Computer Science at Stanford
1978-1979

Prepared for the President's Advisory Committee on Computer Science
by Jonathan King and Denny Brown

January 14, 1980
Chairman's Report

Departmental events since October, 1978

It was the best of times . . .

But overcrowding, as predicted, was the cloud that darkened our Eden.

It was the year that Margaret Jacks Hall was completed and occupied by the Computer Science Department. It was the year that we tried, and failed, to integrate the department in one building. The faculty, students, and staff in Polya Hall, Serra House, and the Powers Building moved in, but the Systems people by and large remained in ERL.

It was the year in which the department's efforts to upgrade its "plant"—computer equipment for experimental computer science work—came to fruition. We now face the challenging (interesting and educational) task of integrating this new equipment into the educational and research programs of the department.

It was a year in which awards continued to flow to the Department's faculty. As you meet, Professor Donald E. Knuth will be receiving the National Medal of Science from the President at the White House. He follows another faculty member, Professor George Dantzig, to this prestigious ceremony.

MARGARET JACKS HALL

I would like to express our gratitude to the University for the beauty and charm of the new building, and to Bill Miller and the Provost's staff, Sydney Burkhart in the Dean's Office, and Bob Floyd, Betty Scott, and Les Earnest in the Department for helping to bring the building project to completion.

The department does not fit into the building. It is currently short by about 20% in office space, and it is short by at least a factor of two in space for machines and laboratory equipment. By Spring Quarter, all conference and seminar rooms, except the Main one on the second floor and a smaller one on the third floor, will have been sacrificed for housing people and machines. All visitor space has been severely rationed, though the department in the past has thrived on its flow of distinguished visitors. All research projects have been informed to be in no-growth mode for lack of expansion space.

How did we get to this state? Understandable mistakes and compromises entered into the planning process that lasted from the early to the mid Seventies. The University was short of building funds (as is natural for it to be). The Department misestimated its growth in faculty and research. The Department, desperate for integrated new space, "colored" its estimates on the low side to make the project
feasible. The University removed stress from the financial program for the building by granting one and a half floors of the building to the Boys Town Research Center in return for a building funds gift. The Department never even considered (shame on us) proposing the construction of a two-level basement, as is being constructed for the Communications Department across Memorial Court.

Alas. Therefore, continued fragmentation is in the cards. Not only were we not able to integrate the Computer Systems faculty and students into MJH, but even the CSD faculty in this group remain in ERL. We and the Integrated Circuits Laboratory of EE were given additional office space in the temporary buildings vacated by Boys Town Research Center. We have proposed that Pine Hall, now superceded by Forsythe Hall, be given over to Computer Science machine and laboratory purposes. The response to that request has been a month of silence. The Dean of Humanities and Sciences apparently has no space left under his control to allocate to us. The space we need is under Provost's Office control. At that level, our shouts are lost in a louder university-wide cacophany.

Please advise.

COMPUTER EQUIPMENT

As discussed in the last report, a DEC PDP-2060 with one million words of main memory was acquired by the department to augment the KL-10 of the AI Lab and the dual KL-10s of SUMEX. It was acquired with funds from NSF, DEC, and the Stauffer Foundation, with financial help from the Deans of Engineering, Humanities and Sciences, and the Vice Provost for Research. It is shared by Computer Science, the Computer Systems Laboratory, the Integrated Circuits Laboratory, and the Operations Research Department.

The SUMEX Project added a DEC 2020 to accommodate clinical testing of medical AI programs, and to handle SUMEX overload.

The Xerox Corporation made a major gift to the department of an environment of personal computer stations (ALTOs), an ETHERNET internal network, and a laser printer (DOVER).

IBM initiated a joint R&D study with the department in Distributed Computing that will shortly bring to us an IBM 4331, twelve Series 1 minicomputers, and a large number of conventional terminals.

ARPA contracts for systems and AI research in VLSI design brought a DEC VAX 11/780, with a second on order for delivery in the Fall.
Hewlett-Packard gifted a number of HP-300 personal computer stations.

A variety of other types of equipment, such as TI minicomputers, a phototypesetting machine, and a Canon Laser Beam desk-top printer were added by gift and purchase.

Essentially all the equipment we own, systems, terminals, and devices, will be integrated by ETHERNET. By mid-year this process will be completed. The transition to this desirable state is painful in the anticipation and in the transition.

We now feel ourselves positioned well for the experimental computer science of the early Eighties. We have opted for an environment of heterogeniety, believing this to present the best set of educational challenges and opportunities. We will be living with the rewards or headaches of this approach for a few years.

**FACULTY**

The department added one senior faculty member, Dr. J. Ullman (formerly of Princeton) in the theory/languages area (with inclination toward theory-of-systems); and one junior faculty member, Dr. R. Schreiber, in Numerical Analysis. Professor Terry Winograd was promoted to tenure; and Professor Joseph Oliger was recommended by the department for promotion to tenure (university decision pending).

We lost one faculty member, Frances Yao (to Xerox PARC, of course.)

As is normal, our relations with the Office of the Dean of Humanities and Sciences has had ebbs and floods, but fortunately for us mostly floods. Presently I report to Associate Dean James Rosse. I want to say, with gratitude to Jim, that I can not imagine how the Department’s relationship to the Dean’s Office could be any better than it is right now. Every request is treated with promptness and decisiveness, always with fairness, the results often exceeding my expectations. We are blessed with a remarkable and dedicated academic administrator.

**CENTER FOR INTEGRATED SYSTEMS**

The department applauds the vigorous pursuit of this project by Professor John Linvill of EE, and has contributed to the pursuit. ARPA has funded projects on VLSI design of Baskett’s, McCarthy’s, and mine. Professors Tarjan and Ullman will be proposing work with a theory orientation in VLSI. All the signs point to this being a major research topic of the department’s within the next two or three years.
STUDENT BODY

The department currently has 114 Ph.D. students and 109 M.S. students. It continues, uniquely among the nation's Computer Science Departments, its high rate of production (approximately 16 per year) of Ph.D.s. In addition to the professional Masters Degree program focused on computer engineering, it is beginning a similar program focused on artificial intelligence. The demand for our students seems insatiable—almost like we were selling computer-based games at Christmas.

SUMMARY

So it was the best of years—awards, building, superb new faculty, equipment, and a great relationship with the boss.

Ah...yes ... there's that little problem about SPACE.

But then we had to leave something for the Advisory Committee to do!

THANKS

You should know that the department functions smoothly because of a dedicated and excellent staff:

Dennis Brown—who handles the bulk of day-to-day academic affairs

Betty Scott—my "vice president for business and finance"

Ralph Gorin—the technical director of the Department's computer facilities (Ralph also manages the LOTS computer)

Carolyn Tajnai—the Department secretary, who manages the flow of paper and students through the front office

Jonathan King—who helped us prepare the Research Report for this year.

Edward A. Feigenbaum
Chairman
Research in the Stanford Computer Science Department

Analysis of Algorithms

Research in the Analysis of Algorithms seeks greater quantitative understanding of the fundamental algorithms of computer science. It includes the development of new, efficient methods for use on computers; the analysis of the performance of important computer techniques and of the computational complexity of problems; studies of programming languages; and supporting studies in combinatorial theory.

