN 0-8186-4688-8 (Microfiche) ISBN 0-8186-8688-X (Casebound)

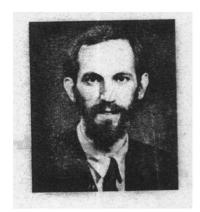
Order from: IEEE Computer Society

Post Office Box 80452 Worldway Postal Center Los Angeles, CA 90080 IEEE Service Center 445 Hoes Lane Piscataway, NJ 08854



THE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS, INC.

General Chairman's Message



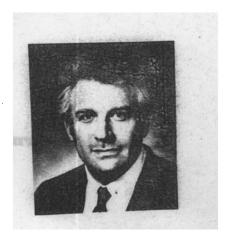
Welcome to the IEEE Computer Society's Second Conference on Artificial Intelligence Applications— The Engineering of Knowledge-Based Systems. We have emphasized knowledge-based systems in this conference because of their leading role in applied artificial intelligence. Other important areas of application such as vision, robotics, learning, man-machine interfaces, and natural language processing are also included. The papers presented here reflect this vision of applied artificial intelligence technology. Theoretical papers that advance the basic technical capabilities in these fields have also been included in the program.

This year, as befits an applications conference, we are proud to have our first exhibition. We hope you will enjoy browsing through the exhibits and will find many useful new products.

Many thanks are due to Charles R. Weisbin, my program chairman, for his hard work and dedication to the conference. It has been a pleasure working with him. I would also like to thank Mabry Tyson for putting together such an appropriate set of tutorials.

Iohn Roach





It is with a great deal of pride and pleasure that I present this proceedings of the Second Conference on Artificial Intelligence Applications—The Engineering of Knowledge-Based Systems. This proceedings reflects directly the intensive effort and diligent review of an outstanding program committee; without the program committee's conscientious effort, this conference could not have accommodated the large number of submitted papers, attracted such outstanding invited speakers, nor kept to the high standards we all sought to attain.

No effort of this magnitude could possibly be achieved without the dedicated involvement of a strong administrative staff. I am deeply indebted to Ms. Erma Howe and her colleagues Ms. Ann Houston, Ms. Ruth Lawson, and Ms. Lucille Whitman, for keeping this entire effort organized and running smoothly.

A word of advice for future program chairmen might be in order. Don't take the job on unless you can get lots of help, secure many more reviewers than you think you'll need (each meeting more papers are submitted), start early, and computerize if possible.

Finally, my thanks go to Ms. Gerrie Katz of the IEEE Computer Society and the conference general chairman, John Roach, whose guidance enabled us to effectively carry out our task.

Charles R. Weisbin

Conference Committee

General Chairman

John Roach Virginia Polytechnic Institute and State University

Program Chairman

Charles R. Weisbin
Oak Ridge National Laboratory

Tutorial Chairman

Mabry Tyson SRI International

Local Arrangements Chairman

Harry Hayman Boca Raton, Florida

Registration

IEEE Computer Society

Program Committee

J. Barhen

Oak Ridge National Laboratory

Griff Bilbro

North Carolina State University

B. (Chandra) Chandrasekaran

Ohio State University

Peter Cheeseman

National Aeronautics and Space Administration

G. de Saussure

Oak Ridge National Laboratory

Richard O. Duda

Syntelligence Company

Richard Gawronski

Oak Ridge National Laboratory

Robert Haralick

Machine Vision International

Ewald Heer

Heer Associates, Inc.

