research avenues. The general theme which threads through all ten papers is the quest for understanding the workings of heuristic knowledge; how it is acquired, stored and used by people, how it can be represented and utilized by machines and what makes one heuristic succeed where others fail.

Contents: Preface, Search and Reasoning in Problem Solving (H.a. Simon); Theory Formation by Heuristic Search, the Nature of Heuristics II; Background and Examples, (D.B. Lenat); Eurisko: A program that learns new heuristics and domain concepts. The Nature of Heuristics III: Program Design Results (D.B. Lenat); Searching for a Cheapest Path in a Tree with Random Costs (R.M. Karp and J. Pearl); Search Rearrangement Backtracking and Polynomial Average Time (P.W. Purdom, Jr.); Consistent-Labeling Problems and their Algorithms: Expected-Complexities and Theory-Based Heuristics (B. Nudel); A General Branch and Bound Formulation for Understanding and Synthesizing and/or Tree Search Procedures (V. Kumar and K. Laveen); A Minimax Algorithm Better Than Alpha-Beta?: Yes and No (I. Roizen and J. Pearl); Pathology on Game Trees Revisited, and an Alternative to Minimaxing (D.s. Nau); Efficient Graph Automorphism by Vertex Partitioning (G. Fowler, et al.).

Consciousness: Natural and Artificial
James T. Culbertson
Libra Publishers, Inc.
Roslyn Heights, NY
March 1983

A new physicalistic theoretical framework. Mental phenomena occur because of a neural *measuring* of stimulus objects. Supplements but does not conflict with the computer theories of brain activity.

Conscious machines can have possible future long term engineering importance. They can be made so as to *also* be intelligent.

Conscious machines, if and when developed, will have engineering applications. Their circuitry is different from present-day AI machines which are intelligent but not conscious. The book explains this.

AI-RELATED DISSERTATIONS

Susanne M. Humphrey
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The following are citations selected by title as being related to AI resulting from a computer search of the Dissertation Abstracts International (DAI) database, produced by University Microfilms International. The online file does not include abstracts, but citations include the DAI reference for finding the abstract in the published DAI. Information for ordering may also be found in the publication. Other elements of the citation are author; title; university, year, and, if available, number of pages; and DAI subject category chosen by the author. References are sorted first by DAI subject category and second by author.

DUNGAN, CHRISTOPHER WRIGHT. A MODEL OF AN AUDIT JUDGMENT IN THE FORM OF AN EXPERT SYSTEM. UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN, 1983, 208 PP. DAI [SECT A] 1983 JUN; 43(12):3949. ACCOUNTING.

ALTERMAN, RICHARD ETHAN. A SYSTEM OF SEVEN COHERENCE RELATIONS FOR HIERARCHICALLY ORGANIZING EVENT CONCEPTS IN TEXT (NEXUS). THE UNIVERSITY OF TEXAS AT AUSTIN, 1982, 187 PP. DAI [SECT B] 1983 JUN;43(12):4052. COMPUTER SCIENCE.

ARSHI, TAYMOOR. BAGIT: A VERY HIGH LEVEL LANGUAGE FOR APPLICATION PROGRAMMING. OREGON STATE UNIVERSITY, 1983, 208 PP. DAI [SECT B] 1983 JUL;44(1):230. COMPUTER SCIENCE.

BROOKS, RICHARD SAMUEL. EXPERIMENTS IN DISTRIBUTED PROBLEM SOLVING WITH ITERATIVE REFINEMENT. UNIVERSITY OF MASSACHUSETTS, 1983, 228 PP. DAI [SECT B] 1983 JUN;43(12):4053. COMPUTER SCIENCE.

CORKILL, DANIEL DAVID. A FRAMEWORK FOR ORGANIZATIONAL SELF-DESIGN IN DISTRIBUTED PROBLEM SOLVING NETWORKS. UNIVERSITY OF MASSACHUSETTS, 1983, 388 PP. DAI [SECT B] 1983 JUN;43(12):4054. COMPUTER SCIENCE.

HSIANG, JIEH. TOPICS IN AUTOMATED THEOREM PROVING AND PROGRAM GENERATION. UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN, 1983, 131 PP. DAI [SECT B] 1983 JUN; 43(12):4056. COMPUTER SCIENCE.