Faculty:

Robert W. Floyd
Professor of Computer Science
Complexity Theory
Analysis of Algorithms

Broadly speaking, Professor Floyd’s current interests center on computational complexity theory and the design of efficient algorithms. He retains an interest in program verification and compiler construction. He is considering shifting his major area of interest into software systems design. Professor Floyd was named as the 1978 recipient of the prestigious Turing Award of the Association for Computing Machinery. During the academic year 1978-79, Professor Floyd spent a sabbatical at M.I.T. where he collaborated with Ron Rivest and Vaughn Pratt.

Donald E. Knuth
Fletcher Jones Professor of Computer Science
Analysis of Algorithms
Combinatorics and Discrete Mathematics

Professor Knuth’s research during the 1978-1979 year has primarily been directed toward developing the METAFONT system for the design of type fonts. This work involves interesting algorithms for digitizing two-dimensional information and for communicating millions of bits of data to “intelligent” typesetting devices at high speeds. He is developing new means of documenting computer software, and systems for the automatic typesetting of programs expressed in Algol-like languages. Another area of research, leading to a formal system for the analysis of programs (by analogy with formal systems for program verification), was also pursued in connection with graduate student Lyle Ramshaw. He helped to initiate a new journal, the Journal of Algorithms, to be published by Academic Press beginning in 1980; and he published several papers dealing with combinatorial properties of permutations. A new book “Tau Epsilon Chi” about his TEX system for mathematical typography was also published during the year. (TEX was used to prepare this report this year.)
The aim of Professor Tarjan's research is to develop efficient algorithms for combinatorial problems, to study the general properties of data structures useful in solving such problems, and to derive lower bounds on the complexity of such problems using simple but realistic computation models. Current projects include an attempt to devise new data structures for certain linear programming problems, a study of two-dimensional bin-packing, further analysis of path compression and its applications, and analysis of time-space trade-offs in a pebble game.

The major interests of Professor Yao are the analysis of algorithms and concrete computational complexity. The central theme of his research is to understand the complexity of specific computations in concrete models. Recently, his research has emphasized the probabilistic analysis of algorithms. Topics studied include a unified complexity measure of probabilistic computations, the decision-tree complexity of pattern matching for random strings, the average-case complexity of selection problems, and analysis of the expected performance of Next-Fit and First-Fit bin-packing algorithms.

Research Associates:

Luis Trabb-Pardo
Research Associate in Computer Science
Document Preparation Systems
Interactive Graphics

Dr. Trabb-Pardo is contributing to the development of the TEX and METAFONT systems of computer-aided mathematical document preparation and font definition. He has developed uniform interface techniques for a range of output devices needed from manuscript development to the production of camera-ready final copy. He is also studying uniform models for defining and managing displays for microprocessor-based interactive graphics devices.

Advanced Ph.D. Students:

Bengt Aspvall (working with Robert Tarjan).
Efficient Algorithms for Certain Linear Programming and Satisfiability Problems

John Gilbert (working with Robert Tarjan).
Graph Separator Theorems and Sparse Gaussian Elimination

Gregory Nelson (working with Robert Tarjan).
Efficient methods for program verification.

Michael Plass (working with Donald Knuth).
Typographical layout optimization.

Jeff Vitter (working with Don Knuth).
Average-case behavior of coalesced hashing algorithms.

Don Woods (working with Robert Tarjan).
Drawing planar graphs.

**Numerical Analysis**

The research in numerical analysis involves two closely related aspects: development of mathematically based theory to solve particular problems, and implementation of appropriate computer algorithms, with emphasis on programming considerations such as coding efficiency, numerical accuracy, generality of application, data structures, and machine independence. A broad library of programs to solve numerical problems is informally maintained by the numerical analysis group, in cooperation with the Stanford Center for Information Processing and the Stanford Linear Accelerator Center. The group runs a weekly series of seminars and maintains wide outside contacts, centered on an active program of visitors to Stanford.

**Faculty:**

George B. Dantzig  
Professor of Computer Science  
and Operations Research  
(Criley Chair of Transportation)  
Numerical Analysis  
Large Scale Models  
Combinatorics  
Linear Programming

Professor Dantzig is interested in the optimization of large-scale systems, particularly in the modelling and optimization of large-scale systems, in combinatorial mathematics and mathematical programming. He has been active in developing the Systems Optimization Laboratory that uses as its principal tools, numerical analysis, advanced methods of data handling, linear and non-linear programming, and systematic experiments comparing algorithms on representative models – for example energy/economic planning models. Professor Dantzig received the National Academy of Sciences Award in Applied Mathematics and Numerical Analysis for 1977; he was appointed a Vinton Hayes Senior Fellow in the Division of Applied Science, at Harvard University, 1978; and he received an Honorary Doctorate Degree from Yale University, 1978.
Gene H. Golub
Professor of Computer Science
Numerical Analysis
Matrix Computation
Structured Linear Systems
Least Square and Eigenval

Professor Golub's work has the unifying theme of matrix computation, with the aim of devising and analyzing algorithms for solving numerical problems that arise in scientific and statistical computations. He has been active in developing new numerical methods which have been incorporated into useful program libraries. Methods that are the subject of recent and current research are ones to: construct all possible matrices of specified structure with prescribed eigenvalues; update solutions when the matrix of coefficients changes by a small rank; compute a few of the extreme eigenvalues of large, sparse matrices; use the conjugate gradient method to calculate the solution of sparse systems which are similar to already solved ones; exploit linear coefficients which may enter normally nonlinear least squares problems; and solve linear least squares problems with linearly or almost linearly independent parameters. Professor Golub gave the George E. Forsythe Memorial Lecture at the SIAM National Meeting of 1978. The Lectureship, established by the ACM's Special Interest Group in Numerical Mathematics (SIGNUM), is awarded every two years for leadership in numerical mathematics. Professor Golub was also awarded the Dean's Award for Excellence in Teaching from Stanford's School of Humanities and Sciences in 1978. Professor Golub was recently named the managing editor of the SIAM journal, SIAM Journal on Scientific and Statistical Computing.

John G. Herriot
Professor of Computer Science
Numerical Analysis
Spline Functions
Partial Differential Equations

Professor Herriot is interested in the development and testing of efficient algorithms for spline interpolation. He is collaborating in this work with two students at Stanford. Algorithms for spline interpolation with fairly general end conditions are being developed. He is also interested in studying and comparing methods for numerical solution of partial differential equations.

Joseph Oliger
Assistant Professor of Computer Science
Numerical Analysis
Ordinary Differential Equations
Partial Differential Equations

Professor Oliger's research is directed toward constructing, analyzing, and implementing efficient algorithms for computing approximate solutions of time dependent partial differential equations. These equations often arise in problems in meteorology, oceanography, and geophysics. Current problems being investigated
include: finding criteria for the stability of approximations of the initial boundary value problem for hyperbolic equations which can be easily checked by engineers and scientists; comparing the efficiencies of various methods; studying adaptive methods for time dependent problems, methods for problems with different time scales, and methods for calculations with non-standard data.

James H. Wilkinson Numerical Linear Algebra
Professor of Computer Science Eigenvalue Problems

Professor Wilkinson is a member of the Stanford faculty on a one-quarter-per-academic-year basis. He has recently retired from the National Physical Laboratory in England. Professor Wilkinson is a member of the Royal Society, and he is often referred to as one of the world’s greatest numerical analysts. Among his major contributions are pioneer work on the analysis of linear algebraic equations, and this contribution has made it possible for the development of stable numerical methods for solving linear programming problems. His book, *The Algebraic Eigenvalue Problem*, is a classic. Professor Wilkinson’s recent work has been associated with the generalized eigenvalue problem which is of great importance in control theory. Professor Wilkinson is noted as an especially excellent teacher and lecturer, and as a willing collaborator with young researchers. At Stanford, he teaches one course per year and participates in the research of the Numerical Analysis group and others around campus.

