Welcome

J. E. Wallace Sterling
Chancellor

Presentation

"The Margaret Jacks Gift"

Paul R. Hanna
Senior Research Fellow, Hoover Institution;
Lee L. Jacks Professor of Child Education, *Emeritus*

Remarks

"The Department of Computer Science"

Edward A. Feigenbaum
Chairman, Department of Computer Science

Address

"Computer Science and Our National Economy"

William F. Miller
President, SRI International;
Professor of Computer Science;
Professor of Public and Private Management
in the Graduate School of Business

Acceptance of Facilities

Gerald J. Lieberman
Vice Provost and Dean of Research

Reception and Tours, 11:30 to 1:00

Architect: William H. Busse
Consulting Engineer: Tom Simonson
General Contractor: Robert Tiscornia
Landscape Architect: Jack C. Stafford
Structural Engineer: Fred Willsea
Stanford Project Manager: Roger Buckhout

MARGARET JACKS HALL
DEDICATION

STANFORD UNIVERSITY
JUNE 20, 1980

MARGARET ANNA JACKS

Margaret Jacks died in Palo Alto on April 7, 1962 at the age of eighty-seven. She was the last survivor of the seven children of California pioneer David Jacks, who came west in 1849 and settled in Monterey.

By nature shy and modest, Margaret nevertheless took on the management of the extensive Jacks properties on the Monterey Peninsula and in the Salinas Valley from the time of her sister, Lee L. Jacks', death in January, 1941. Lee's bequest to Stanford made possible the David Jacks Professorship in Higher Education and the Lee L. Jacks Professorship in Child Education.

Margaret Jacks was a graduate of Radcliffe, an ardent Christian Scientist, and a champion of educational improvement throughout her life. In addition to her many gifts to Stanford for scholarships and faculty salaries, she took a personal interest in the Los Altos children's home known as Twelveacres and made generous contributions to many institutions including College of the Pacific, Occidental University, San Francisco Theological Seminary, Radcliffe, and Mills College. She also founded, with Mrs. Herbert Hoover, the Monterey chapter of the American Red Cross.

Toward the end of her life, Miss Jacks developed a great interest in the preservation of historic Monterey, and founded several organizations dedicated to that purpose. She and her sister, Mary (Mrs. Myron Thomas), purchased the Pacific Building in Monterey and the Stage Coach Inn near Soledad and donated them to California together with funds for their maintenance.

At her death, Margaret Jacks bequeathed to the University one of the largest single gifts in its history. To that date, it was second only to the Founding Grant by Senator and Mrs. Stanford. Her gift has made possible the Vida Jacks Professorship in Education, named for another sister, the Margaret Jacks Professorship in Education, and now the reconstruction of Margaret Jacks Hall.

MARGARET JACKS HALL

Outwardly, the Quad's distinctive sandstone walls and arcades and red clay tile roofs look just as generations of Stanford alumni remember them, dating back to the turn of the century. Inside, however, Margaret Jacks Hall is entirely new. Like Sloan Mathematics Center, Jordan Hall, and History Corner, it has been shaped to the specialized needs of Stanford education and research today and in the decades ahead.

The building was reduced to a shell, its rear roof raised, and its interior built anew with four floors in place of the original three, and a roof terrace giving a wide view across the campus. The architects — Spencer Associates of Palo Alto — have created adaptable and efficient work space for the diverse activities of the Department of Computer Science and Boys Town Center for the Study of Youth Development, without sacrificing the grace and solidity of the old Quad. The oak doors open onto a spacious reception area with a quarry tile floor and a stairway whose wrought iron handrails were saved from the reconstruction of Jordan Hall and Margaret Jacks Hall.

Margaret Jacks Hall represents a nearly ideal accommodation to two often conflicting pressures in the affairs of the University: pressure for growth and change on the one hand, and pressure to preserve our heritage on the other.

THE DEPARTMENT OF COMPUTER SCIENCE, founded in 1965, is a center for graduate level research and education recently rated the best in the United States by a survey of computer science department chairmen. Some sixty-five master's candidates and 100 doctoral candidates come from all parts of the world to work in the Department's strong research groups in analysis of algorithms, theory of computation, artificial intelligence, numerical analysis, and systems. Although the groups' main goal is basic research, there is also considerable emphasis on applications and on interdisciplinary work in such areas as chemistry, genetics, physics, and medicine. Ties are maintained with researchers in the departments of Electrical Engineering, Mathematics, Statistics, and Operations Research, and faculty and students commonly work with investigators in nearby industrial and research organizations.

BOYS TOWN CENTER for the Study of Youth Development is the focal point of research by faculty in nine disciplines — psychology, sociology, education, law, anthropology, pediatrics, psychiatry, economics, and human biology — on children who could be considered at risk for economic, biological, or cultural reasons. In addition to Stanford faculty, visiting scholars from all parts of the world take part in the Center's activities.