SODDY, JAMES STEPHEN. ON THE APPLICATION OF RELEVANCE MEASURES IN MECHANICAL DEDUCTION. MICHIGAN STATE UNIVERSITY, 1982, 94 PP. DAI [SECT B] 1983 JUN;43(12):4059.

LEE, SUKHAN. INTELLIGENT CONTROL OF A PROSTHETIC ARM BY EMG PATTERN RECOGNITION. PURDUE UNIVERSITY, 1982, 322 PP. DAI [SECT B] 1983 JUN;43(12):4090. ENGINEERING, ELECTRONICS AND ELECTRICAL.

MINDEN, GARY JON. THE INFORMATION NETWORK: A MODEL FOR KNOWLEDGE REPRESENTATION. UNIVERSITY OF KANSAS, 1982, 140 PP. DAI [SECT B] 1983 JUN;43(12):4092. ENGINEERING, ELECTRONICS AND ELECTRICAL.

TOGAI, MASAKI. PRINCIPLES AND APPLICATIONS OF FUZZY INFERENCE: A NEW APPROACH TO DECISION-MAKING PROCESSES IN ILL-DEFINED SYSTEMS. DUKE UNIVERSITY, 1982, 155 PP. DAI [SECT B] 1983 JUL;44(1):259. ENGINEERING, ELECTRONICS AND ELECTRICAL.

HORNG, SHI-YUAN. DEVELOPMENT OF AN END-EFFECTOR FOR ROBOTIC DRILLING WITH ON-LINE SENSING AND DIAGNOSIS. THE UNIVERSITY OF WISCONSIN - MADISON, 1983, 271 PP. DAI [SECT B] 1983 JUN;43(12):4107. ENGINEERING, MECHANICAL.

KAWASAKI, HARUKO. AN ACOUSTICAL BASIS FOR UNIVERSAL CONSTRAINTS ON SOUND SEQUENCES. UNIVERSITY OF CALIFORNIA, BERKELEY, 1982, 246 PP. DAI [SECT A] 1983 JUL; 44(1):158. LANGUAGE, LINGUISTICS.

LARSON, RICHARD KURTH. RESTRICTIVE MODIFICATION: RELATIVE CLAUSES AND ADVERBS. THE UNIVERSITY OF WISCONSIN - MADISON, 1983, 460 PP. DAI [SECT A] 1983 JUN;43(12):3897. LANGUAGE, LINGUISTICS.

HONG, TSAI-HONG. PYRAMID METHODS IN IMAGE ANALYSIS. UNIVERSITY OF MARYLAND, 1982, 215 PP. DAI [SECT B] 1983 JUL; 44(1):195. MATHEMATICS.

ASHER, NICHOLAS MICHAEL. TRUTH CONDITIONS AND SEMANTIC KNOWLEDGE: TOWARD A THEORY OF LINGUISTIC UNDERSTANDING. YALE UNIVERSITY, 1982, 360 PP. DAI [SECT A] 1983 JUN;43(12):3935. PHILOSOPHY.

GRAYBOSCH, ANTHONY JOSEPH. COHERENCE AND THE JUSTIFICATION OF BELIEF. CITY UNIVERSITY OF NEW YORK, 1983, 291 PP. DAI [SECT A] 1983 JUL;44(1):192. PHILOSPHY.

LEDDY, THOMAS WINTER. IMAGINATION, METAPHOR, AND COGNITION: INSIDE THE CONCEPT. BOSTON UNIVERSITY GRADUATE SCHOOL, 1983, 434 PP. DAI [SECT A] 1983 JUN;43(12):3937. PHILOSOPHY.

LLOYD, DAN EDWARD. PICTURING. COLUMBIA UNIVERSITY, 1983, 234 PP. DAI [SECT A] 1983 JUL;44(1):192. PHILOSOPHY.

MCGRATH, ELIZABETH ZIM. A REVISED JAMESEAN THEORY OF TRUTH. THE FLORIDA STATE UNIVERSITY, 1982, 104 PP. DAI [SECT A] 1983 JUN;43(12):3937. PHILOSOPHY.

