Research in the Computer Science Department

at Indiana University

1981-82

edited by

Mitchell Wand

Computer Science Department

Indiana University

Bloomington, Indiana 47405

TECHNICAL REPORT NO. 134

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December, 1982

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§1 Faculty

John Barnden, Assistant Professor; Ph.D., Oxford. Artificial intelligence, programming languages, formal semantics.

Cynthia Brown, Assistant Professor; Ph.D., University of Michigan. Analysis of algorithms, compilers.

John Buck, Lecturer; B.S., Virginia Tech. Systems analysis, data base and information systems, computer science education.

James Burns, Assistant Professor; Ph.D. Georgia Tech. Theoretical computer science, parallel and distributed systems, distributed data bases, computer graphics.

Will Clinger, Assistant Professor; Ph.D., MIT. Semantics of programming languages, artificial intelligence, nondeterministic concurrent computation, logic.

George Epstein, Professor; Ph.D., University of California, Los Angeles. Systems design, multiple-valued logic, computer science education.

Robert Filman, Assistant Professor; Ph.D., Stanford University. Artificial Intelligence, programming languages, distributed computing, data base systems, logic, and man-machine interaction.

Daniel Friedman, Associate Professor; Ph.D., University of Texas at Austin. Program methodology, formal semantics, artificial intelligence, distributed computing, simulation languages, applicative languages, LISP.

Stanley Hagstrom, Professor, Computer Science and Chemistry; Ph.D., Iowa State University. Computer hardware, laboratory automation, computer networking, operating systems, software engineering, analysis of algorithms in *ab initio* quantum chemistry.

Smith Higgins, Associate Professor; Ph.D., Notre Dame. Computer science education, number theory, modern algebra.

Douglas Hofstadter, Associate Professor; Ph.D., University of Oregon. Artificial intelligence, perception of patterns and style, self-monitoring and self-perception, philosophy of mind.

Stan Kwasny, Assistant Professor; Ph.D., Ohio State University. Natural language understanding, artificial intelligence, data structures, computational linguistics, data base systems.

John O'Donnell, Assistant Professor; Ph.D., University of Iowa. Computer architecture, operating systems, VLSI design, programming languages.

Franklin Prosser, Professor; Ph.D., Pennsylvania State University. Digital hardware, operating systems, computer science education.

Paul Purdom, Associate Professor; Ph.D., California Institute of Technology. Analysis of algorithms, compilers.

Edward L. Robertson, Associate Professor and Chairman; Ph.D., University of Wisconsin. Theory of computation, computational complexity, hardware and software systems architecture, data bases.

Mitchell Wand, Associate Professor; Ph.D., Massachusetts Institute of Technology. Semantics of programming languages, logic, algebra.

David Wise, Associate Professor; Ph.D., University of Wisconsin. Applicative programming, data structures, multiprocessing architectures and languages.

§2 Facilities

The following is a list of equipment which is available purely for research use in the Indiana University Computer Science Department:

VAX 11/780, 500 Mbyte disk, 3.5 Mbyte RAM, running UNIX 4.1bsd
Canon laser beam printer from Imagen Corporation

In addition, the department has other facilities which are shared between research and instructional uses.

Ungermann/Bass Ethernet terminal servers
HP3000 model 44
Motorola 68000 systems - several systems are on hand.

The department also maintains and operates a digital electronics laboratory which includes facilities for constructing and testing hardware designs. The lab supports a range of prototyping activity from wire wrap construction through fabrication of double sided plated through hole printed circuit boards.

In addition, the following University facilities are available to researchers at Indiana University:

DEC KL10
Prime 750
4 VAX 11/780(VMS)
IBM 4341
CDC Cyber 172, soon to be replaced by CDC 170/855
Calcomp, Versatec and Zeta plotters

§3 Summaries of Research Projects

John A. Barnden

Information Processing using Diagrammatic Imagery

An unconscious-imagery model of human cognition is under investigation in an artificial intelligence project. In the model, temporary symbolic structures appear as imaginal diagrams analogous to real drawings of data structures. The diagrams are states of abstract array-like structures implemented as neural networks. The present study is attempting to elucidate the expressive and problem-solving convenience of the unusual (e.g. hybrid pictorial/abstract) symbolisms natural to the model. The project also involves the computer simulation of the necessary image-manipulation processes.

Concurrent Programming Using Phases

A concurrent programming language, PhasL, is being developed in which the notions of condition and process are united in a single 'phase' concept, and in which there are no sequential control constructs. A PhasL program defines a self-modifying tree of phases. The language allows elegant solution of complex concurrent-programming problems. There are some interesting implementational and formal-semantical problems for which solutions are being devised. Automatically checkable restrictions of the language to allow distributed implementation are being studied. The modification of PhasL into a form suitable for artificial-intelligence applications is receiving attention.

George Epstein

Multiple-Valued Logic

I continued research in multiple-valued logic design. My two basic areas were in theory and applications. In theory, I studied properties of core points in lattices, with A. Horn. In applications, I studied symmetric functions with J.C. Muzio and D.M. Miller, and positive functions with Y.W. Liu.

Robert E. Filman

Meta-Reasoning in Knowledge Representation

A central issue in the creation of an intelligent computer system over a domain is the representation of the knowledge embedded in that domain in machine-usable forms. This research suggests that it is possible to construct intelligent systems where the underlying facts, the legal conclusions derivable from those facts, and the appropriate control strategy to derive those conclusions can all be expressed in machine-usable form as instances of meta-theoretic reasoning. We are exploring the expression and resolution of knowledge representation problems by a combination of procedural attachment, rewriting systems, and meta-theoretic representations, in the context of a first order logic system. Issues to be addressed include the representation of heuristics and control, hypothetical reasoning, non-monotonic systems, knowledge and belief, time, strategies, learning and game theory.