David B. Hertz

University of Miami

S.S. Iyengar

Oak Ridge National Laboratory

C.C. Jorgensen

Oak Ridge National Laboratory

Avi Kak

Purdue University

Robert Levinson

University of Texas

Judea Pearl

University of California, Los Angeles

Harry E. Pople

University of Pittsburgh

Elaine Rich

Micro-Computer Systems

John Roach

Virginia Polytechnic Institute and State Universit

Linda Shapiro

Machine Vision International

Robert Simmons

University of Texas

Charles R. Weisbin

Oak Ridge National Laboratory

TABLE OF CONTENTS

ORI	EGI NAI	PAGE	IS
OF	POOR	QUALI	ΓY

General Chairman's Messageiii
Program Chairman's Messagev
Conference Committeevii
Program Committeeix
Part 1
Papers Accepted for Presentation and Publication
December 11, 1985
Keynote
Artificial Intelligence: Problems and Issues H. Pople
Session 1A: Reasoning with Uncertainty
Chair: Peter Cheeseman
How to Do with Probabilities What People Say You Can't (Invited)
Inexact Reasoning in Expert Systems: A Stochastic Parallel Network Approach
Hierarchical Evidence
MERLIN: A Tool for Automated Inferencing with Uncertainty
Evolution and Modification of Probability in Knowledge Bases
Session 1B: Expert Systems for Diagnostic Evaluation
Chair: Bob Moore
A Recursive Expert Troubleshooting System Utilizing General and Specific
Knowledge 34 D.L. Larner 34
Knowledge-Based Diagnosis of Electronic Instrumentation
Sensor-Based Fault Diagnosis in a Flight Expert System
Problem Solving in the Domain of Quantitative Well Log Interpretation
An Architecture for Consideration of Multiple Faults
PAGE-1: A Troubleshooting Aid for Nonimpact Page Printing Systems

Session 2A: Computer Vision
Chair: Avi Kak
The Role of AI in Computer Vision (Invited)
L.G. Shapiro Symbolic Stereo from Structural Descriptions
K.L. Boyer and A.C. Kak
A Homogeneous Architecture for Knowledge-Based Image Understanding Systems 88 H. Niemann
A Rule-Based System for Improving on Image Segmentation
Three-Dimensional Shape Reconstruction from Image by Minimum Energy Principle
P. Liang and J.S. Todhunter
Finding Trajectories of Feature Points in a Monocular Image Sequence
Session 2B: Applications and Analysis
Chair: Dan Chester
Word Shape Analysis in a Knowledge-Based System for Reading Text
An Expert System for Data Reduction
W.K. Utt, J.B. Anderson, F.J. Bollag, and S.D. Nystrom
A Knowledge Representation for Reasoning About Petroleum Geology
The Knowledge-Based Test Assistant's Wave/Signal Editor: An Interface for the
Management of Timing Constraints
J.E. Arnold Knowledge-Directed Recursive Rule Compilation in Expert Database Systems
J. Han and L. Travis
*Sub-Definiteness, Over- Definiteness , and Absurdity in Knowledge
Representation (Some Algebraic Aspects)
·
December 12, 1985
Keynote
Artificial Intelligence Versus Machine Intelligence: Facts and Fiction
Session 3A: Intelligent Robotics
Chair: Ewald Heer
Learned Navigation Paths for a Robot in Unexplored Terrain (Invited)
Low-Level Learning for a Mobile Robot: Environment Model Acquisition
M.P. Turchan and A.K.C. Wong Mission Planning System for an Autonomous Vehicle
(G. Pearso and D. Kuan
Opporturistic Scheduling for Robotic Machine Tending