Scientific Symposium

1:00 to 5:00 p.m.
Room 040, Building 420

Computer Science and Scientists:
Two Personal Perspectives

Donald E. Knuth
Professor of Computer Science
National Medal of Science, 1979
ACM Turing Award, 1974

Robert W. Floyd
Professor of Computer Science
ACM Turing Award, 1978

Intermission

Generating Computer Generations
(The George and Alexandra Forsythe Memorial Lecture)

C. Gordon Bell
Vice President of Engineering
Digital Equipment Corporation

Intermission

Programs with Common Sense – 21 Years After

John McCarthy
Professor of Computer Science
ACM Turing Award, 1971

Computer Science and Medicine:
A Personal View from the Bridge

Edward H. Shortliffe
Assistant Professor of Medicine
(General Internal Medicine)
and, by courtesy, of Computer Science
ACM Grace Murray Hopper Award, 1976

Outline of talk for Jacks Hall Dedication (June 20 1980)

1. Subtitle: On the Psychological Barrier Between Computer Science and Mathematics
2. How we got here. Computing starts at Stanford in 1953 with IBM CPC.
   Jack Herriot is first director of computation center, a joint venture of Statistics Dept + ERL.
   Statistics Dept had been founded in late 40's, splitting off from Mathematics. Albert Bowker first chmn.
   Forsythe arrives soon afterwards; Here's how he summed up early hist in a letter written in 1967
   (1)
3. As archive-browser, I learned early that
   Summaries written after the fact don't give much of the true flavor.
   First thesis in what we would now consider "pure CS" 1956 Howard Demuth ... "basic research" project at SRI Jerre Noe, Bill Kautz; Joe Pettit
   I don't think Forsythe ever knew him or knew of this thesis. In fact the files show that George's insight into the true nature of CS increased dramatically in 1960 [several years before I did]. Here's part of a letter he wrote in Feb 1960 in response to a letter asking what he thought about computer-oriented research & computer-assisted instruction:
   (6)

... he goes on to discuss curricula, having essentially no ideas on how to teach more than about five courses: 3 in numerical analysis, 1 introductory Alcock, for freshmen, 1 machine-language for grad students. Thus, at this time he had a very limited outlook; and he was hard at work finishing a book on NA. ∧ The change seemed to come when he finished that book; I found his notes of an interesting luncheon discussion with Perlis and others during Summer 1960, concerning university's response to rising use of computers in the world. Hamming visit Sep 60 – Sep 61 had significant impact and pretty soon George realized, ∧ more consciously that he was interested in a great deal concerning computers besides numerical analysis. Partly also this was due to his increased responsibilities (9)

Mention (10) Bowker sug. Jan 15 1960 ...

(7)

(8)

3. Fursy the head also of Comp Center; interesting to read their early newsletters, mostly full of tips for BALGOL users. Then I noticed a new kind of item in July 63

(13)

4. About this time another historic event took place.

(11)

(12)

Polya mentor from (11) Mentor the blackboard at Polya III.

5. Department formed 1965. (3)

6. Personal story (14) (15) (16)

7. Back to theme of psychological barriers: clear that a new discipline has many growing pains and is misunderstood by most people.

Newell/Perlis/Simon letter 1967 (2)

This is the kind of thing one says to other scientists but I believe it's not the real reason CS has thrived. Real reason is in fact related study to psychology — modes of thinking. We CS types had a home. Other people will 'think it off beat at best'.

Algorithmic thinking Interdisciplinary

8. Analysis of algorithms as a subfield of CS. J of Alg's.

My work — to find the right way to study and understand algorithms.

Quality of students

November 28, 1967

Prof. L. Duane Pyle
Assistant Head
Computer Sciences
Purdue University
Lafayette, Indiana 47907

Dear Professor Pyle:

In reply to your letter of 14 November, I have dug a little into our history. Herriot and I carried on numerical analysis within the Mathematics Department, and master's degrees were granted in mathematics (with specialty in scientific computation) from before 1957 through 1961. I have guided numerical analysis theses for the Ph.D. in mathematics, and the first of these received his degree in 1960.

About 1960 we were trying to see how to get a nonnumerical computer scientist to Stanford, and realized that the Mathematics Department wouldn't want him. Then Dean Albert Bowker proposed setting up a Division of the Mathematics Department. This was actually set up in the spring or summer of 1961. We were called the Computer Science Division and had our own sub-budget of the Mathematics Department, under our own control. In autumn 1961 our faculty consisted of Jack Herriot, Harold Van Zoeren, and me. Van Zoeren was our first nonnumerical faculty member, with an appointment as instructor of Computer Science and was not regarded as a member of the Mathematics faculty.

Students started to transfer from Mathematics into our department during 1961-62, and new students entered in September 1962. During the academic year 1961-62 our courses were all called Mathematics xxx, to conform with the catalog written in January 1961, but in 1962-63 they were all called Computer Science xxx.