MOSER, PAUL KENNETH. JUSTIFIED BELIEF: REASONS, REGRESSES, AND FOUNDATIONS IN EPISTEMIC JUSTIFICATION. VANDERBILT UNIVERSITY, 1982, 304 PP. DAI [SECT A] 1983 JUL;44(1):193. PHILOSOPHY.

RUSSELL, WILLIAM BENJAMIN. WITTGENSTEIN'S 'GRAMMAR'. UNIVERSITY OF TORONTO, 1982. DAI [SECT A] 1983 JUN;43(12):3939. PHILOSOPHY.

YOUNG, THOMAS KENT. THE ROLE OF WANTS IN THE NATURE AND JUSTIFICATION OF PRACTICAL REASONING, WITH SPECIAL REFERENCE TO RICHARD BRANDT'S THEORY OF RATIONALITY. SOUTHERN ILLINOIS UNIVERSITY AT CARBONDALE, 1982, 185 PP. DAI [SECT A] 1983 JUL;44(1):195. PHILOSOPHY.

ALEXANDER, JAMES HERBERT, III. COMPUTER TEXT EDITING: THE DEVELOPMENT OF A COGNITIVE SKILL. UNIVERSITY OF COLORADO AT BOULDER, 1982, 222 PP. DAI [SECT B] 1983 JUN; 43(12):4174. PSYCHOLOGY, EXPERIMENTAL.

CHIARELLO, CHRISTINE LYNN. HEMISPHERE DYNAMICS IN LEXICAL ACCESS: AUTOMATIC AND ATTENTIONAL PROCESSES. UNIVERSITY OF CALIFORNIA, BERKELEY, 1982, 112 PP. DAI [SECT B] 1983 JUL; 44(1):343. PSYCHOLOGY, EXPERIMENTAL.

COMPUTER SCIENCE.

TRAWICK, DAVID JAMES. ROBUST SENTENCE ANALYSIS AND HABITABILITY. CALIFORNIA INSTITUTE OF TECHNOLOGY, 1983, 170 PP. DAI [SECT B] 1983 JUL;44(1):233. COMPUTER SCIENCE.

WALL, RAJENDRA SOOKDEO. THE THEORY AND USE OF SCENARIOS. UNIVERSITY OF MASSACHUSETTS, 1983, 222 PP. DAI [SECT B] 1983 JUN;43(12):4060. COMPUTER SCIENCE.

YAU, MANN-MAY J.. HIERARCHICAL REPRESENTATION OF THREE-DIMENSIONAL DIGITAL OBJECTS. STATE UNIVERSITY OF NEW YORK AT BUFFALO, 1983, 217 PP. DAI [SECT B] 1983 JUL; 44(1):243. COMPUTER SCIENCE.

YAVERBAUM, GAYLE J.. REQUIREMENT ANALYSIS FOR DECISION SUPPORT SYSTEMS: AN INVESTIGATION OF THE DECISION PROCESS (MBA, MANAGEMENT). DAI [SECT B] 1983 JUL;44(1):235. COMPUTER SCIENCE.

YOUNG, ROBERT LEE. EXPLORATIONS IN STORY UNDERSTANDING USING CONTEXTUALLY ACCESSED SEMANTIC NETWORKS. THE UNIVERSITY OF TEXAS AT AUSTIN, 1982, 376 PP. DAI [SECT B] 1983 JUN;43(12):4060. COMPUTER SCIENCE.

KELLER, ARNOLD. THE COMMA CONVERSER: AN INTELLIGENT COMPUTER-ASSISTED LEARNING PROGRAM TO TEACH THE USE OF THE COMMA. CONCORDIA UNIVERSITY (CANADA), 1982. DAI [SECT A] 1983 JUL;44(1):49. EDUCATION, AUDIOVISUAL.

ALLEN, JOYCE ELIZABETH. THE EFFECTS OF TEXT SOURCE, DECODING ABILITY, AND READING MODE ON THE ABILITY OF PRIMARY GRADE CHILDREN TO DRAW INFERENCES. UNIVERSITY OF KANSAS, 1982, 213 PP. DAI [SECT A] 1983 JUN;43(12):3794. EDUCATION, CURRICULUM AND INSTRUCTION.