An Intelligent Pilot for an Autonomous Vehicle System
Task Bidding and Distributed Planning in Flexible Manufacturing
Session 3B: Expert System Architecture
Chair: Jacob Barhen
A VLSI Implementation of Fuzzy Inference Engine: Toward an Expert System
on a Chip
M. Togai and H. Watanabe Behavior Rule Systems for Distributed Process Control
B. Burg, L. Foulloy, J.C. Heudin, and B. Zavidovique
An Expert Diagnostic and Prediction System Based on Minimal Cut Set Techniques20
M. Schwarzblat and J. Arellano
A Distributed Computational Model of Plausible Classification Reasoning
SUBEX: A Focus of Attention Technique for Rule-Based Inference
Session 4A: Knowledge Acquisition and Representation
Chair: David Hertz
*Where Knowledge Acquisition Tools Fit in the Scheme of Things (Invited)
Representation of Spatial Structure and Function in Diagnosis
Z. Xiang, J.G. Chutkow, S.C. Shapiro, and S.N. Srihari *Extraction of Expert System Rules from Text
C.J. Petrie, Jr. Using Information Retrieval Techniques in an Expert System
A Comparative Study of Different Approaches to Qualitative Physics Theories
Doing R1 with Style
A. van de Brug, J. Bachant, and J. McDermott
Incorporating Knowledge Rules in a Semantic Data Model: An Approach to Integrated Knowledge Management
Session 4B: Expert Systems for Design
Chair: John Roach
PEARL: A Knowledge-Based Expert Assisted CAD Tool
DAS/Logic™: A Rule-Based Logic Design Assistant
MicroScope: Rule-Based Analysis of Programming Environments
A Planning System with Analysis
An Exercise in Engineering Circuit Design Using an Expert
System
Branch and Bound Search for Automatic Linking Process of Seismogram28
K-Y. Huang, K.S. Fu, and Z.S. Lin

December 13, 1985

Keynote	
Generic Tasks in Knowledge-Based Reasoning: Characterizing and Designing Expert Systems at the 'Right' Level of Abstraction	4
Session 5A: Learning	
Chair: B. Chandrasekaran	
Intelligent Instrumentation and Process Control	2
On the Futility of Arbitrarily Increasing Memory Capabilities of Stochastic Learning	_
Automata30 B.J. Oommen	8
Automatic Generation of Expert Systems from Examples	3
Problem Solving: A Methodology for Modeling and Generating Heuristics	0
Session 5B: Man-Machine Interaction	
Chair: Elaine Rich	
Management of User Expectations in a Conversational Advisory System	8
SPIRIT: A Flexible Tutoring Style in an Intelligent Tutoring System	6
A Man-Machine Interface to a Knowledge-Based System for Validating	
Oceanographic Reports	2
R.F. Wachter and V.G. Sigillito SKIPPER: A Prototype Sailing Instructor	7
J.D. Sable, R.M. Peterson, and A.D. Robbi	:/
A Natural Language Database Interface That Provides Cooperative Answers	2
Raising User Proficiency Through Active Assistance: An Intelligent Editor	8
Improving Human-Computer Interaction by Learning a Model of User Preferences36 J. Roach and M. Wilding	4
Session 6A: Natural Language Understanding	
Chair: Charles R. Weisbin	
Natural Language Understanding: How Natural Can It Be? (Invited)	2
Learning Causal Models by Understanding Real-World Natural Language	
Explanations	8
GROK—A Knowledge-Based Text Processing System	4
K.K. Obermeier	;
Creating Relational Databases from English Texts39 H. Alshawi	0

