BEGINNING OF COMPUTING AND COMPUTER SCIENCE AT THE UNIVERSITY OF MARYLAND

Jack Minker
minker@cs.umd.edu
Department of Computer Science
and
Institute for Advanced Computer Studies
University of Maryland at College Park
College Park, Maryland, U.S.A.

January 8, 2004

ABSTRACT

Computing as a University of Maryland-wide activity started formally on February 1,1962 with the hiring of Professor Werner C. Rheinboldt as Director of the Computer Science Center. This paper traces the beginnings of computing at Maryland starting with the use of computers in the late 1940s and the first courses that taught computer programming. It describes the events leading to the hiring of Rheinboldt, the formation of the Computer Science Center, Rheinboldt's objectives to provide an outstanding computation facility, with research and educational components, and how those objectives were achieved. It discusses the role of Mr. John Menard, Assistant Director of the Computer Science Center and the accomplishments of Professor William F. Atchison as Director of the Computer Science Center, following Professor Rheinboldt's resignation as Director in 1965.

The developments of the start of the Department of Computer Science on July 1, 1973 are traced with Acting Chairman Professor William F. Atchison, through the appointment of Professor Jack Minker as the first permanent Chairman of the Department in 1974 and the five years of his tenure to 1979. It discusses Minker's role in the development of the Department to be among the leading departments of computer science in the United States.

DEDICATED TO[1]:

Werner C. Rheinboldt

John Menard

and

William F. Atchison

[1]The history of computing and the Department of Computer Science owes a great debt to Werner C. Rheinboldt, the first Director of the Center, who had the vision to make it all happen. He was assisted ably by John Menard who was Assistant Director of the Center. William F. Atchison succeeded Rheinboldt as Director and was the Chairman of the Curriculum 68 Report of the ACM that defined the curriculum for computer science.

PREFACE

One of the projects I wanted to undertake in my 'retirement' was to write a history of how computing started at the University of Maryland up to the beginning years of the Department of Computer Science. I came to the University of Maryland as a Visiting Member in 1967. I had been invited to the University by the then Director of the Computer Science Center, William F. Atchison. In 1966 I invited Bill Atchison to be a member of my Program Committee for the National ACM Conference that had its meeting in Washington, DC. Bill agreed to be a member and we got to know one another then. I asked Bill if I could come to the University as a visitor for a year. He graciously invited me and, the next year the faculty invited me to stay as a permanent faculty member. I was delighted to become a faculty member and subsequently became the first permanent Chair of the Department of Computer Science in 1974, one year after the Department started on July 1, 1973.

Computing started as a formal discipline at Maryland on February 1, 1962. I thought that it would be interesting to develop a history of the period from the late 1940s when faculty at Maryland first started to use computers until the end of my chairmanship in 1979. To extend the history beyond that period to the present time would have been a major undertaking and would have diverted me from other projects I wanted to do, namely to write about the involvement that I had in human rights for computer scientists, and scientists in general.

My objective was to cover several periods: the late 1940s–1961; the period from 1961–1962 when Werner C. Rheinboldt was offered the position of Director of computing and was hired as a consultant until the time he was able to start on February 1, 1962; the period from 1962–1973 when the Computer Science Center was formed; and the period 1973–1979 when the Department of Computer Science was in its infancy and covered the period when I was Chairman of the Department.

It seemed to me that since I had been part of this history, I would have been able to reconstruct what had happened, except, perhaps for the period before I joined the faculty. This was partially the case; however, reconstructing events in each period had its own challenges.

In the period 1940–1961 I wanted to learn who had taught the first computer courses, who was on committees that had tried to convince the University to provide computer capabilities for research and education, and who had asked that such a committee be initiated. To find answers to these questions, I turned to the Hornbake Library. I scoured the minutes of the Board of Regents, went through the Course Catalog descriptions from 1945–1965, and the extensive collection of Vice-President for Academic Affairs, R. Lee Hornbake. I was able to reconstruct the first courses in computing. However, I could not find the names of those faculty who had urged that a committee be formed to investigate purchasing a central computer for the University. Although I had found that Dr. John Toll, Chairman of the Physics Department had been chair of such a committee, I could neither find who the members of his committee were nor who had encouraged the University to form such a committee with Dr. Toll as its Chairman. Dr. Toll has turned over his extensive files to the Hornbake Library; however they are not indexed and it would have been a prohibitive task to go through over 60 years of his files. I phoned Dr. Toll, to determine if he could recall what happened in the 1950s, but he could not remember. He thought that Dr. Monroe Martin, who was Director of the Institute for Fluid Dynamics, might have been on that committee. It took a while to find where I might reach Dr. Martin, who was over 90 years old. I found that he was in a nursing home, and phoned him. Unfortunately, he did not recall much from that period. Others who I tried to contact were either deceased, ill, or simply did not recall. Although there were impediments, I was able to piece together much of what happened in this time frame.

