Historical Development of Computer Science at Purdue University

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It is safe to say that, with a few important exceptions, computers and computing had almost a negligible impact on the curricula of our major universities even as late as 1960. During the late fifties while computer use was exploding at major aerospace and leading technology industries, most educational institutions still had either antiquated computer equipment or, more likely, no computer at all. The lack of advanced computer equipment at educational institutions led to a serious imbalance between research being conducted at leading universities and that being done at government laboratories and high technology firms. To correct this imbalance the National Science Foundation created in 1960 the Office of Computing Activity whose major function was to assist universities to acquire modern computing facilities. In retrospect, this NSF Program was fantastically successful not only in helping schools to acquire modern computers so that faculty could keep abreast of new research developments but also in promoting the concept of computers for instructional purposes and eventually the cause of computer science. By the early 1960's almost all major institutions had installed reasonably modern large scale computers. At the same time there was a noticeable increase in courses on programming to enlarge the body of users, both faculty and student, that could absorb the newly available computer resources.
In the late fifties and early sixties the concept of Computer
Science as a discipline was not seriously considered except in the minds
of a few visionaries. The concept of interdisciplinary studies with
the computer as an important part was, however, being advanced at several
institutions. Among these one should mention the Communications Science
Program at the U. of Michigan which was started in 1957 and the Dept. of
Systems and Communications Science at Carnegie-Mellon University,
started in 1962. Interdisciplinary programs such as these were in a sense
the forerunners of Computer Science programs. During this period there
were also beginning to develop some strong research groups in computer

Purdue had shown some early interest in computing in the early fifties.
Alan Perlis was hired at Purdue in 1951 to run a computing laboratory which
at the time consisted of an IBM Card Programmed Calculator. In 1953 an
Electrodata Datatron 204 computer was acquired. It was here that Dr.
Perlis and some of his students including Tom Cheatham, did some of his
early work on compilers leading eventually to the IT Compiler. Later
in 1958 a Univac Solid State 80 Computer was acquired primarily for
computerized classroom scheduling, another area in which Purdue had shown
early leadership. By the time I arrived at Purdue in 1962, however, there
had been a marked deterioration in the computer environment. Dr. Perlis
had already left Purdue in 1955 to go to Carnegie Institute of Technology,
the Datatron 204 was being dismantled and the Univac Solid State 80 was
being used as a special purpose computer for a limited number of adminis-
trative purposes.

In the Spring of 1962 Dr. Felix Naas, who had just accepted a position
as Head of the Mathematics Department at Purdue University, approached me about the possibility of going to Purdue to develop a program in computer science. Dr. Haas had formerly been Chairman of the Mathematics Department at Wayne State U., and had learned about me there since I had formerly held an Associate Professorship at that school. Dr. Haas was promoting at this time the important concept that mathematics should be considered as a science. In his mind mathematics departments should be stressing the use of mathematics as an important tool in problem solving thus broadening the more traditional concept of mathematics as a pure art form. He also foresaw the tremendous potential impact that computers would have on society, and he correctly predicted that universities would have to develop computer science as a discipline. It was only natural in his mind to associate computer science with the mathematical sciences given his background as a mathematician. At the same time as an experienced administrator he was aware of the difficulties that statistics and applied mathematics groups experienced within traditional mathematics departments. To avoid these difficulties he advocated at Purdue the creation of a unique organizational structure, a Division of Mathematical Sciences, which in turn would contain separate departments for each of the identifiable groups within the mathematical sciences. This organizational structure was approved by the Board of Trustees in 1962 and was put into place by the fall of 1962. Initially there were three separate departments, those of Computer Science, Statistics and Mathematics. The applied mathematicians chose to remain within the Department of Mathematics.

In 1962 I was Manager of the Department of Programming and Analysis within the Computing Laboratory at Aerospace Corp. Prior to that, from
1956 to 1960, I had held a similar position at Space Technology Laboratories, a division of a company now known as TRW. In both positions I was responsible for developing programs for ballistic missile and satellite trajectory calculations, and for developing libraries of numerical subroutines for various scientific applications. My own interest in computers began in 1950 when after receiving a Ph.D. in applied mathematics from the U. of Michigan, I was invited to spend the summer working at Aberdeen Proving Grounds where the ENIAC and EDVAC computers were housed. It is interesting to note that the Aberdeen Laboratory attracted a large number of mathematicians who have since become eminent computer scientists. Among my colleagues at Aberdeen that year were Alan Perlis, David Young, Mario Juncosa, Saul Gorn, Bernard Dimsdale and many others.

In the summer of 1952, I worked at Oak Ridge in Dr. Alston Householder's Mathematics Group which had just accepted delivery of an early Iliiac Computer. From 1950 to 1956 I was a professor at Wayne State University where I taught courses in numerical analysis and in programming. Wayne State had acquired a Burroughs UNIVAC computer early in the fifties and a little later an IBM 650, thus establishing there an early interest in computing.

Thus by 1962 when Felix Haas offered me a position as Director of the Computation Center and Head of a soon-to-be-founded Department of Computer Science, I already had some 10 years of experience in numerical analysis and in programming. I accepted Dr. Haas's offer and arrived at Purdue on July 1, 1962.