**Advanced Ph.D. Students:**

Daniel Boley (working with Gene Golub).

Computing controllability/observability decompositions in linear dynamic systems.

John Bolstad (working with Joseph Oliger).

Mesh refinement for time-dependent partial differential equations.

William Coughran (working with Joseph Oliger).

Stability for variable coefficient initial boundary value problems.

Eric Grosse (working with Gene Golub).

Numerical methods in crystallography.

**Heuristic Programming Project**

The Heuristic Programming Project focuses on both theoretical and applied aspects of artificial intelligence research. The work of the group is aimed at the design of knowledge-based systems which are expert at solving problems in specific fields. The application fields have been carefully chosen both to provide a rich source of
research problems, and to advance basic research in the areas of greatest interest to the project. These areas of basic interest include the study of scientific problem solving, hypothesis induction, and theory formation. A number of highly successful long-term collaborations exist between this group and scientists in medically related fields. It is also a major group in a nationwide community of artificial intelligence research groups addressing biomedically relevant problems and sharing the SUMEX computer facility, housed at the Stanford Medical School.

**Faculty:**

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<tr>
<th>Name</th>
<th>Department and Areas</th>
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<tr>
<td>Bruce G. Buchanan</td>
<td>Heuristic Programming Project, Artificial Intelligence</td>
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<td>Scientific Inference, Biomedical Applications</td>
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<td>Edward A. Feigenbaum</td>
<td>Knowledge Engineering, Models of Scientific Problem Solving</td>
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<td>Chairman, Computer Science Department</td>
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Professor Buchanan is exploring problems of scientific inference, theory formation, and knowledge acquisition by computer. He was a major contributor to the heuristic search model of scientific inference in the DENDRAL program, which provides explanations of analytic data in organic chemistry. He is building on this with the METADENDRAL program, which finds regularities in large sets of data and proposes general principles to account for them. Professor Buchanan's interest in biomedical applications of artificial intelligence has led to interdisciplinary projects at the Medical School, including work on the MYCIN program whose goal is to provide computer assisted therapy consultation. Aspects of this work include: representing knowledge in production rules, reasoning about complex and uncertain situations, explaining the line of reasoning, and acquiring new knowledge. This research is being extended to a domain-independent system, called EMYCIN ("essential MYCIN"). MYCIN research is also being extended to the understanding of tutorial dialogues and their application to teaching about drug therapy in MYCIN's area of competence. Professor Buchanan was named Program Chairman of the 1979 International Joint Conference on Artificial Intelligence (Tokyo). He is on the editorial boards of Artificial Intelligence and the IEEE Transactions on Pattern Recognition and Machine Intelligence.

Professor Feigenbaum has played a major role in organizing the Heuristic Programming Project and involving it in applications drawn from scientific and medical domains. He has recently been active in starting several new research projects in the
broad area of modelling scientific problem solving. These are in the areas of experiment planning in molecular genetics; structure determination in protein crystallography; and pulmonary function diagnosis and treatment. Professor Feigenbaum is also greatly interested in making the results of artificial intelligence research accessible and usable to those outside the field. He is directing the writing of an "AI Handbook" which will organize the concepts, methods, and techniques of artificial intelligence in encyclopedia form. He is involved in an analogous project in software, the AGE project, whose goal is to provide software packages to aid the construction of expert computer programs by people other than artificial intelligence researchers. As department chairman, Professor Feigenbaum has overseen the move to new quarters in the Stanford Quadrangle and has played an important part in improving the level of computing facilities available in the department.

Joshua Lederberg  
Artificial Intelligence  
President, The Rockefeller University (NYC)  
Machine-Aided Inference in Experimental Science

Professor Lederberg’s research interests are rooted in his experimental work in molecular biology, but for many years he has been investigating ways in which computer science could be used to support the work of the laboratory investigator in the cognitive domain. His concrete efforts in this direction include the DENDRAL and MOLGEN programs within the Heuristic Programming Project. At the present time, his main interest in computer science is how to represent formal and informal knowledge in the field of molecular genetics so as to facilitate machine induction of new hypothetical principles to be tested in the laboratory. This work is proceeding in the MOLGEN project. Program tools for constructing large knowledge bases representing genetic concepts, laboratory transformations and strategies have been built. The next step will be to test these tools on sample problems drawn from contemporary research in the genetics laboratory. Eventually, it is hoped to have a set of programs which can assist the working geneticist in planning experiments and generating new hypotheses. In addition to his work with MOLGEN, Professor Lederberg was the founding principal investigator of the SUMEX-AIM computer resource and will continue as an associate to Professor Feigenbaum’s leadership for this national community of artificial intelligence researchers with biomedical interests who use it.

Douglas B. Lenat  
Models of Discovery  
Assistant Professor of Computer Science  
Knowledge Representation

Professor Lenat is conducting research on the processes and knowledge used to suggest and test new discoveries in science, particularly in elementary mathematics. He has developed a line of computer programs which contain rules for
analogic and inductive reasoning to direct an exploration of the space of theorems of number theory. As part of his investigations of discovery, he has studied various knowledge representation methods, such as production rules, cooperating expert knowledge sources, and frame-like entities referred to as "beings". Professor Lenat is now trying to expand his work on scientific discovery to the domain of molecular genetics.

Research Associates:

Harold Brown
Research Associate in Computer Science
Expert Systems
Applications in VLSI Design

Dr. Brown is currently developing intelligent systems to assist in the design of very large scale integrated circuits (VLSI). His specific aim is to create a high performance, technology independent, knowledge based program to generate automatically the layout of a custom integrated circuit from a cell-based, symbolic layout of the circuit. A longer range goal is to develop layout programs which accept more abstract inputs, such as circuit schematics.

S. Jerrold Kaplan
Research Associate in Computer Science
Computational Linguistics
Intelligent query systems

Dr. Kaplan's primary interest is in computational aspects of the pragmatics of Natural Language. His area of application is the development of domain-transparent techniques for producing cooperative and informative responses to Natural Language database queries. Such responses increase the functionality and efficiency of database query systems, and are particularly useful when a user has made incorrect assumptions about the nature of the domain. Other research includes the design of flexible user interfaces for medical knowledge-base systems and real time digital music synthesis.

H. Penny Nii
Research Associate
Multiple Sources of Knowledge
Biomedical Applications

Ms. Nii was responsible for the system design and implementation of a major project concerning the application of heuristic techniques to signal understanding (passive sonar). She is the originator and currently the group leader of the AGE Project, an attempt to cumulate AI tools and aid users in the design of knowledge-based programs. Her primary interests include problems in the organization and utilization of multiple sources of knowledge and in problem solving, improving user interfaces to computers, and design as a problem solving task.
James G. Nourse  
Research Associate in Chemistry  
Heuristic Programming  
Chemistry Applications

Dr. Nourse's current research concerns adding stereochemical (three dimensional) information into the DENDRAL programs. Those programs were developed with a very limited concept of chemical molecules. They were represented as two dimensional graphs, whose only important feature was the type and connectivity of nodes. In actual chemistry, the three dimensional molecular structure plays a crucial role in determining many properties. Thus, there is a need for introducing this factor to get more effective heuristics in structure generation programs using chemical constraints for pruning.

