

## Table of Contents

CONTRIBUTING AUTHORS	xi
PREFACE	xiii
JUDGE: A CASE-BASED REASONING SYSTEM William M. Bain	1
CHANGING LANGUAGE WHILE LEARNING RECURSIVE DESCRIPTIONS FROM EXAMPLES Ranan B. Banerji	5
LEARNING BY DISJUNCTIVE SPANNING Gary L. Bradshaw	11
TRANSFER OF KNOWLEDGE BETWEEN TEACHING AND LEARNING SYSTEMS P. Brazdil	15
SOME APPROACHES TO KNOWLEDGE ACQUISITION Bruce G. Buchanan	19
ANALOGICAL LEARNING WITH MULTIPLE MODELS Mark H. Burstein	25
THE WORLD MODELERS PROJECT: OBJECTIVES AND SIMULATOR ARCHITECTURE Jaime Carbonell and Greg Hood	29
THE ACQUISITION OF PROCEDURAL KNOWLEDGE THROUGH INDUCTIVE LEARNING Kaihu Chen	35
LEARNING STATIC EVALUATION FUNCTIONS BY LINEAR REGRESSION Jens Christensen	39
PLAN INVENTION AND PLAN TRANSFORMATION Gregg C. Collins	43
A BRIEF OVERVIEW OF EXPLANATORY SCHEMA ACQUISITION Gerald Dejong	47
THE EG PROJECT: RECENT PROGRESS Thomas G. Dietterich	51



LEARNING CAUSAL RELATIONS	55
Richard J. Doyle	
FUNCTIONAL PROPERTIES AND CONCEPT FORMATION	59
J. Daniel Easterlin	
EXPLANATION-BASED LEARNING IN LOGIC CIRCUIT DESIGN	63
Thomas Ellman	
A PROPOSED METHOD OF CONCEPTUAL CLUSTERING FOR STRUCTURED AND DECOMPOSABLE OBJECTS	67
Douglas Fisher	
EXPLOITING FUNCTIONAL VOCABULARIES TO LEARN STRUCTURAL DESCRIPTIONS	71
Nicholas S. Flann and Thomas G. Dietterich	
COMBINING NUMERIC AND SYMBOLIC LEARNING TECHNIQUES	75
Richard H. Granger, Jr. and Jeffrey C. Schlimmer	
LEARNING BY UNDERSTANDING ANALOGIES	81
Russell Greiner	
ANALOGICAL REASONING IN THE CONTEXT OF ACQUIRING PROBLEM SOLVING EXPERTISE	85
Rogers Hall	
PLANNING AND LEARNING IN A DESIGN DOMAIN: THE PROBLEMS PLAN INTERACTIONS	89
Kristian J. Hammond	
INFERENCE OF INCORRECT OPERATORS	93
Haym Hirsh and Derek Sleeman	
A CONCEPTUAL FRAMEWORK FOR CONCEPT IDENTIFICATION	99
Robert C. Holte	
NEURAL MODELING AS ONE APPROACH TO MACHINE LEARNING	103
Greg Hood	
STEPS TOWARD BUILDING A DYNAMIC MEMORY	109
Larry Hunter	



LEARNING BY COMPOSITION Glenn A. Iba	115
KNOWLEDGE ACQUISITION: INVESTIGATIONS AND GENERAL PRINCIPLES Gary S. Kahn	119
PURPOSE-DIRECTED ANALOGY: A SUMMARY OF CURRENT RESEARCH Smadar Kedar-Cabelli	123
DEVELOPMENT OF A FRAMEWORK FOR CONTEXTUAL CONCEPT LEARNING Richard M. Keller	127
ON SAFELY IGNORING HYPOTHESES Kevin T. Kelly	133
A MODEL OF ACQUIRING PROBLEM SOLVING EXPERTISE Dennis Kibler and Rogers P. Hall	137
ANOTHER LEARNING PROBLEM: SYMBOLIC PROCESS PREDICTION Heedong Ko	141
LEARNING AT LRI ORSAY Yves Kodratoff	145
COPER: A METHODOLOGY FOR LEARNING INVARIANT FUNCTIONAL DESCRIPTIONS Mieczyslaw M. Kokar	151
USING EXPERIENCE AS A GUIDE FOR PROBLEM SOLVING Janet L. Kolodner and Robert L. Simpson	155
HEURISTICS AS INVARIANTS AND ITS APPLICATION TO LEARNING Richard E. Korf	161
COMPONENTS OF LEARNING IN A REACTIVE ENVIRONMENT Pat Langley, Dennis Kibler, and Richard Granger	167
THE DEVELOPMENT OF STRUCTURES THROUGH INTERACTION Robert W. Lawler	173