It was very common in the early sixties for administrators to identify the computing center with academic computer science. Appointments
as Directors of Computing Centers at major institutions were almost without exception people who had strong academic credentials, and these Directors assumed dual responsibility of providing computing services and of introducing courses or programs in computer science. My own appointment was no exception to this rule. Upon arriving at Purdue I was faced with the dual responsibility of upgrading the computer facility and launching the academic program in computer science. As already noted the computing environment at Purdue was at this time in a very poor state. One of our first acts was to prepare a proposal to the Office of Computing Activity to help us acquire modern computing facilities. An IBM 7090 and a 1401 were subsequently ordered late in 1962 and installed in 1963. The 7090 was later upgraded to a 7094.

I also began in the summer of 1962 a series of discussions with faculty from various disciplines in order to elicit their support for the proposed program in computer science.

The concept of computer science as a discipline met some opposition, as might be expected, particularly from the school of Engineering. The major opposition did not have to do with jurisdictional questions - nationwide this problem arose somewhat later and the Purdue Electrical Engineering School did not yet appreciate the coming importance of computing -- it had to do rather with the definition of the field of computer science and with whether programming was a subject matter worthy of study at a university.

The summer of 1962 was also spent in hiring faculty and in developing a curriculum. There were of course no computer science departments in existence to serve as models so that we had to develop our own courses and
curricula from scratch. My first major appointment was Dr. Saul Rosen. Saul had had considerable experience in designing computer systems having worked for the Burroughs and Philco Computer Divisions for many years. In addition to Dr. Rosen, and myself the faculty in the fall of 1962 consisted of Dr. Duane Pyle, a recent Purdue graduate in mathematics, and Dr. R. Kenyon, an EE Purdue graduate. Additional staffing, courses and curricular matters will be discussed in greater detail later.

As already noted, by the time I arrived at Purdue, the Division of Mathematical Sciences had already been approved. This Division was located in the School of Engineering for convenience primarily because the School of Humanities, Science and Social Sciences which had formerly housed the Mathematics Department provided an inhospitable environment for growth. In the spring of 1963 a new School of Science was created and it included the Division of Mathematical Sciences as well as the Departments of Physics, Chemistry and Biology. The 1963-64 Graduate School Catalog contains a listing of the new School of Science with Felix Haas as Dean and the Division of Mathematical Sciences together with the Department of Computer Science with myself as Head. It also contains a listing of the staff in computer science and a description of available degree programs. At that time the department offered only M.S. and Ph.D. programs in Computer Science. Undergraduate degrees in CS were not offered until 1968.

Organizationally, there was a common budget for the three departments within the Division of Mathematical Sciences but the departments had control over their own courses and curricula as well as hiring. The budgets were later completely separated. During the early sixties other schools were also taking steps to initiate computer science programs.
At Stanford, for example, a Computer Science Division, headed by George Forsythe, was formed within the Mathematics department in 1961. John McCarty joined this group in 1962 and Gene Golub in 1963. A formal department of Computer Science was established at Stanford in Jan. 1965 within the School of Humanities and Science. Ed Feigenbaum and Bill Miller joined this department soon thereafter.

At Carnegie-Mellon University the Department of Computer Science, aided by a 5 million dollar grant from the Mellon Foundation, was officially formed in Feb. 1965. It was at first located in the College of Engineering and later moved into the School of Science. Al Perlis was named Chairman of this department whose initial faculty included Allen Newell, Bob Floyd and Dave Parnas. Both the Stanford and Carnegie-Mellon programs were and still are graduate programs only.

There was also considerable movement in the direction of computer science research at other institutions such as MIT, Illinois and Michigan but to my knowledge the institutions discussed above were the first to initiate formal departments and degree programs in computer science.

At Purdue at least the location of the Computer Science Department within the Division of Mathematical Science proved to be an extremely sound decision since many of the leading figures in computing were originally mathematicians and we were thus able to attract these leaders by offering them joint professorships in Mathematics and Computer Science. Almost all of our early key appointments were trained as mathematicians. They included Saul Rosen, a systems programmer who at the time was consulting privately in the computer systems area, Walter Gautschi, a numerical analyst who came to us from the Oak Ridge National Laboratories,
John Rice, a numerical analyst who had worked at General Motors and the National Bureau of Standards, and J. Richard Buchi, a theoretician who came to us from the U. of Michigan. Additional key appointments which came somewhat later included Maury Halstead in Compilers and Languages, Peter Denning in Operating Systems, Paul Young in Computational Complexity, and Carl deBoor in Numerical Analysis.

Curriculum-wise we decided in 1962 that we would offer MS and Ph.D. degrees in two areas: Numerical Analysis and Programming and Systems. Our early appointments gave us considerable strength in the area of numerical analysis. Recruiting in the area of programming, systems and languages proved to be much more difficult, first because established people in these areas were scarce and second because even those who had established reputations often lacked academic credentials. Some of them lacked the Ph.D. degree, and most had few publications in established journals. Then too there were few standards by which to judge publications in these areas. Still it was obvious to us even then that the uniqueness and further growth of computer science lay in the programming, systems and language areas and that these areas would have to be strengthened if it was to survive as an academic discipline.