Dennis H. Smith  
Research Associate in Chemistry  
Chemistry Applications

Dr. Smith has been associated with the DENDRAL project since 1971. His activities have included participation in both development of DENDRAL and Meta-DENDRAL programs and applications of these programs to chemical problems. His participation in program development has been in the role of designer and end-user, thus bridging the gap between the producers of such systems (e.g., CONGEN, REACT, STEREO and Meta-DENDRAL, with Drs. Carhart, Varkony, Nourse and Buchanan) and their applications to diverse problems in his own work and that of others in the chemical community. His studies have included applications of the programs to instrumental analysis and structural problems in metabolic chemistry, environmental chemistry and natural products of biological importance. His current work is involved with design of semi-automated systems for the chemical laboratory in which computer programs assist chemists in analysis and interpretation of spectroscopic and chemical data gathered on unknown molecular structures.

Advanced Ph.D. Students:

Janice Aikins (working with Bruce Buchanan and Ed Feigenbaum).  
Using prototypes to guide goal-directed reasoning in knowledge-based systems.

Avron Barr (working with Ed Feigenbaum).  
A knowledge-based program that knows what it doesn't know: acquiring metalevel knowledge.

Bob Blum (working with Ed Feigenbaum in an interdisciplinary program).  
Inferring new medical knowledge from large clinical data banks, using a frame-based knowledge base.

Chuck Clanton (working with Bruce Buchanan).
Medical reasoning, physician problem-solving, and the impact of knowledge-based computer systems.

Lawrence Fagan (working with Ed Feigenbaum and Bruce Buchanan).
Representation of dynamic clinical knowledge: measurement interpretation in the intensive care unit.

Peter Friedland (working with Ed Feigenbaum).
Applications of artificial intelligence to molecular genetics.

Jonathan King (working with Ed Feigenbaum and Bruce Buchanan).
The use of domain semantics for efficient retrieval from very large databases.

John Kunz (working with Ed Feigenbaum).
Knowledge engineering in clinical decision making.

Mark Stefik (working with Bruce Buchanan).
Knowledge-based system for planning experiments in molecular genetics.

William Van Melle (working with Bruce Buchanan).
A domain-independent development system for creating efficient rule-based expert systems.

Systems

Systems research in the Computer Science Department spans many different topics and takes place in many different settings. For example, program verification and processor design research take place in the Artificial Intelligence Laboratory. The greatest concentration of systems research takes place within the Computer Systems Laboratory, a joint laboratory of the Departments of Computer Science and Electrical Engineering. Major areas of interest include reliability, networks, data bases, and concurrent programs. The systems faculty revised the software curriculum in Spring '78 for the 1978-1979 academic year. They revised the hardware curriculum in Spring '79 for the 1979-80 academic year. [Some of the faculty members listed here are officially in the Electrical Engineering department rather than Computer Science].

Faculty:

Forest Baskett
Operating Systems
Assistant Professor of Computer Science
Performance Evaluation
and Electrical Engineering
Computing System Organization

Professor Baskett is interested in the design and analysis of computing systems and computing system components. He is also interested in designing and developing display oriented personal computing systems in a scientific networking environment, including a multiprocessor computing engine. Another area of his interest is computing system design for VLSI and VLSI design systems.
The emphasis of Professor Flynn's work is on computer architecture and organization, especially interpretive computer design. An emulation laboratory has been built to aid in the study of both physical and conceptual processors and the basic characteristics of "optimal" instruction processors. Central to the laboratory is the EMMY machine, which can emulate a wide range of architectures. Other areas of research include memory hierarchy design, understanding and modelling program behavior, and studying characteristics of parallel processors such as limits on their performance.

Professor Hennessy's primary interest is in the area of programming methodology and programming language design. He is investigating programming language features which support the construction of reliable software. Professor Hennessy is also interested in the special problems of software design in the operating systems environment. Currently, he is investigating the problems of software construction for distributed systems.

Dr. Luckham directs the Program Analysis and Verification Group at the Artificial Intelligence Laboratory. The work of this group is largely devoted to developing new programming languages and automated aids to programming. The group has implemented a verifier for a nearly complete version of the Pascal programming language. The verifier is currently being run at Stanford and six other research laboratories to test its portability and to obtain some preliminary feedback from different user groups. A user manual is available. A special version of this verifier for automatic detection of runtime errors in programs has also been implemented. The success of the verifier depends on recent advances made by Dr. Luckham's group in theorem proving, specifically the theory and implementation of cooperating special purpose decision procedures. Such systems are the best method of constructing theorem provers that has been found to date. It is expected that such theorem provers will play an important role in the implementation of sophisticated analysis and decision programs in application areas other than program verification. The group is working on a concurrent systems programming language. Aspects of this project include language design, programming techniques for parallel processes,
theory of documentation of concurrent systems, and implementation of a verifier
and compiler for a subset of Ada that includes multi-tasking. Other staff members
of the Group include Dr. Derek Oppen and Dr. Friedrich Von Henke.

Edward J. McCluskey
Professor of Computer Science
and Electrical Engineering

Computer Architecture
and Organization
Multiprocessor Systems
and Logic Design
Design for Testability
and Testing Theory
Fault-Tolerant Computing

Professor McCluskey is concerned with the development of insight into the ar-
chitecture and implementation of computer systems for which the reliability,
availability, and maintainability are important as well as the cost and performance.
Of particular importance are the development of measures that combine both the
performance and reliability aspects of the system. These measures are then used to
evaluate existing designs in order to develop an understanding of the good features
and to invent new features and designs. Special attention is currently being paid
to the problem of designs which are easily tested. A quite different area of research
involves the development of techniques for designing IIL circuits which operate
with four rather than two signal levels. Professor McCluskey was the founder of
the Digital Systems Laboratory and is currently the Director of its Center for
Reliable Computing which includes the research of four faculty members as well
as a number of students and research associates.

Susan Owicki
Assistant Professor of Electrical Engineering
Program Verification
Concurrent Programs
Operating Systems

Professor Owicki’s main research interest is the verification of concurrent programs
of the sort found in operating systems, computer networks, and large data base
systems, where the criteria for correctness are more varied than in sequential
programs. She is attempting to develop a clear understanding of these criteria and
to find proof techniques for verifying that they are satisfied. A related interest
is the design of programming languages for concurrent programs, and the effects
of language on program design and verification. Professor Owicki is currently
investigating the design of a verifiable operating system and verifiable protocols for
distributed data base systems. She received the 1977 ACM Systems and Languages
Paper Award for the paper "An Axiomatic Proof Technique for Parallel Programs",
coauthored with David Gries.
Fouad Tobagi
Assistant Professor of Electrical Engineering

Professor Tobagi’s major interests are in the area of the mathematical modelling, analysis, and optimization of computer systems, data communications systems, and computer networks. He has participated in the design, analysis, and measurement of the ARPA Packet Radio Network. Currently, he is investigating a variety of questions concerning radio packet switching, and the performance of real time transmission protocols in environments consisting of interconnected networks.

William M. van Cleemput
Assistant Professor of Electrical Engineering

Professor van Cleemput’s interests are in the area of digital systems design, with a special emphasis on providing computer aids to designers. His current research concentrates on various aspects of the circuit layout problem: generating logic diagrams, flow charts, printed circuit board designs, and integrated circuit layouts. The aim of the current research project is to develop automated layout techniques that produce acceptable designs in a short period of time so that they will be economically competitive with existing manual methods and will permit the introduction of the newest technology circuits in a shorter time. Another area of interest is digital design languages. The current tendency in hardware design is no longer to build and test a prototype, but rather to describe a design in a suitable language and to validate this description at various levels of detail. Most design languages today allow description of a system at a single level of detail only (the register-transfer level), while most validation is done through extensive simulation. The aim of this research is to provide description capabilities at various levels of detail and to perform design validation without simulation, where this is feasible.