COMPLEX LEARNING ENVIRONMENTS: HIERARCHIES AND THE USE OF EXPLANATION Michael Lebowitz	179
PREDICTION AND CONTROL IN AN ACTIVE ENVIRONMENT Alan J. MacDonald	183
BETTER INFORMATION RETRIEVAL THROUGH LINGUISTIC SOPHISTICATION Michael L. Mauldin	189
MACHINE LEARNING RESEARCH IN THE ARTIFICIAL INTELLIGENCE LABORATORY AT ILLINOIS Ryszard S. Michalski	193
OVERVIEW OF THE PRODIGY LEARNING APPRENTICE Steven Minton	199
A LEARNING APPRENTICE SYSTEM FOR VLSI DESIGN Tom M. Mitchell, Sridhar Mahadevan, and Louis I. Steinberg	203
GENERALIZING EXPLANATIONS OF NARRATIVES INTO SCHEMATA Raymond J. Mooney	207
WHY ARE DESIGN DERIVATIONS HARD TO REPLAY? Jack Mostow	213
AN ARCHITECTURE FOR EXPERIENTIAL LEARNING Michael C. Mozer, Klaus P. Gross	219
KNOWLEDGE EXTRACTION THROUGH LEARNING FROM EXAMPLES Igor Mozetic	227
LEARNING CONCEPTS WITH A PROTOTYPE-BASED MODEL FOR CONCEPT REPRESENTATION Donna J. Nagel	233
RECENT PROGRESS ON THE MATHEMATICIAN'S APPRENTICE PROJECT Paul O'Rorke	237
ACQUIRING DOMAIN KNOWLEDGE FROM FRAGMENTS OF ADVICE Bruce W. Porter, Ray Bareiss, and Adam Farquhar	241



CALM: CONTESTATION FOR ARGUMENTATIVE LEARNING MACHINE	247
J. Quinqueton and J. Sallantin	
DIRECTED EXPERIMENTATION FOR THEORY REVISION AND CONCEPTUAL KNOWLEDGE ACQUISITION	255
Shankar A. Rajamoney	
GOAL-FREE LEARNING BY ANALOGY	261
Alain Rappaport	
A SCIENTIFIC APPROACH TO PRACTICAL INDUCTION	269
Larry Rendell	
EXPLORING SHIFTS OF REPRESENTATION	275
Patricia J. Riddle	
CURRENT RESEARCH ON LEARNING IN SOAR	281
Paul S. Rosenbloom, John E. Laird, Allen Newell, Andrew Golding, and Amy Unruh	
LEARNING CONCEPTS IN A COMPLEX ROBOT WORLD	291
Claude Sammut and David Hume	
LEARNING EVALUATION FUNCTIONS	295
Patricia A. Schooley	
LEARNING FROM DATA WITH ERRORS	299
Jakub Segen	
EXPLANATION-BASED MANIPULATOR LEARNING	303
Alberto Maria Segre	
LEARNING CLASSICAL PHYSICS	307
Jude W. Shavlik	
VIEWS AND CAUSALITY IN DISCOVERY: MODELLING HUMAN INDUCTION	311
Jeff Shrager	
LEARNING CONTROL INFORMATION	317
Bernard Silver	
AN INVESTIGATION OF THE NATURE OF MATHEMATICAL DISCOVERY	321
Michael H. Sims	



LEARNING HOW TO REACH A GOAL: A STRATEGY FOR THE MULTIPLE CLASSES CLASSIFICATION PROBLEM Henri Soldano and Hélène Pigot	327
CONCEPTUAL CLUSTERING OF STRUCTURED OBJECTS R. E. Stepp	333
LEARNING IN INTRACTABLE DOMAINS Prasad V. Tadepalli	337
ON COMPILING EXPLAINABLE MODELS OF A DESIGN DOMAIN Christopher Tong	343
WHAT CAN BE LEARNED? L.G. Valiant	349
LEARNING HEURISTIC RULES FROM DEEP REASONING Walter Van De Velde	353
LEARNING A DOMAIN THEORY BY COMPLETING EXPLANATIONS Kurt VanLehn	359
LEARNING IMPLEMENTATION RULES WITH OPERATING- CONDITIONS DEPENDING ON INTERNAL STRUCTURES IN VLSI DESIGN Masanobu Watanabe	363
OVERVIEW OF THE ODYSSEUS LEARNING APPRENTICE David C. Wilkins, William J. Clancey, and Bruce G. Buchanan	369
LEARNING FROM EXCEPTIONS IN DATABASES Keith E. Williamson	375
LEARNING APPRENTICE SYSTEMS RESEARCH AT SCHLUMBERGER Howard Winston, Reid Smith, Michael Kleyn, Tom Mitchell, and Bruce Buchanan	379
LANGUAGE ACQUISITION: LEARNING PHRASES IN CONTEXT Uri Zernik and Michael Dyer	385
REFERENCES	391
INDEX	425