An early decision at Purdue was to offer a master's degree program oriented toward industry since we were convinced that this would be an attractive source of employment for our graduates. This emphasis continues to this day. The bulk of our graduate students are clearly industry oriented even at the Ph.D. level. Excellent relations were established with leading industrial firms and computer manufacturers. We developed very early an especially attractive program with Bell Laboratories, the
so-called One-Year On-Campus-Program in which Bell would hire students with BS degrees and send them to Purdue to obtain a master's degree in computer science. Bell has, of course, made similar arrangements with other universities. Purdue has also established excellent relations with West Coast aerospace firms based partially on my own work-related contacts with those firms. Indeed our initial entering student body in 1963 consisted mostly of programmers who had been working in west coast aerospace firms and who wanted to get advanced degrees. By and large our initial students had received their BS degrees in mathematics and had received on the job training in programming. A large percentage of our graduates continue to find employment at companies like TRW, Aerospace Corp., Hughes Aircraft and McDonnell-Douglas. Other companies which hired significant numbers of our graduates include Bell Labs, IBM, Sandia Labs, Los Alamos Scientific Labs, General Motors. Almost all of our early graduates were employed as scientific programmers or as system programmers. Some of our very earliest graduates and their current affiliations are:

Morris Bennett (M.S.), President of Geodynamics Corp;
B. Evans (Ph.D.), Prof. of Computer Science at San Luis Obispo College,
Ken Brown (Ph.D.), Prof. of Computer Science at U. of Minnesota;
Doug Kerr (Ph.D.), Prof. of Computer Science at Ohio State Univ.
Larry Axsom (Ph.D.), Director of Computer Research at Cincinnati Milacron;
and Larry Landweber (Ph.D.), Chairman of Computer Science Dept., U. of Wisconsin.

As already noted there were no models to follow in curricular development. The ACM Curricular Committee on Computer Science (C^3S) did not begin to meet until 1964 and it was several years later before reports on courses in computer science were published. As already noted we began our
master's program with two areas of emphasis: numerical analysis and programming and systems. Courses in numerical analysis were relatively easy to establish and introduce and there was relatively a good supply of textbooks. A sequence of six graduate courses in numerical analysis and mathematical programming were introduced and offered beginning in 1962. These included CS514 (Introduction to Numerical Analysis), CS515 (Numerical Solution of Linear Systems), CS520 (Mathematical Programming), CS513 (Approximation Theory), CS614 (Solution of Ordinary Differential Equations) and CS615 (Solution of Partial Differential Equations).

In the Programming and Systems Area we introduced the following courses: CS401 (Programming Languages), CS500 (Programming and Systems), CS580 (Intro. to Data Processing), CS600 (Advanced Programming Systems I) and CS601 (Advanced Programming Systems II). In the theory area we offered three courses: CS581 (Logic and Automata), CS680 (Computational Complexity and Algorithms), and CS681 (Artificial Intelligence).

There were of course no text books in either the systems or languages areas. Prof. Rosen who taught most of these courses had to rely on personally developed notes, manuals and selected papers. Indeed his selection of milestone papers were later collected and published as a textbook by McGraw-Hill in 1967 and included papers by Backus, Dijkstra, Newell, Floyd, McCarthy, Dennis and Corbato among others. Of course we also introduced some undergraduate level courses in programming where we relied primarily on vendor manuals and notes for teaching material.

For the master's degree students specializing in Numerical Analysis were required to take the following courses: CS514, 515, 520, 401, 500, 581 and some mathematics courses. Those specializing in Programming and
Systems were required to take CS401, 500, 600, 514, 515, 581 plus suitable electives from mathematics or engineering for a total of 33 credit hours.

The Computer Science Program at Purdue has of course grown substantially over the years and the curriculum has undergone substantial revision. We began with about a dozen graduate students and 4 faculty in 1962 and by 1968 we had about 120 graduate students and 12 faculty. In 1968 we introduced an undergraduate degree in computer science and this program has grown even more rapidly. By 1970, we had a faculty of 18 with 200 undergraduate majors and 120 graduate majors. Today we have a faculty of 24, 600 undergraduate majors, 130 graduate students, and 3500 course enrollments per semester. We graduate about 100 BS students, 45 MS students and 7-8 Ph.D.'s annually. At the undergraduate level students are allowed to select one of 5 options. These are the General Option (for graduate school preparation), the Systems and Programming Option, the Business Data Processing Option, the Scientific-Programming Option, and an Interdisciplinary Option. Similarly at the graduate level we identify major areas of concentration for students in the MS program. These include Programming Systems, Programming Languages, Information Systems, Data Base Systems, Software Methodology, Computer Graphics, Numerical Computation and Theory of Computing.

It has now been 16 years since the formation of the Department of Computer Science at Purdue. The continuing growth of computer science, at Purdue and elsewhere, and the excellent acceptance by industry of our graduates is very gratifying and attests to the wisdom of Dr. F. Haas, now Provost at Purdue, in recommending the creation of this Department of Computer Science in 1962.