CARROLL, RICHARD RUSSELL. COGNITIVE STRATEGIES EMPLOYED BY CHILDREN IN SOLVING ISOLATED AND EMBEDDED ANALOGIES. FORDHAM UNIVERSITY, 1983, 249 PP. DAI [SECT A] 1983 JUN; 43(12):3795. EDUCATION, CURRICULUM AND INSTRUCTION.

YOUNG, LUCY MIRISCIOTTI. AN ANALYSIS OF THE EFFECT OF THE LOGO COMPUTER PROGRAMMING ENVIRONMENT UPON THE REFLECTIVE AND IMPULSIVE COGNITIVE STYLES OF SECOND-GRADE STUDENTS. UNIVERSITY OF PITTSBURGH, 1982, 136 PP. DAI [SECT A] 1983 JUL;44(1):64. EDUCATION, CURRICULUM AND INSTRUCTION.

BARTEE, JAMES WILLIAM. COGNITIVE COMPLEXITY AND THE ATTRIBUTION PROCESS. UNIVERSITY OF WASHINGTON, 1983, 110 PP. DAI [SECT A] 1983 JUL;44(1):108. EDUCATION, PSYCHOLOGY.

HART, ASHLEY BRUCE, II. SIMULTANEOUS AND SUCCESSIVE PROCESSING AND READING DECODING AND COMPREHENSION: AN INTERACTIVE INTERPRETATION. KENT STATE UNIVERSITY, 1982, 137 PP. DAI [SECT A] 1983 JUL;44(1):115. EDUCATION, PSYCHOLOGY.

LEHRER, RICHARD. THE INTERACTIVE ROLES OF STRUCTURE AND STRATEGY IN KNOWLEDGE ACQUISITION: MICROGENETIC LEARNING AND PROBLEM SOLVING IN PHYSICS. STATE UNIVERSITY OF NEW YORK AT ALBANY, 1982, 385 PP. DAI [SECT A] 1983 JUL;44(1):117. EDUCATION, PSYCHOLOGY.

TIRRE, WILLIAM CHARLES. ASSOCIATIVE ERRORS IN CHILDREN'S ANALOGICAL REASONING: A COGNITIVE PROCESS ANALYSIS. DAI [SECT A] 1983 JUN;43(12):3856. EDUCATION, PSYCHOLOGY.

WILCOX, DEE ANN. THE TRANSFER OF INSTRUCTION IN ARITHMETIC PROBLEM SOLVING. WASHINGTON UNIVERSITY, 1982, 123 PP. DAI [SECT A] 1983 JUN;43(12):3858. EDUCATION, PSYCHOLOGY.

GOODFRIEND, PHYLLIS RUTH. THE EFFECT OF COGNITIVE ORGANIZATION ON READING COMPREHENSION. HOFSTRA UNIVERSITY, 1982, 158 PP. DAI [SECT A] 1983 JUN;43(12):3861. EDUCATION, READING.

GUO, TEN-HUEI. ADAPTIVE CONTROL OF A MANIPULATOR AND ITS MICROPROCESSOR IMPLEMENTATIONS. PURDUE UNIVERSITY, 1982, 155 PP. DAI [SECT B] 1983 JUN;43(12):4088. ENGINEERING, ELECTRONICS AND ELECTRICAL.

FANG, SHENG-PING. THE PICTORIAL SUPERIORITY EFFECT: AN EVALUATION OF THE FRAME THEORY. UNIVERSITY OF CALIFORNIA, RIVERSIDE, 1982, 134 PP. DAI [SECT B] 1983 JUL; 44(1):343. PSYCHOLOGY, EXPERIMENTAL.

GARDNER, MICHAEL KING. SOME REMAINING PUZZLES CONCERNING ANALOGICAL REASONING AND HUMAN ABILITIES. YALE UNIVERSITY, 1982, 80 PP. DAI [SECT B] 1983 JUN;43(12):4177. PSYCHOLOGY, EXPERIMENTAL.

GREENSPAN, STEVEN LLOYD. SEMANTIC FLEXIBILITY AND REFERENTIAL SPECIFICITY: IMPLICATIONS FOR AN INTERACTIVE THEORY OF SENSE AND REFERENCE. STATE UNIVERSITY OF NEW YORK AT BUFFALO, 1983, 188 PP. DAI [SECT B] 1983 JUL;44(1):344. PSYCHOLOGY, EXPERIMENTAL.