The period starting with the search for a Director of Computing in approximately late 1960 up to the time Werner Rheinboldt was hired is covered extensively. This is also true of the period from February 1, 1962 to July 1, 1973, which covers the Computer Science Center. During this

period, Rheinboldt was engaged in developing a computing center; an educational program which eventually led to degrees at the Master of Science, Doctor of Philosophy and Baccalaureate levels; and a research program. These eventually led to the formation of the Department of Computer Science. It would not have been possible for me to cover this material without the help and cooperation of John Menard, who was the Assistant Director for computing under Rheinboldt when the Computer Science Center was first formed. Menard and Rheinboldt worked together for several years before they both came to Maryland. Menard kept all of his files and took them with him when he left the Center. He sent some of his files to the Department, when he retired. Most of these files were sent to the Hornbake Library, and some were given to me. In addition, Menard kept five large notebooks that he retains in his home, and made them available to me. He also read the material I wrote, commented upon it, and sent me his personal remembrances of events in e-mail messages. His interest and help were invaluable. I checked out his personal remembrances, wherever possible with documents that I found. His memory was fantastic, but not infallible. Rheinboldt also read drafts of the paper, explained some things, corrected others, and was extremely helpful. The files of Dr. Hornbake were also invaluable. Dr. Hornbake maintained all of his correspondence. The Hornbake Library has indexed his files and I was able to access those that dealt with computing as related to this history.

To my surprise, the task of reconstructing events in the period 1973–1979 was much harder than I had imagined. It is not easy to reconstruct events in the past based on memory alone. I was well aware of that problem, but thought that it would be relatively straight forward to reconstruct events after reading some of the documents available. I was correct on this point; however, to my consternation and surprise the documentation that covered the first year of the Department, and my chairmanship were not available. This was not because I was lax in keeping important documentation, but because without consulting the faculty, the documentation that I left behind in the chairman's office was destroyed. There was a need for space for files in the department administrative offices and, rather than consulting faculty or placing the files in a repository, they were destroyed. Fortunately I was able to reconstruct events from Annual Reports that I started, which contained detailed information needed for the history of the period, and also from an ad-hoc newsletter, PRINTOUT, that I asked Dr. Richard Hamlet, who was then in the Department, to be Editor-in Chief. It was fortunate that Hamlet had retained copies of the Annual Report, and most of the PRINTOUT newsletters, and kindly made them available to me. From this material I was able to reconstruct the material from 1973–1979.

The story of the development of computing, the Computer Science Center, and the Department of Computer Science at the University of Maryland revolves around several key individuals. Vice-President Hornbake, who had the foresight to start a central computing activity; Werner Rheinboldt who was the central person who made it all happen and was responsible for the development of the Computer Science Center including the construction of a new building and purchase of computers, the educational program which led to the computer science degree programs and eventually the Department, and the start of computer science research; John Menard who supported Rheinboldt and took care of many of the details in the Center; William F. Atchison who replaced Rheinboldt as Director of the Center in 1966 when Rheinboldt stepped down to emphasize his research and education, and who ably nurtured the education program and was the world-leading expert in computer science education; and Jack Minker who became the first permanent Chairman of the Department of Computer Science and molded it into a strong research-oriented department ranked in 1980 by the National Academy of Science in the top 12 among all computer science departments in the country.

I decided that it would not make for a cohesive story if it were written chronologically since many related events took place during different periods of time. To overcome this problem I added

an appendix that provides a chronological development of events in the history. The text is also supplemented by several other appendices. I have also added two appendices that list all of the faculty who were in the Computer Science Center during the period 1962-1973 and the faculty from 1973-2002. The listings provide information about all faculty including the major honors that they received. I thought it would be useful to have a listing of all computer science faculty who had been at Maryland and therefore extend the listing to include all faculty up to the date of this report. I have also added a listing of the computer staff in the Center, the computer equipment in the Department laboratory during its initial years, and a list of all courses in computer science offered at the start of the Department in 1973. Finally, a listing is given of all Ph.D. students during the period 1973–1979, their advisors and theses titles.

Charles (Chuck) J. Rieger III volunteered to write a perspective of the Department from his view as a faculty member. Chuck's perspective is included as a Foreword to this paper.

Jack Minker, Professor Emeritus
Department of Computer Science and
Institute for Advanced Computer Studies
Fall 2003

FOREWORD

The year was 1973. ARPA was in full swing with its research funding for networking, man/machine interaction, and artificial intelligence. The world was poised to break the shackles of mainframe computing and embrace computing in an exciting and completely new form - wherein the computer actually sat right beside you and interacted with you one-on-one! The years surrounding 1973 were most certainly heady ones for computing: Seminal designs for open network architectures and protocols were well underway, the Alto personal computer was starting to whir at PARC, new object-oriented and windows-based computing paradigms were starting to come into focus, breathtaking advances in single-chip microprocessor architectures were taking place, and there was unbridled enthusiasm about the prospects of machine intelligence. It was also a time in which many universities were starting to acknowledge computer science as a bona fide discipline in its own right, recognizing the need for a new type of academic department that would stake out a research and teaching environment for this blossoming field.