P.W. Palumbo	Commentation of Banking Tolores
Automatic Classification and S S.R. Young and P.J. Haye	Summarization of Banking Telexes
Session 6B: Expert Systems	Explanation and Verification
Chair: John Stewart	
Validation of a Multivariate Sp	pecified Pictorial Pattern Class Description for
H.S. Todd	of Random Generated Instances
R. Rubinoff	t Systems: The CLEAR System
M. Numao and T. Fujisak	
J.B. Lee and E.A. Stohr	Portfolio Management Decision Making420
	Decision Support System Integrating Terrain and
	43. o, B.G. Lee, and R.A. Upton
Progress in Knowledge-Based	I Flight Monitoring
D.C. Chen	
	Dout 9
Panare	Part 2 S Accepted for Publication Only
Papers	s Accepted for Publication Only
Building Knowledge-Based O	s Accepted for Publication Only perating System Consultants44
Building Knowledge-Based O M.A. Billmers and M.G. A Knowledge-Based System A	s Accepted for Publication Only perating System Consultants
Building Knowledge-Based O M.A. Billmers and M.G. A Knowledge-Based System A G. Biswas, V. Subramani Rapid Acquisition and Combi	perating System Consultants
Building Knowledge-Based O M.A. Billmers and M.G. A Knowledge-Based System A G. Biswas, V. Subramani Rapid Acquisition and Combi Same Domain	perating System Consultants
Building Knowledge-Based O M.A. Billmers and M.G. A Knowledge-Based System A G. Biswas, V. Subramani Rapid Acquisition and Combi Same Domain	perating System Consultants
Building Knowledge-Based O. M.A. Billmers and M.G. A Knowledge-Based System A. G. Biswas, V. Subramani Rapid Acquisition and Combis Same Domain	perating System Consultants
Building Knowledge-Based Of M.A. Billmers and M.G. A Knowledge-Based System A.G. Biswas, V. Subramani Rapid Acquisition and Combis Same Domain J.H. Boose KARMA: Knowledge-Based A. P.K. Bose and M. Rajinik GENIE: An Inference Engine F. Brundick, J. Dumer, T. Knowledge Representation and M. Rajinik Rowledge Representation and M.G. A. Knowledge Representation and M. Rajinik Representation and M.G.	perating System Consultants
Building Knowledge-Based O. M.A. Billmers and M.G. A Knowledge-Based System A. G. Biswas, V. Subramani Rapid Acquisition and Combis Same Domain	perating System Consultants
Building Knowledge-Based O. M.A. Billmers and M.G. A Knowledge-Based System A. G. Biswas, V. Subramani Rapid Acquisition and Combis Same Domain	perating System Consultants
Building Knowledge-Based O. M.A. Billmers and M.G. A Knowledge-Based System A. G. Biswas, V. Subramani Rapid Acquisition and Combis Same Domain	perating System Consultants
Building Knowledge-Based Of M.A. Billmers and M.G. A Knowledge-Based System A.G. Biswas, V. Subramani Rapid Acquisition and Combisme Domain	perating System Consultants
Building Knowledge-Based Of M.A. Billmers and M.G. A Knowledge-Based System A.G. Biswas, V. Subramani Rapid Acquisition and Combis Same Domain J.H. Boose KARMA: Knowledge-Based A. P.K. Bose and M. Rajinik GENIE: An Inference Engine F. Brundick, J. Dumer, T. Knowledge Representation and Diagnostic Medical Decision M.E. Cohen, D.L. Hudse Complexity, Uncertainty, and B.R. Fox and K.G. Kemp, Computer Algebra Applied to A. Garcia-Ortiz A Survey of Expert System To J.F. Gilmore and K. Pulas	perating System Consultants
Building Knowledge-Based Of M.A. Billmers and M.G. A Knowledge-Based System A.G. Biswas, V. Subramani Rapid Acquisition and Combis Same Domain J.H. Boose KARMA: Knowledge-Based A. P.K. Bose and M. Rajinik GENIE: An Inference Engine F. Brundick, J. Dumer, T. Knowledge Representation and Diagnostic Medical Decision M.E. Cohen, D.L. Hudson D.L. Hudson B.R. Fox and K.G. Kemp, Computer Algebra Applied to A. Garcia-Ortiz A Survey of Expert System To J.F. Gilmore and K. Pulas MEDCAT/CATS: Two Contra	perating System Consultants
Building Knowledge-Based Of M.A. Billmers and M.G. A Knowledge-Based System A.G. Biswas, V. Subramani Rapid Acquisition and Combis Same Domain J.H. Boose KARMA: Knowledge-Based A. P.K. Bose and M. Rajinik GENIE: An Inference Engine F. Brundick, J. Dumer, T. Knowledge Representation and Diagnostic Medical Decision M.E. Cohen, D.L. Hudson D.L. Hudson B.R. Fox and K.G. Kemp, Computer Algebra Applied to A. Garcia-Ortiz A Survey of Expert System To J.F. Gilmore and K. Pulas MEDCAT/CATS: Two Contra	perating System Consultants