HANSON, RAYMOND HENRY. AN INVESTIGATION OF THE SIMILARITY AND CONTRAST MODELS OF METAPHORICAL AND CATEGORICAL SEMANTIC PROCESSING. PURDUE UNIVERSITY, 1982, 248 PP. DAI [SECT B] 1983 JUN;43(12):4178. PSYCHOLOGY, EXPERIMENTAL.

KIMCHI, RUTH. PERCEPTUAL ORGANIZATION OF VISUAL PATTERNS. UNIVERSITY OF CALIFORNIA, BERKELEY, 1982, 78 PP. DAI [SECT B] 1983 JUL;44(1):345. PSYCHOLOGY, EXPERIMENTAL.

KIRCHER, JOHN CHARLES. COMPUTERIZED DECISION-MAKING AND PATTERNS OF ACTIVATION IN THE DETECTION OF DECEPTION. THE UNIVERSITY OF UTAH, 1983, 110 PP. DAI [SECT B] 1983 JUL; 44(1):345. PSYCHOLOGY, EXPERIMENTAL.

MAGEE, LOCHLAN EVERARD. PICTURES, WORDS AND ACCESS TO INFORMATION. UNIVERSITY OF TORONTO, 1982. DAI [SECT B] 1983 JUN;43(12):4179. PSYCHOLOGY, EXPERIMENTAL.

MALCUS, LAWRENCE. CONTOUR FORMATION, SEGMENTATION, AND SEMANTIC ACCESS IN SCENE AND OBJECT PERCEPTION. STATE UNIVERSITY OF NEW YORK AT BUFFALO, 1983, 156 PP. DAI [SECT B] 1983 JUL;44(1):345. PSYCHOLOGY, EXPERIMENTAL.

MCDONNELL, CHERYL JOANNE. ACCESS OF MEANING FOR IDIOMATIC EXPRESSIONS. UNIVERSITY OF SOUTH CAROLINA, 1982, 101 PP. DAI [SECT B] 1983 JUL;44(1):347. PSYCHOLOGY, EXPERIMENTAL.

MORROW, DANIEL GEORGE. THE ROLE OF PREPOSITION AND VERB ASPECT CATEGORIES IN FOREGROUNDING NARRATIVE CONTENT. UNIVERSITY OF CALIFORNIA, BERKELEY, 1982, 208 PP. DAI [SECT B] 1983 JUL;44(1):347. PSYCHOLOGY, EXPERIMENTAL.

(Continued on page 23)

in the year 1981; additionally, it includes some items omitted or garbled in the IInf Bibliography published earlier. More information about IInf may be found in IInf Annual Report 1981 (in Polish, in preparation) and in IInf Biennial Report 1980/1981 (in English, in preparation).

Please refer to the address indicated in the beginning of this section, for more information.

Dynamically Stable Legged Locomotion

Marc Raibert, Harry B. Brown,
Michael A. Chepponis, Eugene F. Hastings,
Sesh Murthy, Francis C. Wimberly
CMU-RI-TR-83-1
January 27, 1983

This report documents our recent progress in exploring balance and dynamic stability in legged systems. There have been five areas of progress, each described in a separate chapter in the pages that follow.

- □ Balance in 2D can be achieved with a surprisingly simple control system. The control system has three separate parts, one that controls hopping height, on that controls the velocity of forward travel, and one that controls body attitude. A physical 2D one-legged hopping machine that employs such a three-part control system hops in place, runs from place to place at speeds of up to 27 mph, maintains its balance when disturbed, and leaps over small obstacles.
- □ Control of locomotion in 3D can build upon the results obtained in 2D. Simulations suggest that a 3D one-legged machine could run and balance using the same three-part controller developed for 2D, provided that additional extra-planar mechanisms operated to suppress roll, yaw, and lateral motions.
- □ We have designed and built a physical one-legged that will permit experimentation in the control of balance in 3D. The device has a simple pneumatic leg that is positioned by a hydraulic hip. It will hop on an open floor without a system of physical constraints.
- □ Last year we developed a method for obtaining balance that uses tabulated data. This year the method was extended by showing that the volumous tabular data can be approximated by a polynomial surface of moderate degree, without much loss of control precision.
- □ We refined our understanding of the mechanisms responsible for balance by simulating and comparing three different algorithms for horizontal control; one just places the foot during flight and sweeps the leg during stance, and the third places the foot during flight and controls body attitude during stance. Each of the three methods elucidate a different principle of dynamic stability.