In December 1961 we requested permission to award a Master of Science in Computer Science. This was formally approved on 30 January 1962. Apparently the first new master's degrees were awarded in September 1962.

John McCarthy joined our faculty in September 1962, as Professor of Computer Science.

In December 1963 the chairman of the Mathematics Department asked to be relieved of any responsibility for our Computer Science Division, because our scientific directions had become so diverse from that of the Mathematics Department. In January 1964 this was agreed to by the School of Humanities and Sciences, and from then on we were in fact a department, if not in name.

After several more persons had joined the faculty, we were established officially as a separate department of the School of Humanities and Sciences in January 1965, and were immediately authorized to grant a Ph.D. degree. The first Ph.D. was given in Autumn 1966, but there had been a couple of inter-departmental degrees with a computer science component in earlier years.

We have never requested authority to give a bachelor's degree. In the early days we thought it would be a mistake, at least at Stanford. But now we think it would make sense here, but have too few resources to expand our faculty load right now.

I guess I still feel that our department was one of the first computer science departments in fact, but clearly it's a matter of definition when we started to exist.

Sincerely yours,

George E. Forsythe
Executive Head

GEF:jj

WHAT IS COMPUTER SCIENCE?

Professors of computer science are often asked: "Is there such a thing as computer science, and if there is, what is it?" The questions have a simple answer:

Wherever there are phenomena, there can be a science to describe and explain those phenomena. Thus, the simplest (and correct) answer to "What is botany?" is, "Botany is the study of plants." And zoology is the study of animals, astronomy the study of stars, and so on. Phenomena breed sciences.

There are computers. Ergo, computer science is the study of computers. It remains only to answer the objections.

Objection 1. Only natural phenomena breed sciences, but computers are artificial, hence are whatever they are made to be, hence obey no invariable laws, hence cannot be described and explained. Answer. 1. The objection is patently false, since computers and computer programs are being described and explained daily. 2. The objection would equally rule out of science large portions of organic chemistry (substitute "silicones" for "computers"), physics (substitute "superconductivity" for "computers") and even zoology (substitute "hybrid corn" for "computers"). The objection would certainly rule out mathematics, but in any event its status as a natural science is idiosyncratic.

Objection 2. The term "computer" is not well defined, and its meaning will change with new developments, hence computer science does not have a well-defined subject matter. Answer. The phenomena of all sciences change over time; the process of understanding assures that this will be the case. Astronomy did not originally include the study of interstellar gases; physics did not include radioactivity; psychology did not include the study of animal behavior. Mathematics was once defined as the "science of quantity."

Objection 3. Computer science is the study of algorithms (or programs), not computers. Answer. 1. Showing deeper insight than they are sometimes credited with, the founders of the chief professional organization for computer science named it the Association for Computing Machinery. 2. In the definition, "computers" means "living computers"--i.e., the hardware, their programs or algorithms, and all that goes with them. Computer science is the study of the phenomena surrounding computers. "Computers plus algorithms," "living computers," or simply "computers" all come to the same thing--the same phenomena.

Objection 4. Computers, like thermometers, are instruments, not phenomena. Instruments lead away to their user sciences; the behavior of instruments are subsumed as special topics in other sciences

(not always the user sciences--electron microscopy belongs to physics, not biology). Answer. The computer is such a novel and complex instrument that its behavior is subsumed under no other science; its study does not lead away to user sciences, but to further study of computers. Hence, the computer is not just an instrument but a phenomenon as well, requiring description and explanation.

Objection 5. Computer science is a branch of electronics (or mathematics, psychology, etc.). Answer. To study computers, one may need to study some or all of these. Phenomena define the focus of a science, not its boundaries. Many of the phenomena of computers are also phenomena of some other science. The existence of biochemistry denies neither the existence of biology nor of chemistry. But all of the phenomena of computers are not subsumed under any one existing science.

Objection 6. Computers belong to engineering, not science. Answer. They belong to both, like electricity (physics and electrical engineering) or plants (botany and agriculture). Time will tell what professional specialization is desirable between analysis and synthesis, and between the pure study of computers and their application.

Computer scientists will often join hands with colleagues from other disciplines in common endeavor. Mostly, computer scientists will study living computers with the same passion that others have studied plants, stars, glaciers, dyestuffs, and magnetism; and with the same confidence that intelligent, persistent curiosity will yield interesting and perhaps useful knowledge.

Some Computer Scientists at
Carnegie-Mellon University
Pittsburgh, Pennsylvania

Allen Newell

Alan J. Perlis

Herbert A. Simon

July 10, 1967

(3)

News Item from Stanford

As of January 1965 Stanford University has a separate Computer Science Department within the School of Humanities and Sciences. There is a faculty of eight persons, including the following ACM members: E. A. Feigenbaum, G. E. Forsythe, G. H. Golub, J. G. Herriot, W. F. Miller, C. B. Moler, John McCarthy, and N. E. Wirth. The fields now covered include numerical analysis, programming languages and systems, artificial intelligence, and computer control of external devices. Gene M. Amdahl is a visiting faculty member for Winter quarter, 1965. The new department is authorized to give the M. S. and Ph.D. degrees in Computer Science. G. E. Forsythe is Executive Head.