Using a Predictive Parse to Create a Modeless Editor	14
K. Hammer, J. Hardin, D. Rudisill, and A. Goldfein	
ESSA: An Approach to Acquiring Decision Rules for Diagnostic Expert Systems	20
J.J. Hannan and P. Politakis	
Representation of Procedural Knowledge for Expert Systems	26
R.T. Hartley	
A Retrospective View of CACE-III: Considerations in Coordinating Symbolic and	
Numeric Computation in a Rule-Based Expert System	32
J.R. James, P.P. Bonissone, D.K. Frederick, and J.H. Taylor	
A General Purpose Language for Coupled Expert Systems	39
C.I. Kalme	40
TIME-1: Semantic System for Dynamic Object Domain	48
E.Y. Kandrashina, O.N. Ochakovskaja, and Y.A. Zagorulko	
EP-X: A Knowledge-Based System to Aid in Searches of the Environmental Pollution	- 1
Literature	32
D.A. Krawczak, P.J. Smith, S.J. Shute, and M. Chignell	=0
ANALYST II: A Knowledge-Based Intelligence Support System	20
S.J. Laskowski, H.J. Antonisse, and R.P. Bonasso	4
Evaluation of Expert Systems: An Approach and Case Study	04
J. Liebowitz WELDEX—An Expert System for Nondestructive Testing of Welds	72
S. Mahalingam and D.D. Sharma	12
Finding Simple Routes: 'Ease of Description' as an Objective Function in Automated	
Route Selection	77
D.M. Mark	′′
Knowledge Acquisition Through Natural Language Dialogue	82
J.H. Martin	02
Positional Representation of English Words	87
S.R. Mukherjee and M. Sloan	
A Lisp-Based System for Generating Diagnostic Keys	92
B. Pinkowski	
The COMPASS Expert System: Verification, Technology Transfer, and Expansion	97
D.S. Prerau, A.S. Gunderson, R.E. Reinke, and S.K. Goyal	
Using Rule Induction to Combine Declarative and Procedural Knowledge	
Representations	03
C.E. Riese and S.M. Zubrick	
E.T. Expert Technician/Experience Trapper	07
M.C. Rowe, R. Keener, A. Veitch, and R.B. Lantz	
Extended Production Rules for Validity Maintenance	13
P.R. Schaefer, I.H. Bozma, and R.D. Beer	
One Cornerstone in the Mathematical Foundations for a System of Fuzzy-Logic	
Programming	18
D. Schwartz	
A Knowledge Representation for Roving Robots	21
H.C. Shen and G.F.P. Signarowski	
Reasoning About Causation in Knowledge-Based Systems	29
Y. Shoham	_
Tatting Inference Nets with Bayes' Theorem	35
P. Snow	
Recognition of 3-D Objects Via Spatial Understanding of 2-D Images	41
J.T. Tou and C.L. Huang	
Directed Search with Feedback	47

Fractal Actors for Distributed Manufacturing Control	653
H. Van Dyke Parunak, B.W. Irish, J. Kindrick, and P.W. Lozo	
Process Tracing as a Method for Initial Knowledge Acquisition	661
V.R. Waldron	
Dynamic Programming in the Recognition of Connected Handwritten Script	666
K.H. Wong and F. Fallside	
The ES/AG Environment—Its Development and Use in Expert System Applications	671
D.V. Zelinski and R.N. Cronk	
INKA: The INGLISH Knowledge Aquisition Interface for Electronic Instrument	
Troubleshooting Systems	676
B. Phillips, S.L. Messick, M.J. Freiling, and J.H. Alexander	
Author Index	683

^{*}Not available at time of publication

Part 1

Papers Accepted for Presentation and Publication

•

Keynote Speaker

Harry Pople

"Artificial Intelligence: Problems and Issues"

3