The report closes with a bibliography on legged locomotion containing about 350 references.

Precision Flexible Machining Cells Within a Manufacturing System

Mark R. Cutkosky, Paul S. Fussell,
and Robert Milligan, Jr.
CMU-RI-TR-83-2
March 1983

This report discusses the conceptual design of a manufacturing cell for a small-batch manufacturer. The cell produces precision parts with a minimum of machining equipment. The cell design emphasizes near-term technology and uses off the shelf items where possible. The proposed cell can run unattended for a moderate period of time (eg. over-night). The design philosophy is to treat the cell components and control programs as discrete modules in a hierarchy. The resulting cell is easily integrated into a larger system. It is also readily modified or expanded as more sophisticated equipment and techniques becomes available.

Grippers for an Unmanned Forging Cell

Mark R. Cutkosky and Eiki Kurokawa
CMU-RI-TR-83-3
December 20, 1983
18 pages

The following report describes the design and construction of two grippers for use is a flexible unmanned forging operation. The forging operation employs two large industrial robots, one to load and unload billets from a furnace at over 2000 deg F and a second to remove the forged pieces from a forging machine and present them ato a gaging station for inspection.

The gripper for the first robot uses special materials and a water cooled shell to withstand the very high temperatures it encounters. It employs a number of sensors to monitor temperatures and loading conditions.

The second gripper is an especially flexible design, suited to a wide variety of irregular shapes. The gripper jaws are articulated to contorom to the rough forgining produces by the cell. Once the jaws are fully closed they are locked in place so that the orientation of the part is preserved.

(More CMU reports in the next issue.)

(Continued from page 15)

OKADA, YOSHIO. THE ENCODING AND RETENTION PROCESSES UNDERLYING JUDGMENT OF SPATIAL LOCATIONS. THE ROCKEFELLER UNIVERSITY, 1982, 275 PP. DAI [SECT B] 1983 JUL; 44(1):347. PSYCHOLOGY, EXPERIMENTAL.

WALKER, WILLIAM HENRY. RETRIEVAL OF KNOWLEDGE FROM MEMORY: A GENERALIZATION OF THE RAAIJMAKERS-SHIFFRIN RETRIEVAL MODEL. UNIVERSITY OF COLORADO AT BOULDER, 1982, 243 PP. DAI [SECT B] 1983 JUN;43(12):4183. PSYCHOLOGY, EXPERIMENTAL.

INHOFF, ALBRECHT WERNER. A TWO STAGE MODEL OF ON LINE PROCESSING DURING THE READING OF SHORT STORIES. UNIVERSITY OF MASSACHUSETTS, 1983, 94 PP. DAI [SECT B] 1983 JUN;43(12):4127. PSYCHOLOGY, GENERAL.

ROBERTS, MICHAEL. OVERCOMING SOME SOURCES OF ERROR IN SYLLOGISTIC REASONING. NEW SCHOOL FOR SOCIAL RESEARCH, 1982, 94 PP. DAI [SECT B] 1983 JUL;44(1):292. PSYCHOLOGY, GENERAL.

SCHMALHOFER, FRANZ JOSEF. COMPREHENSION OF A TECHNICAL TEXT AS A FUNCTION OF EXPERTISE. UNIVERSITY OF COLORADO AT BOULDER, 1982, 197 PP. DAI [SECT B] 1983 JUL;44(1):293. PSYCHOLOGY, GENERAL.

RICHARDSON, GEORGE DONALD. SPATIAL COGNITION. UNIVERSITY OF CALIFORNIA, SANTA BARBARA, 1982, 389 PP. DAI [SECT A] 1983 JUL; 44(1):284. SOCIAL GEOGRAPHY.