CSD - Organization

(5)

-305-

January 16, 1964

Professor William D. Munro
Acting Director
Numerical Analysis Center
University of Minnesota
Minneapolis 14, Minn.

Dear Professor Munro:

At Stanford we distinguish carefully between the Computation Center (a service institution like the library) and the Computer Science Division (an academic group for teaching and research). I happen to head both at present, but these serve two different functions.

The Computation Center reports to the office of the Graduate Dean, to a new Associate Dean for Research, and through him to the Provost. We are a facility serving all schools of the University, and some large independent projects like the Stanford Linear Accelerator Center and Stanford Research Institute. Its annual cash flow couldn't possibly fit comfortably in any department or even school of the University.

The Computer Science Division is at present an autonomous part of the Mathematics Department. We have a separate budget from the School of Humanities and Science, and we have a separate control over choosing faculty. The Chairman of the Mathematics Department is advised about personnel matters, but has no vote. I would guess that we will become a separate department in another year or two, after we grow a bit larger.

The reason we started in the Mathematics Department is mainly historical. Professor Herriot and I were Professors of Mathematics, and had the urge to hire colleagues interested in programming, artificial intelligence, and such topics which are not considered Mathematics. We could never have hired a person in such fields if he had to pass a Mathematics Department vote in competition with professors like Hormander and Spencer, who arrived about the same time.

Because of this arrangement, the faculty appointed since Herriot and me do not hold any title in the Mathematics Department, but instead have titles like Professor of Computer Science. Probably some will later be joint with Engineering, or with Medicine, etc.

There is a separate Master of Science in Computer Science, involving mainly courses in Mathematics and Computer Science. We have

no regular Ph.D. in Computer Science as yet, but I think we will about the time we become a separate department. Right now we have set up one or two interdepartmental Ph.D. programs, tailor-made for each candidate, involving Computer Science with such departments as Physics, Applied Physics, Statistics, Operations Research, Mathematics and Electrical Engineering.

There have been five Ph.D.'s awarded in Mathematics in which the theses were in numerical analysis, guided by me. The qualifying examinations were the usual ones in mathematics, with no concessions to the rather considerable amount of computing which the candidates learned. The total programs involved a certain amount of computer mathematics as optional courses. All numerical analysis at Stanford is taught in the Computer Science Division, although some classical analysis taught in the Mathematics Department is very closely related.

At present a number of students want to do theses in the area of artificial intelligence, guided by John McCarthy of our Division. Some of these are trying for a Ph.D. in Mathematics. If they pass the exams, and if the thesis has a substantial mathematical content, the Mathematics Department has agreed that McCarthy may guide it, whether or not the Computer Science Division remains within Mathematics. We haven't had any cases on which to see how this works. My guess is that the majority of these candidates will switch to an interdepartmental Ph.D. or to a Ph.D. in Computer Science, when we set it up. With rare exceptions, they are just not enough interested in pure mathematics to face those severely competitive examinations. In the coming decade, then, I feel that Ph.D.'s awarded for theses in programming, artificial intelligence, logical design, information retrieval, pattern recognition, and any other areas we may get into, will generally be either in Computer Science, or in an interdepartmental format involving Computer Science.

This leaves the question of the ten-year future of Stanford Ph.D.'s in numerical analysis. On this opinions differ. Some feel that these men should always get Ph.D.'s in Mathematics. Others feel that a good many should take a Ph.D. in Computer Science. My own feeling tends toward the latter.

If a student is very strong and very interested in Mathematics, I think he would do well to get a Ph.D. in Mathematics. Certainly that currency is well recognized everywhere, whereas a Ph.D. in Computer Science will probably remain rather funny money for a while, until the Computer Science movement has taken a firmer hold nationally. But the majority of good graduate students become fascinated with the opportunities in computing itself. They want to build hardware and software systems for the solution of problems, or just for the sake of building

INSTITUTE OF TECHNOLOGY
NUMERICAL ANALYSIS CENTER • MINNEAPOLIS 14

systems. They will learn enough numerical analysis to see what problems there are, but they find "classical" research in numerical analysis rather difficult and forbidding. In contrast, they can see rather early what do do about such matters as building a time-sharing system for bringing men and machines into interaction. So they tend to be drawn away from Mathematics by the easier victories to be achieved in Computing.

Another factor which draws students away from the Mathematical aspects of computing is the direction of growth of our faculty. Because good programming courses are taught at Stanford, and because they are very popular indeed, our enrollments are high in programming. The University administration sees these enrollments, and urges us to obtain good faculty persons in the areas of programming. If this keeps up, our faculty will be less and less in numerical analysis, and more and more in programming and other non-numerical areas. This in turn means that our graduate students will be exposed more and more to non-numerical computing.