Gio Wiederhold
Assistant Professor of Computer Science

Professor Wiederhold’s chief interest is the design of useful computer systems. Activities in this rather broad topic range from formalizations to gain a better understanding of the capabilities of future systems to the application of modern software design techniques to current hardware. He is particularly interested in applications which are of a size or complexity which is not easily handled by current computer systems so that a quantitative engineering analysis is warranted prior to implementation. Professor Wiederhold’s current research activities include: conceptual database models as the basis for a database query and update processing interface; the development of the use of AI techniques in database access; operating
system services to support modern database systems; the further development of several medical and planning database projects; and the investigation of the interaction of alternative multiprocessor architectures with several classes of large computing problems drawn from artificial intelligence, distributed databases, and numerical analysis.

**Advanced Ph.D. Students:**

Richard Carr (working with John Hennessy)
Paging Algorithms in Interactive Systems

Ramez El-Masri (working with Gio Wiederhold).
Data model design and integration using the structural database model.

Erik Gilbert (working with Gio Wiederhold).
Effective operating system design for a high-performance multiprocessor.

Brent Hailpern (working with Susan Owicki).
Verification of concurrent processes using temporal logic.

Sassan Hazeghi (working with Forest Baskett)
Analysis in Optimization of Compiled Code

Richard Karp (working with David Luckham).
Mechanical verification of operating systems.

Thomas McWilliams (working with Forest Baskett).
Verification of Timing Constraints in Large Digital Systems

Michael Powell (working with Forest Baskett)
The Role of Buffering in File System Performance

Terry Roberts (working with Tom Moran at Xerox Palo Alto Research Center).
Evaluation of text editors.

David Wall (working with Susan Owicki).
Selective broadcast algorithms for packet-switched networks.

L. Curt Widdoes (working with Forest Baskett).
Performance analysis of lookahead computers: the S-1 Mark I and Mark IIA

Clark Wilcox (working with Michael Flynn).
A high-level language emulation.
Research at the Stanford AI Laboratory consists of a number of related research projects, with both basic and applied research objectives. Current projects include basic research in artificial intelligence and formal reasoning, image understanding, mathematical theory of computation, program verification, natural language understanding and knowledge-based programming. The Lab is also a center for computer systems research supporting the basic AI research.

Faculty:

Zohar Manna
Professor of Computer Science

Mathematical Theory of Computation
Logical Analysis and Synthesis of Programs
Semantics of Programs

The aim of Dr. Manna's research is to develop the mathematical theory of computation and to make its results accessible to practical application. The theoretical aspect of this research involves the mathematical explication of computational phenomena. For example, various techniques have been developed and formalized for proving as theorems properties of computer programs. A special mathematical model, the "fixedpoint" theory, has been employed for studying the properties of recursive programs. Abstract programs, each representing a class of concrete programs, have been studied as a tool for comparing the power of various programming language features. The practical aspect of this subject relates to the mechanical verification of computer programs. Efforts have been made to find relationships between existing verification methods and to develop new methods. Related efforts are intended to lead to the automation of many of the processes a programmer usually performs by hand, such as debugging, documentation, modification, and optimization. An ultimate goal of this research is the development of synthesis techniques, by which the entire programming task is performed automatically.

John McCarthy
Professor of Computer Science

Formal Reasoning
Mathematical Theory of Computation

Professor McCarthy has worked in the area of formal reasoning applied to computer science and artificial intelligence since 1957. He has recently developed a technique for completely characterizing LISP and other recursive programs within first order logic by supplementing Cartwright's first order form of the functional equation by a minimization schema. This technique is well suited to automatic proof checking, and in collaboration with Cartwright and Stanford students Professor McCarthy is
exploiting this breakthrough by verifying more complex programs directly within first order logic. In addition many of the standard program verification techniques can be represented by axiom schemas in this system. Recently McCarthy has discovered how to represent facts about knowledge and belief in unmodified first order logic and the solution works no matter how many mental qualities must be treated. He has also recently discovered that an axiom schema of first order logic called a minimization schema can be used to represent in a flexible way the conjecture that the entities that can be shown to exist on the basis of the information in a certain data base are all the relevant entities that exist. This conjecture is a common feature of human reasoning. Professor McCarthy has investigated continuous functionals that don’t arise from simple recursive programs. Some of them require parallel evaluation, and the work may lead to a treatment of program correctness that unifies parallel programs with the more usual sequential programs. In 1979 McCarthy developed a new formalism called "Elephant" for expressing sequential programs as sentences in first order logic. The formalism permits programmers to avoid defining some data structures by referring explicitly to the past. In addition to his research activities, Professor McCarthy directs the LOTS interactive computer facility for computer science and other course work. In the academic year 1979-80 McCarthy will be on leave at the Center for Advanced Studies in the Behavioral Sciences where he will chair a working group on artificial intelligence and philosophy.

Terry Winograd
Assistant Professor of Computer Science

Natural Language Understanding
Knowledge Representation Linguistics

Professor Winograd's research during 1978-79 was in three areas: knowledge representation; linguistic and cognitive theory; and human interaction with computers. He continued work on the development of KRL (Knowledge Representation Language) in collaboration with researchers at the Xerox Palo Alto Research Center. A second version of KRL has been implemented and is now being evaluated in an experimental application. In linguistic theory, Professor Winograd is continuing to develop his point of view of language understanding as an activity depending on process and context, rather than as the static phenomenon described by analytic linguists. The notions of process and context range across many aspects of language and cognition. Some of the ideas in this area, especially the philosophical underpinnings, are being developed together with Fernando Flores, a former minister of the Chilean government and research associate in the Stanford Communications department. The third area of Professor Winograd's recent work concerns making computers easier to use, both for programmers and non-professionals who inter-
act with computer systems. He has examined better ways to express computing concepts than have been possible with traditional kinds of programming languages.

Research Associates:

Thomas Binford  
Research Associate in Computer Science

Dr. Binford has led the computer vision and robotics group at the AI lab. During the past year, he has developed an analytic model of stereo vision, developed a quasi-optimal path calculation analysis for manipulators, led the design and implementation of a model-based vision system, and participated in research on an edge-based stereo system. The research group has completed the AL system for assembly, force control software for AL, force sensor interfacing, and developed an interactive programming system related to AL, called POINTY. They have made a high level object modeling and graphics system based on generalized cone representation, and a stereo vision system. Dr. Binford plans to extend the research described above in the areas of stereo vision and shape representation. The robotics group will extend its research to advanced programming systems which use parts representation in problem-solving systems for planning assemblies. Work will begun in research to aid handicapped persons. Research is supported for applications in manufacturing, planetary exploration, and photointerpretation.

Lewis G. Creary  
Research Associate in Computer Science

During the past year, Dr. Creary has worked in the Formal Reasoning Group, on epistemological problems of Artificial Intelligence. He has designed an improved logic-oriented language for representing information about propositional attitudes such as belief and desire, and a related computational approach to reasoning about such information. He is presently implementing these theoretical developments in a knowledge-based problem solver that will focus on commonsense problems whose solution requires explicit reasoning about the knowledge and goals of presumably rational agents. One goal of this implementation effort is to bring recently developed constraint-propagation techniques for hierarchical planning into a logical framework that will permit a more systematic approach to the reasoning involved in such techniques. Other areas of current interest to Dr. Creary include the representation and use of uncertainty information in AI programs, and design principles for a general intelligence.
Sid Liebes
Research Associate in Computer Science
Robotics Vision

Dr. Liebes has recently joined the robotics group. His recent experience is in the design and development of interactive computer-based stereo topographic analysis systems. His interests include the automation of stereo correspondence in both narrow and wide angle stereo imagery, and the analysis of higher level stereo interpretive problems.