What I am implying is that future students of numerical analysis are likely to be strongly influenced by other aspects of computing. Their theses are likely to be hybrids between numerical analysis and systems design. They may be enough concerned with setting up systems for getting approximate solutions to real problems in new ways, and enough less concerned with numerical mathematical analysis that their theses may be pretty un-mathematical. They will, nevertheless, be significant theses in Computer Science.

Please excuse the verbosity. Good luck with your newly wedded department.

Sincerely yours,

George E. Forsythe
Director

GEF:sd

bcc: Prof. Royden

NUMERICAL ANALYSIS LABORATORY
UNIVERSITY OF ARIZONA
Tucson, Arizona

(6)

TO: University Computing Center Directors (and others interested in university education and research in fields related to automatic computation)

FROM: Dr. A. Wayne Wymore, Director
Numerical Analysis Laboratory

An informal steering committee has been formed to prepare a proposal for a national invitational conference of University Computing Center Directors and other interested people on problems of mutual interest. The committee is under the chairmanship of P. M. Morse, MIT with W. F. Freiberger, Brown University, as secretary.

A list of subjects suitable for a basis for discussion was drawn up, with two persons appointed for each subject to gather relevant information and canvass qualified people for their contributions.

Two of these subjects are:

1. COMPUTER ORIENTED RESEARCH (with responsibility delegated to H. R. Rymer, Northwestern University, W. B. Kehl, University of Pittsburgh) and

2. CURRICULUM AND INSTRUCTION (with responsibility delegated to A. W. Wymore, University of Arizona, E. L. Buell, Worcester Polytechnic Institute).

These areas are so closely related in the academic framework that it was felt they should be handled together. Our present purpose in writing then, is to gather relevant information and canvass qualified people for their contributions. We are not, however, making a survey; we are asking for contributions in whatever form you wish to make them. We would appreciate simple expressions of interest, ideas, essays or full scale, formal papers or reports; in short: anything and everything which might constitute a contribution to the general areas of computer oriented research and curriculum and instruction, anything which might provide a basis for discussion at the proposed national conference. Particularly impassioned and eloquent responses will be considered for individual discussion at the conference. For your convenience, an outline is herewith enclosed containing topics of known general interest pertinent to the areas under consideration. This outline is meant as a suggestion only; your response may take any form you like, cover any topics you think appropriate. Please give serious consideration to making some response to this invitation; the success of the proposal for a national conference may depend on it. Please address your response to me that it may be received by March 1, 1960. I look forward to hearing from you.

Sincerely,

A. Wayne Wymore

Dr. A. Wayne Wymore
Director

AWW:jh

Enc.

Topic Outline for Response to Invitations
for Contributions to a National Conference of University Computing
Center Directors in the Areas of Computer Oriented Research
and Curriculum and Instruction.

With reference to your academic milieu you may want to cover the following points:

1. Facilities
   - 1.1. Description of available hardware
   - 1.2. Description of the administration of the facility for
     - 1.2.1 Instruction
     - 1.2.2 Computer oriented research
     - 1.2.3 Other research
   - 1.3. Description of organizational location of the administration of the facility

2. Curriculum
   - 2.1. Present situation
     - 2.1.1 Present undergraduate curriculum in computing
     - 2.1.2 Degrees offered
     - 2.1.3 Courses offered for credit in computing (Describe Lectures, Labs, Texts, Level, Enrollment, Department, Outline of topics, Instructors (Department, Qualifications))
     - 2.1.4 Description of non-credit courses
     - 2.1.5 Thesis work at graduate levels
   - 2.2. Your proposed curriculum
     - 2.2.1 Departmental organization of computing personnel for teaching purposes
     - 2.2.2 Degree programs in computing, requirements, levels, etc.
     - 2.2.3 Names of new departments, new degrees
     - 2.2.4 Thesis work at graduate levels, organization
   - 2.3. Philosophical basis for proposing (or not proposing) degrees, departments, etc.

3. Computer Oriented Research
   - 3.1. Present and past situation with regard to computer oriented research work
     - 3.1.1 Who and in what area?
     - 3.1.2 Thesis work - in what departments, in what areas and under whom?
   - 3.2. Proposed situation with regard to computer oriented research
     - 3.2.1 Outstanding unsolved problems
     - 3.2.2 Appropriate topics for thesis work at M.S., Ph.D. levels. Examples of suitable papers.
     - 3.2.3 Topics not appropriate for research
     - 3.2.4 Organization for computer oriented research
     - 3.2.5 Industrial vs. Academic involvement in computer oriented research
   - 3.3. Philosophy - reslation of computer oriented research to classical research areas.

PROF. GEORGE E. FORSYTHE
DEPARTMENT OF MATHEMATICS
STANFORD UNIVERSITY
STANFORD, CALIFORNIA

February 29, 1960

Dr. A. Wayne Wymore
Director, Numerical Analysis Laboratory
University of Arizona
Tucson, Arizona

Dear Dr. Wymore:

This is a response to your invitation for contributions etc. in the areas of computer-oriented research etc. The numbers in parens are those of your outline.

I am most interested in the impact of modern information processing by automatic digital computers on university curricula and organization. What special talents should be recruited for a university faculty? What departments should be organized? What courses should be taught? What are suitable Ph.D. areas?

(2.2.3) In discussing these matters there is a basic and important question of what name to give the fields. You use the phrase "fields related to automatic computation" and also "computer-oriented research." Some say "computer sciences." Internationally, the phrase "information processing" seems to have caught on, although it would seem to encompass more than automatic information processing. How general a name you want to use for an area depends on how broad an area you want to try to unify. My own vote is for "information processing," because I see a general unity in the use of automatic computers in diverse areas. The lack of reference to automatic computers is okay with me; I think much of the progress in the area goes on without specific machine application. For example, I think that the work on ALGOL would be important, even if there were no automatic computers. In any case, I think we should all try to settle on a name, and use it widely--just as a symbol of the emergence of a new discipline. I use "computer lore" as a slang phrase.

(2.3) Sentiment at Stanford is rather conservative. Although we see information processing emerging, we do not rush into new curricula and new organizations, for several reasons:

1. We think we have high standards in selecting faculty members, and there are not many people around who seem likely to be strong research workers in the new areas and also to be strong faculty members.

2. We feel that most students are more likely to learn their fundamentals in established departments, and to develop their analytical power in areas

where the structure of the subject is understood. In other words, many of us feel that a M.A. or Ph.D. in mathematics (for example) may be better preparation for a career in information processing than a newly invented M.A. or Ph.D. degree in information processing.

3. It is certainly true that most of us can guide a Ph.D. candidate in a classical subject far better than we could a Ph.D. candidate in information processing.

4. There is an interesting difficulty in trying to set up a new type of department and offer a Ph.D. degree. You want many of your new Ph.D.'s to join other university faculties, but, for one to do so, there must be a department that will accept his Ph.D. A Ph.D. graduate from an isolated first department of Information Processing is going to have trouble landing an academic job. I am told that the first Statistics Departments had this trouble, that they very nearly foundered on the issue. What saved Statistics was that two or three departments were founded nearly at once.

5. New departments, like new courses, seem to attract weaker students, on the average, than old ones. Probably it's because the teachers of new courses haven't established definite standards of competence in students.

The above five points are not the last word at Stanford. But they seem to represent reasons for making change slowly. I feel that for some years we will nurture faculty members of a future Department of Information Processing within our present faculties of mathematics, statistics, electrical engineering, business administration, physics, sociology, industrial engineering, etc. This seems to be satisfactory at Stanford, where there is a strong tradition of tolerance. It might not be satisfactory at some other universities.

(2.2.2) Numerical analysis (the art and science of scientific computation) is part of the science of information processing, and offers the same choices on a smaller scale that the whole science offers. That is, one wonders whether to teach it in special courses, or whether to work it into other mathematics courses. At the undergraduate level, I think there are advantages in trying to work it into mathematics courses that most students take. For one reason, it's so important that every one should get the point of view of modern digital computing. And, at the undergraduate level, it is largely a point of view, and not a mass of information or technique. Finally, it's always better to have fewer courses in the catalog, and more unity of curricula. If ALGOL really takes over, I believe a short course in it should be pushed at young undergraduates, and that that should be all the coding we teach. Then I think there should be a semester or two-quarter senior-graduate course on what every physicist, engineer, and mathematician should know about modern computation. This should be selective and not comprehensive. You couldn't teach this course to juniors; they don't know enough analysis or algebra. Some of my ideas on how to work numerical analysis into undergraduate

mathematics courses will be found in my article, THE ROLE OF MATHEMATICS IN THE UNDERGRADUATE CURRICULUM, Amer. Math. Monthly, vol. 66 (1959), pp. 651-662. I have changed my mind about some matters discussed there, but the point of view remains correct, I think. The major difficulty about sprinkling numerical analysis here and there is that the faculty don't know what to teach, and there aren't suitable textbooks. This is a real problem.

In graduate work there is room for considerable specialization in numerical analysis, of course. The number of specialized courses can be left to the desires of the faculty. And one would expect graduate students in the areas of information processing to study machine languages.

As far as (1.3) is concerned, we have just begun to realize what a big business digital information processing has become at Stanford. My present concern is that the administration centralize the responsibility for information processing, so that individual departments or services won't be free to buy their own computers without coordinating with a central agency. We also want to prevent an unnecessary export of our university money for the purpose of buying computer time elsewhere. Finally, we'd like to set up a mechanism to encourage people to include adequate computing money in their project proposals.

I consider such a centralized responsibility to be like that of the university library. It does not imply that all computing operations will themselves be centralized--branch centers may exist, just as branch libraries exist. But the choice between a branch facility and the central facility should be made by a central university agency that takes due account of the whole university's needs.