Derek C. Oppen
Research Associate in Computer Science
Program Verification

Dr. Oppen's main interest is in developing techniques for reasoning about programs and the data structures they manipulate. A primary goal has been to design a simplifier, or theorem-prover, for efficiently simplifying expressions and formulas over the sorts of data structures typically found in programming languages. Related work includes obtaining decidability results and complexity bounds for various theories of data structures, investigating the role of parallelism in theorem proving, and designing efficient pattern matching algorithms for dynamically changing data bases. Dr. Oppen is also interested in various theoretical aspects of program verification and semantics, for instance, in extending programming logics to handle types and run-time interrupts.

Friedrich W. von Henke
Research Associate in Computer Science
Program Verification

Dr. von Henke's principal interest is in program verification as part of a methodology for developing reliable software. His work is concerned with analysis and development of specification and verification techniques and their application in program development; it includes investigating program transformations and data structures. Related areas of interest are mathematical theory of computation and mechanical program generation. Dr. von Henke is also involved in design of programming languages for and implementation of concurrent systems.

Richard Weyhrauch
Research Associate in Computer Science
Mathematical logic

Dr. Weyhrauch is in charge of the work on FOL, an interactive proof generator for First Order Logic proofs. One purpose of this work is to see if traditional ideas about formal systems are of any use to AI. There have been several major accomplishments over the past year. FOL now has a powerful evaluator for first order expressions. This uses an improved semantic attachment facility. For any particular theory, FOL now provides a suitable meta theory. This, together with the use of reflection principles, allows a user to implement any subsidiary deduction
rules he chooses. These features are currently being used to demonstrate how it is possible to build theories of theory building, i.e. we can reason not only about objects, but we can also reason about how we make theories of these objects. This kind of meta reasoning has far reaching consequences for AI. For example, we can reason about the control structures of routines that search for theorems. Another area of current research is perception. The question is: how can we get from sense data the theories of the world. There are several projects involved with this question. A third area of interest is in mathematical theory of computation. Here the attempt is to develop a recursion theory of LISP and to create a single unified environment in which we can both the evaluate programs and prove properties of the functions they define.

**Advanced Ph.D. Students:**

Doug Appelt (working with Terry Winograd)
Planning natural language utterances to satisfy multiple goals.

R. David Arnold (working with Tom Binford).
Automated stereo perception.

Martin Brooks (working with Zohar Manna).
Automatic debugging of LISP programs.

Rodney Brooks (working with Tom Binford)
Model-Based Vision

Robert Elschlager (working with Cordell Green).
Assimilation of natural language program descriptions.

Anne Gardner (working with Terry Winograd).
A legal reasoning program.

Richard Gabriel (working with Terry Winograd and Cordell Green).
Automatic explanation within a program synthesis system.

Don Gennery (working with Tom Binford).
The use of computer stereo vision in modelling the environment of an exploring vehicle.

Chris Goad (working with G. Kreisel, Department of Philosophy).
The computational content of proofs.

Ron Goldman (working with Tom Binford)
Geometric and spatial representation of objects in the domain of mechanical assembly.
David Levy (working with Terry Winograd).
   Modeling discourse comprehension: an exploration of the syntax of linguistic thought.

Paul Martin (working with Terry Winograd).
   Resource-limited understander for goal directed dialogues.

Larry Masinter (working with Terry Winograd).
   A program is not its listing II programming systems which are uncommitted to factorization according to object or process.

Brian McCune (working with Cordell Green).
   Building program models incrementally from informal descriptions.

Hans Moravec (working with John McCarthy).
   Obstacle avoidance by computer vision.

Jorge Phillips (working with Cordell Green).
   Knowledge-Based Algorithm Development

Wolfgang Polak (working with David Luckham).
   Theory of compiler specification and verification.

William Scherlis (working with David Luckham).
   Topics in program transformation.

Louis Steinberg (working with Cordell Green).
   Dialogue moderator for an automatic program synthesis system.
Graduates 1978-79

**Ph.D. degrees**

**Winter 1978**

Alan Borning "A System for Building Simulations Using Constraints" advisor: Winograd.


Mitch Model "Monitoring System Behavior in a Computational Environment" advisor: Winograd.

**Spring 1978**


Elaine Kant "Efficiency Estimation: Controlling Search in Program Synthesis" advisor: Green.

Lyle Ramshaw "Verifying Program Performance by Formalizing the Analysis of Algorithms" advisor: Knuth.

**Summer 1979**

William Clancey "Transfer of Expertise by an Intelligent Tutor" advisor: Buchanan.

William Lesser "Synthesis of Recursive Programs" advisor: Green.

Thomas Lengauer "Upper and Lower Bounds for Time-Space Tradeoffs" advisor: Tarjan.


John Shoch "Design and Performance of Local Computer Networks" advisor: Wiederhold.

David Wilkins "Using Patterns and Plans to Solve Problems and Control Search" advisor: McCarthy.

**Masters Degrees**

**Autumn 1978**

Wendy Pelkes

Armando Rodrigues

**Winter 1979**

Fernando Castaneda-Ramos

Harold Deering

Thomas Pressburger

Madeleine Shaw

**Spring 1979**

James Bennett

Gregory B. Ennis

James B. Garvin

Thomas Gross

Fabrice Pierre Laurens

David E. Menicacy

Alain Moot-tham

Hirosaki Nakashita

Yoshikio Okay

Thomas Rogers

Harold Westphal

**Public Lectures 1978-79**

9/26/78 CS Colloquium 8. Jerrold Kaplan (University of Pennsylvania) "Cooperative Responses to a Natural Language Data Base Query System"

9/27/78 NA Seminar Alexander Chorin (University of California, Berkeley) "Advection Algorithms With Applications to Flame Theory"

9/27/78 CSL Seminar Charles Neuhauser (Computer Systems Laboratory, Stanford) "The Stanford Simulation Laboratory"

9/28/78 CS200 Denny Brown (Stanford Computer Science Department) "Research in the Stanford Computer Science Department"

10/3/78 AI Colloquium Richard Weyrauch (Stanford AI Laboratory) "Some Ideas about Perception"

10/3/78 CS Colloquium Don Knuth (Stanford Computer Science Department) "Mathematical Typography"

10/4/78 NA Seminar Margaret Wright (Department of Operations Research) "Some Issues in the Design and Implementation of Optimisation Algorithms"

10/4/78 CSL Seminar Dr. H. P. Sherman Lee (Amdahl Corporation) "Amdahl 470 V/8 and its Execution Unit"

10/5/78 CS200 Don Knuth (Stanford Computer Science Department) "Introduction to Analysis of Algorithms"

10/5/78 Special Public Lecture in CS319B Carl Hewitt (MIT) "Some Controversial Conjectures in the Semantics of Concurrent Systems"

10/9/78 AI Colloquium Richard Waddington (SRU-International) "A Deductive Approach to Program Synthesis"

10/10/78 CS Colloquium John McCarthy (Stanford Computer Science Department) "Computing in China and the Far East"
10/11/78 NA Seminar Michael Overton (Stanford Computer Science Department) "Step-length Algorithms for Minimising a Class of Non-Differentiable Functions"

10/11/78 CSL Seminar George O'Leary (Floating Point Systems, Inc.) "High-Speed Computer System Design"

10/12/78 CS200 Gene Golub (Stanford Computer Science Department) "Numerical Analysis at Stanford"

10/16/78 AI Colloquium Bob Eichler (Stanford Computer Science Department) "Programming in English"

10/17/78 CS Colloquium Prof. John Rice (Purdue University) "Software for Numerical Computation"

10/18/78 CSL Seminar Dr. Jack Grimes (Tektronix, Inc., Beaverton, Oregon) "Stack Machines: What are they?"