Good luck to you on your plans for a national conference. If I recall correctly, the Council of the American Mathematical Society agreed to have your conference meet with the Society, but not to "sponsor" the conference. The latter decision was based on the understanding that your conference is to be primarily on administrative matters.

Sincerely yours,

George E. Forsythe

GEF:bs

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(7)

October 27, 1961

Mr. Ross H. Flenner
Research Assistant
Digital Computer Laboratory
University of Illinois
Urbana, Illinois

Dear Mr. Flenner:

I'll answer your letter with respect to my course Math. 136, which is using the 220 in a big way this fall for the first time. It is a junior-senior-graduate course with 139 enrolled, meeting thrice a week for 10 weeks. I taught machine-language coding for about a week, and something of the logic of circuits and machine organization. For the following 15 hours or so I am lecturing the BALGOL language, which is a sort of "ALGOL 59." I have assigned two problems so far in BALGOL. Each student is independently writing a BALGOL program and putting it into the in box. I hope to do two or three more problems, ending up with something rather substantial. In the last couple of weeks I expect to get into numerical analysis and fancy applications of computers.

Before a problem is handed to the students, I have written (in BALGOL) a procedure called GRADER which furnishes the student random data (really a function of his number and the time). The program then returns control to the student's program. After the student is through his calculations, he calls GRADER again, and I check his results against mine. Finally, I line-print him information about the data, his answers, and his grader, and punch a card for my grade record.

To save compilation time, GRADER is converted to machine-language and put on the library tape (along with SIN, COS, etc.)

To understand how all this works, you'd have to see our operating system. We accept piles of programs in BALGOL every day. It was 288 in one 16-hour day. Syntactical errors are checked in the source language. These student problems just float through the system with everyone else's. The secret is a fast-compiling compiler and an automatic operating system.

I don't have a lot of statistics. Problem 1 is finished. I believe 131 students made a total of 385 passes--some without GRADER and some with it. [We now include GRADER on every run, to cut down the double running of good programs.] The average

number of runs per student was about 3. The average time per run was about 45 seconds, I believe. (We know how to reduce this.) So this took a total of about 5 hours. Of course, problem 1 was pretty trivial--add a few numbers, and then find the sun of the subset of the numbers which were positive. But I expect that student competence in the language will grow as the problems get harder.

My later problems will probably involve maybe 500 or 1000 words of compiled program per student. My early grader programs run around 500 machine words or so, with lots of format strings for messages. I just wouldn't even consider trying to write such things in a machine language. But in BALGOL I write them in about half an hour. Some assistants then convert the program in a few minutes to machine language and put it on the tape.

I just wouldn't have time to write a grader program in machine-language. And I don't believe I could delegate this fundamental program to an assistant. We certainly couldn't handle 140 students without the automatic grading.

BALGOL is absolutely dominating Stanford's computation; students and faculty like the language and use it for almost everything. Only one major customer prefers machine language. And several house experts use machine language a lot for special purposes like running two line-printers together. We have many useful machine-language procedures which work easily into a BALGOL program.

I don't know what data I could marshall. I've programmed in machine language for years. But never before could I create programs of hundreds and even thousands of words so easily and with such accuracy. It's just a new era.

Perhaps Professors Gere or Oakford will answer you separately.

Sincerely yours,

George E. Forsythe
Director

GEF:ro

P.S. Professors Gere and Oakford received a copy of your wire.

cc Prof. J. M. Gere, Civil Engineering
cc Prof. R. V. Oakford, Industrial Engineering

It occurs to me that I would very much like to be located at the same place you are, if this is feasible; at any rate your plans have a nontrivial place in the nonlinear function I am trying to optimize!" ...

15 Feb 22 1967 My letter to Floyd about dilemma of where to make a permanent home. "I believe the four places that are now uppermost in my mind are Stanford, Cornell, Harvard, and Caltech (in that order). I expect to take about a year before I make up my mind, with Jill's help. Then discussion of pros and cons ... e.g. can build a house within walking distance of campus ... lots of people always coming to visit ... near Berkeley ... West coast ..." I tend to favor Stanford very strongly at the moment. The only thing that would upset these arguments and make me think things through over again would be if you would yourself very much like to be a professor at Cornell but not at Stanford. Under the hypothesis that I joined the faculty at Stanford, would you also like to join? Under ... Cornell ... ? If the answers are no-yes, I have to reevaluate everything. If the answers are no-no, yes-no, yes-yes, I will go to Stanford pretty definitely"

Bob's reply re Stanford: "The only problem is that they are overloaded now ... it might be best to let this get worked out before going there — though they may be able to do so quickly. I understand that lack of space is also a problem ... Right now, Stanford looks like the best choice."

Later Berkeley replaced Cornell

16 Feb 7 1968 from GEF "Thanks for the copy of volume one. It looks great. My main problem was snatching it away from Bill Miller and others to get it to the deans.