10/18/78 CS200 John McCarthy (Stanford Computer Science Department) "Research at the Stanford AI Lab"

10/24/78 CS Colloquium Professor Donald Michie (University of Edinburgh) "Computable Sub-games of Chess"

10/24/78 NA Seminar Richard Goodman (University of Miami) "Modelling Computer Arithmetic"

10/25/78 NA Seminar W. G. Strang (MIT) "Quadratic Programming, Quasi-Newton Methods and Non-linear Mechanics"

10/25/78 CSL Seminar Prof. P. A. Tobagi (Computer Systems Laboratory) "On the Design and Performance Analysis of Multipath Packet Radio Systems"

10/26/78 CSL Seminar Barry W. Halsey (MIT) "A New Strategy for Multilevel Memory"

10/29/78 CS200 Terry Winograd (Stanford Computer Science Department) "KRL and Natural Language Research"

10/31/78 CS Colloquium Joseph Traub (Carnegie Mellon (Visiting UC Berkeley)) "Fast Algorithms for Power Series Manipulations"

11/1/78 CSL Seminar Dr. John Palmer (Intel, Santa Clara) "A Proposed Standard for Floating Point Arithmetic"

11/2/78 CS200 Mike Flynn (Stanford Computer Science Department) "The Computer Systems Lab"

11/5/78 Forsythe Lectures Michael Rabin (Israel) "The Benevolence of Chaos - I"

11/9/78 AI Colloquium Curt Widgowe (Stanford Computer Science Department) "The S-1 Multi-Processor"

11/7/78 CS Colloquium Ole-Johan Dahl (University of Oslo) "Time Sequences Applied to Program Description"

11/8/78 NA Seminar Peter Henrici (ETH, Zurich, and Stanford) "Why Does Backward Recurrence Work?"

11/8/78 CSL Seminar Dr. Gary Tsijdm (UNIVAC, Blue Bell, Pennsylvania) "CPU Design with VSLI"

11/9/78 Forsythe Lectures Michael Rabin (Israel) "The Benevolence of Chaos - II"

11/9/78 Analysis of Algorithms Lunch Ruediger Reischuk (Fakultat Fur Mathematik, Univ. Bielefeld, Bielefeld, West Germany) "On the Relation Between Pathlengths in Graphs and Turing Machine Complexity"

11/9/78 CS200 Ed Feigenbaum (Stanford Computer Science Department) "The Heuristic Programming Project"

11/13/78 AI Colloquium R.C.T. Lee (National Tsing Hua University) "The Stationary Probabilities of the Transposition Heuristic and the Moving to the Front Heuristic for Sequential Searching"

11/14/78 CS Colloquium Paul Armer (Charles Babbage Institute) "The Problem of Obsolescence of Knowledge of the Computer Scientist"

11/15/78 NA Seminar Ake Bjork (Linkoping University, Sweden) "On Conjugate Gradient Methods for Solving Sparse Linear Least Square Problems"

11/15/78 CSL Seminar Dr. David Crockett (Hewlett-Packard Company, Santa Clara) "Design Considerations for the HP 300 (AMIGO) Computer System"

11/18/78 CS200 Soheir Mansa (Stanford Computer Science Department) "Aspects of the Logic of Programming"

11/20/78 AI Colloquium Terry Winograd (Stanford Computer Science Department) "Artificial Intelligence / Cognitive Science: Where Are We Headed?"

11/21/78 CSL Seminar Cleve Moler (Visiting Professor, Stanford 78-79) "Matrix Algorithms and Digital Image Processing"

11/22/78 NA Seminar Linda Petzold (Sandia Laboratories) "An Efficient Method for Highly Oscillatory Ordinary Differential Equations"

11/27/78 NA Seminar Giovanni Moncato (Istituto di Calcoli Numerici, University of Turin) "Numerical Quadrature"

11/27/78 AI Colloquium Chris Goad (Stanford Computer Science Department) "Interpreting and Compiling Proof/Program Hybrids"

11/27/78 Seminar in Combinatorial Mathematics Prof. David Matula (Southern Methodist University) "Subtree isomorphism and Packing"

11/28/78 CS Colloquium David W. Matula (Southern Methodist University) "Fixed-Slash and Floating-Slash Arithmetic"

11/29/78 NA Seminar Anne Greenbaum (Lawrence Livermore Laboratory) "A Basis for Comparison of Conjugate Gradient Methods"

12/3/78 CSL Seminar Ray W. Sanders (Computer Transmission Corporation) "The Challenge of Applying New Microcomputer Technology to Distributed Data Processing and Computer Networks"

11/30/78 CS200 Forest Baskett (Stanford Computer Science Department) "Multiprocessing - Design and Analysis"
12/4/79 Ph.D. Oral Alan Borning (Stanford Computer Science Department) "A System for Building Simulations Using Constraints"

13/4/79 AI Colloquium Juan Buitres (Stanford Computer Science Department) "A Goal Command Language for the First-Order Logic Proof Checker"

12/5/79 Ph.D. Oral Juan Buitres (Stanford Computer Science Department) "A Goal Command Language for the First-Order Logic Proof Checker"

12/5/79 CSL Colloquium Terry Winograd (Stanford Computer Science Department) "Beyond Programming Languages"

12/6/78 NA Seminar Mitch Smooke (Sandia Laboratories) "Piecewise Perturbation Series Solutions of the Radial Schroedinger Equation"

12/6/78 CSL Seminar Dr. Ed Miller (Software Research, San Francisco) "Software Testing"

13/7/79 CS200 Tom Binford (Stanford Computer Science Department) "The Robotics Projects at Stanford"

13/11/78 AI Colloquium Red Brooks (Stanford Computer Science Department) "ACRONYM: A Model Based Vision System"

1/8/79 NA Seminar C. Van Loan (Cornell University) "Total Least Squares"

1/9/79 CS Colloquium Vaughan Pratt (MIT) "An Algorithm for Software Engineers"

1/10/79 NA Seminar C. W. Gear (University of Illinois) "Practical Theoretical Development in Numerical Integration"

1/10/79 CSL Seminar Al Despain (University of California, Berkeley) "X-Tree: A Hierarchical Multi-Processor System"

1/18/79 CS Colloquium Dr. Ronald Fagin (IBM San Jose) "Extendible Hashing: A fast access method for dynamic files"

1/17/79 NA Seminar Stan Jensen (Lockheed Research) "Studies in Iterative Techniques for Large Symmetric Eigenproblems"


1/23/79 CS Colloquium Heinz Von Foerster (University of Illinois) "Biological Computer Lab at the University of Illinois"

1/17/79 NA Seminar H. Wosniakowski (University of Warsaw and UC Berkeley) "Optimal Algorithms for Numerical Problems"

1/17/79 CSL Seminar Dr. Roy L. Rusko (IBM Corporation) "The Impact of VLSI on Design and Design Automation"

1/30/79 CS Colloquium Prof. Humberto Maturana (University of Chile) "Intelligence of Intelligence"
3/7/79 CSL Seminar William R. Crowther and Severo M. Ornstein (Xerox PARC) "Paralyzing Programs"


3/14/79 NA Seminar David Yun (IBM Research and Stanford) "Fast Algorithms for Toeplitz Systems, Pade Approximants and Euclidean Algorithms"


3/22/79 Robotics Seminar Prof. T. Kanade (Kyoto University, Japan) "Positive and Negative Chairs: How to recover 3d shape from a single picture"

3/29/79 Special Seminar Prof. Jeff Ullman (Princeton Univ.) "Design Theory for Relational Databases"

3/29/79 Algorithms for Lunch Bunch Prof. Ed Loftman (Univ. of California at Santa Barbara) "Two-Dimensional Bin-Packing Algorithms"

4/4/79 NA Seminar Oscar Buneman (Stanford EE Department) "Tetrahedral Finite Elements and Interpolation"

4/10/79 CS Colloquium David Yun (IBM) "Indefinite Integration - A Decision Procedure"


4/11/79 CSL Seminar Prof. Stanton A. Glantz (Cardiovascular Research Institute, UCSF) "Computers in Medicine"


4/17/79 CS Colloquium Doug West (Stanford Computer Science Department) "Parallels Between Optimization and Extremal Combinatorics"

4/18/79 NA Seminar Randolph Bank (The University of Texas at Austin) "Multi Grid Methods"

4/18/79 PHD Oral Hector Garcia Molinas (Stanford Computer Science Department) "The Design of Update Algorithms for Distributed Databases"

4/18/79 CSL Seminar Prof. Charles Wetherell (Dept. of Applied Science, Univ. of Calif., Davis) "Dataflow: Architecture and Language"

4/23/79 AI Colloquium Shahid Mjtahaj (Stanford) "AL Manipulator Language"

4/24/79 PHD Oral Elaine Kent (Stanford Computer Science Department) "Efficiency Considerations in Program Synthesis: A Knowledge-Based Approach"

4/24/79 CS Colloquium Professor David Huffman (U.C. Santa Cruz) "A Scientist Looks at the Art of Paperfolding"

4/25/79 PHD Oral Lawrence M. Fegan (Stanford Computer Science Department) "Representation of Dynamic Clinical Knowledge: Measurement Interpretation in the Intensive Care Unit"

4/25/79 NA Seminar Dan Sorensen (University of Kentucky) "Collinear Scaling Algorithms for Unconstrained Optimisation"


5/1/79 CS Colloquium John McCarthy (Stanford Computer Science Department) "The Elephant (It Never Forgets) Programming Language"

5/2/79 CSL Seminar Prof. Gary Lindstrom (University of Utah) "Referencing and Retention in Block-Structured Coroutines"

5/3/79 PHD Oral Lyle Ramshaw (Stanford Computer Science Department) "Verifying Program Performance by Formalising the Analysis of Algorithms"

5/3/79 SRI AI SEMINAR Richard Weldinger (SRI) "Program Synthesis: A Deductive Approach"

5/8/79 Program Verification & Analysis Seminar Michael Jenkins (Queen's Univ. & IBM Cambridge Scientific Center) "Array Theory - An Introduction"

5/9/79 CS Colloquium Prof. C. West Churchman (School of Business Administration, UC-Berkeley) "Systems Approach and Its Enemies"

5/9/79 CSL Seminar Dr. Andrew Heller (IBM, San Jose) "Microprogramming and Microprogramming in Large Computer Systems"

5/10/79 SRI AI Seminar Bob Moore (SRI) "Possible-world Semantics for Knowledge and Action"

5/15/79 Program Verification and Analysis Seminar Dr. Greg Haynes (Texas Instrument) "Reliability in a Distributed Computer System for Air Traffic Control"

5/15/79 CS Colloquium Dr. Richard Fikes (Xerox PARC) "Odyssey: A Knowledge-Based Personal Assistant"

5/18/79 NA Seminar Peter Lewis (Naval Postgraduate School) "Generation of Stochastic Point Processes by Thinning"
5/18/79 CSL Seminar Ms. Portia Issaason (Electronic Data Systems, Dallas, Texas) "Computers by the Millions (The Challenge to Computer Engineering)"

5/17/79 SRI AI Seminar Jerry Hobbs (SRI) "Some Problems in Processing Natural Language Discourse"

5/18/79 PhD Oral Michael Overton (Stanford Computer Science Department) "Projected Lagrangian Algorithms for Nonlinear Minimax and e1 Optimization"

5/21/79 PhD Oral Thomas Lengauer (Stanford Computer Science Department) "Upper and Lower Bounds for Time-Space Tradeoffs"

5/21/79 Program Verification and Analysis Seminar Jonathan King (Stanford Computer Science Department) "Rephrasing Database Queries for Efficiency Using Domain and Database Structural Knowledge"

5/23/79 CS Colloquium Bill Miller (Stanford Computer Science Department) "Economics and Behavioral Aspects of Computing and Business"

5/23/79 NA Seminar D. Nikolaev (Moscow State University) "Methods for the Solution of Elliptic Difference Equations"

5/23/79 NA Seminar V. Voevodin (Moscow State University) "On the Development of Numerical Linear Algebra at Moscow State University"

5/24/79 SRI AI Seminar Marty Temenbaum and Harry Barrow (SRI) "Vision Research"

5/29/79 CS Colloquium Edward J. McCluskey (Stanford Computer Science Department) "Fault-Tolerant Computer Systems"

5/30/79 PhD Oral William J. Clancey (Stanford Computer Science Department) "Transfer of Rule-Based Expertise Through a Tutorial Dialogue"

5/30/79 CSL Seminar Mr. Bill Roberts (Digital House, Newport Beach, CA) "DEC LSI-11/23 Computer Architecture"

5/30/79 NA Seminar Elias de Doncker (Catholic University at Louvain, Belgium) "New Euler-Maclaurin Expansions and their Application to Quadrature over the e-Dimensional Simplex"

5/31/79 SRI AI Seminar Kurt Knolige (SRI) "PROSPECTOR: A Knowledge-Based System for Mineral Exploration"

6/5/79 CSL Colloquium Rick Hayes-Roth (Rand) "Simulation in AI and AI in Simulation"

6/8/79 CSL Seminar Ashok Dhawan (TRAN Telecommunications Corp., Santa Clara, CA) "Architecture of a Hybrid Switching System"

6/8/79 Numerical Analysis Seminar Philip Gill (Systems Optimization Laboratory) "Scaling Finite-Difference Estimation and other Topics in Practical Optimization"

6/7/79 SRI AI Seminar Earl Sacerdote (SRI) "New Directions in Problem-Solving Research"

Stanford CS Reports, 1978-1979


STAN-CS-78-588 (HPP-78-10), Alain Bonnet, "BAOBAB, A Parser for a Rule-Based System Using a Semantic Grammar", 41 pages, June 1978.


STAN-CS-78-670, Ronald L. Graham, Andrew C. Yao, and P. Frances Yao, "Information Bounds are Weak in the Shortest Distance Problem", 39 pages, June 1978.


STAN-CS-79-706, F. Francie Yao, "Graph 2-Isomorphism is NP-Complete", 12 pages, January 1979.