March 14 1968 resignation from Caltech "It is not easy for me to leave a mathematics department, since computer science has traditionally been only a hobby with me. But during the last few years it has become clear to me that the computer science knowledge I've accumulated forms part of an important academic discipline; and I cannot communicate this knowledge as effectively as I should if I remain in a mathematics department."

1 Forsythe letter re founding of dept

2 Newell/Perlis/Simon letter

3 News item for CACM 1965

4 Other schools: Purdue 1962 UW 1964 (name change Dept of Math → Dept of CS) Michigan 1965 Commonwealth Pennsylvania, Carnegie Tech. Stanford MIT

5 Forsythe letter re future of dept

6 Forsythe' early 1960 letter very conservative

7 Forsythe 1961 letter re BALGOL

8 Conversations with other professors from math, philosophy, physics: 'This is not fundamental science.'
Forsythe: Language design is a general abstract mechanism, not the design of an object. } Spring 1961
"Well, at least they thought it mighty offbeat. Bowker supported me."

9 Notes of meeting Forsythe/Bowker December 3 1960 'Bowker spoke of a Div of Math Dept like the former div of chem engineering in Chemistry and offered job to me if I want it... This may be a first step towards having a separate department of Comp. Sci. within H & S."

10 Forsythe letter ~~Feb 1960~~ ... Finishing a book ... Summer discussions with Perlis and others
Bowker suggest to Forsythe Jan 15 1960 "Stan area should grow by hiring good people. GOF should prepare a list of some six people who ought to be hired and what they would work on."

11 "The new Computation Center of Stanford University was dedicated on Friday August 9 1963. There were tours of Pine and Polya Halls, an outdoor luncheon with addresses by Dr. Richard Hamming and Professor George Forsythe, and a technical address by Professor George Polya." It had rained lightly up to a few minutes before everybody sat down for outdoor luncheon. List of about 275 people who attended, including Mr. Joseph P. Eichler of Eichler Homes.

Polya spoke on obtaining exact upper and lower bounds for certain real-valued functionals of domains from relatively few data. The opening technical address in Room 111 Polya Hall. Polya introduced as a founder of AI via heuristics as well as MA

[Boyden says Polya wished a plaque to be put up stating that he didn't give any money.]
Bowker spoke; on his way to be Chancellor of CUNY.
"If any credit is due to me [Bowker] it is that I had sense enough to hire George Forsythe as Director"
Forsythe spoke on Stanford's current strengths in research and development in Computer Science
numerical analysis
programming: "some of our undergraduate and graduate students produced the fastest and most flexible compiler we know of for the IBM 7090" [Sub ALGOL] SU-BALGOL
List-Processing programs, Time sharing programs inspired by McCarthy
Time sharing 'It's like a master playing chess with 50 duffers at once. The computer is busy all the time; a person waits for only a few milliseconds; and balance is again restored.'
PDP-1 tied to 7090
Artificial Intelligence, 'the use of computing machines as extensions of the human mind.'
... what human beings and machines can do working together. The time is ripe for a rapid increase in the practical results of artificial intelligence.
450 students in autumn quarter introductory programming classes.
"Our total work load for spring quarter was 22000 [student] jobs. I don't believe any other university is providing anything like such service to such a large percentage of its student body.
Once the students learn to use a computer gracefully, many continue to use it later on for homework, as workers on research projects, for their PhD dissertations, and so on. We have them hooked."

12 Hamming's speech at 1963 dedication: [Hamming arrived Sep 1960

The wide use of computers requires not only formal training on how to control the computers, but more importantly a whole new view of the world and its ideas. You are all aware of how Darwin's idea of evolution has penetrated into fields remote from biology, how often today we ask: 'How did this evolve?' If I had to summarize in a single word the influence of computers on the world of ideas I would say "Algorithm" meaning a detailed, step-by-step, description of how the various parts are interrelated. The word "algorithm" does not describe everything involved in the computer revolution, just as the word "evolution" does not summarize all of modern biology, but in both cases the words tend to show the power of the central idea and its ability to spread and affect the views of apparently remote fields of human thought.

su comp ctr bulletin

13 July 10 1963 "Stanford has another new computer, the PDP-1 .... The PDP-1 brings cathode-ray tube output to the Computation Center for the first time. ... Another thing the PDP-1 brings to Stanford for the first time is Space War. Steve Russell wrote the Space War program at MIT and brought it to Stanford when he came here more than six months ago ... Whenever the PDP isn't busy on something else, somebody is playing Space War; it's rare to find the PDP free, even at three in the morning.

"Professor Henriot has been using our 7090 while in Grenoble."

via mail and punched cards

14 Dec 19 1963 I write to Forsythe declining his suggestion that I come to Stanford then, saying Jill and I wanted to stay put in Southern Calif at least five more years. "I must tell you however that the attraction to Stanford for the future is so strong that I am contemplating buying a lot up in that area now on which Jill and I will plan to build our dream house when we move"