It was in this setting that Jack Minker and his colleagues in the Computer Science Center at Maryland decided that the time was right to establish a Department of Computer Science. Jack's vision was to build a department with strong foundations for research in all the main areas of computer science, including systems, languages, artificial intelligence, numerical analysis, and theory. The new department would be built on the strong intellectual foundations already present in the computing center, and it would grow by recruiting new faculty members with strengths in each of the major disciplines of computing. Jack's vision was also that the new Department be an open one, with strong research ties to both government and industry through partnerships and funding. And he also wanted to build a department that would be recognized for its excellence in teaching, at both the undergraduate and graduate level.

Evidently, I popped onto Jack's radar screen just as his mission was getting underway. I first met Jack in the summer of 1973 when he visited the AI Lab at Stanford, where I was in the process of finishing up my dissertation. I still have fond memories of the annual late-summer wine and cheese party at the AI Lab (up in the foothills several miles off campus), where Jack and I chatted about the possibilities of me joining the faculty to teach and do AI research in his new Department. Although I don't remember the details of what we discussed, he certainly convinced me that the future was bright and wide open for developing a world-class Department of Computer Science at Maryland. So Linda and I (and our almost-2-year-old son Andy) moved back east in December 1973, and I started in Jack's new department as an assistant professor, Spring semester 1974.

The department and environment was everything Jack had said it would be - a number of talented and creative faculty who were already there, a good (and soon to become excellent) computing infrastructure, and hoards of undergraduate and graduate students eager to learn. I discovered that I had complete freedom to define my own research directions, as well as considerable latitude to set up new graduate seminars and even undergraduate courses. As Department Chairman and close personal friend, Jack was most certainly my mentor during my first years there, helping me understand what was needed to make a department actually run smoothly - teaching, research, administration, funding, and a bit of campus politics from time to time. It was a microcosm that paralleled a corporation in many respects, and Jack, as chairman, was master of them all from my vantage point. And he most certainly made good on his promise to continue building a world class faculty: The new hires during his tenure as chairman, combined with the talents that were there prior to the Department's formation, packed a powerful research punch by any university's standards by the end of Jack's tenure as chairman in 1979.

Jack also had a knack for keeping the Department's name out in front of the research community. One good example in which I was involved was the Department's participation in NASA panels on interplanetary robotic exploration (chaired by Carl Sagan during the 1977-1980 time frame),

in which we traveled around to various NASA sites with other researchers to give presentations of our views on what was possible in the area of unmanned interplanetary exploration. Those meetings both broadened my horizons as a young researcher, and extended Maryland's ties with other research communities around the country. Another example was the Department's affiliation with IVIC, a research institute in Caracas, wherein Maryland Computer Science faculty members traveled to Venezuela to teach and exchange research ideas with IVIC colleagues. Although our main purpose was to share our own research with the IVIC participants, I got an invaluable view of what the research community was like in an academically distant land. Looking beyond such research connections as these, Jack's contributions to the Committee of Concerned Scientists, and the ACM's Committee on Scientific Freedom and Human Rights (which stood up for academic and political freedom for such scientists as Andrei Sakharov and Anatoly Shcharansky), directly connected the rest of us in the Department to some of the most important international issues of the times. Watching Jack's passion for involvement in these committees always helped me remember that there is much more to being a scientist or professor than simply doing research.

As it turned out, I got bitten by the entrepreneurial bug, and left the faculty in January 1982 to start a high tech company (and, subsequently, two others). My focus on the business world had been so utterly complete that I had literally not set foot on campus or seen anyone on the faculty for over 21 years. Then, last October 2002, came a call from Jack. He was hoping to collect as much information as possible for his History of Computing at Maryland. He was hoping he'd left a message on the right "Chuck Rieger" answering machine, but it had been such a long time he wasn't completely sure. Well, luckily it was, because I immediately called him back to let him know how great it was to hear from him. We set up a lunch meeting on campus for the following Friday.

Two things struck me as I drove onto campus after those 21 years. First, there were still lots of pretty coeds! Second, I was lost! The campus itself seemed to have about doubled in density since 1982, and the old computer science building had somehow become fused with another structure that I did not recognize at all! After groping my way to a parking lot (which, judging from the subsequent ticket on my windshield, was not the correct place to have parked), then, after a couple of false starts on foot, eventually finding and entering the A.V. Williams building (which was not there in 1982), I could see very clearly what had happened: The department had GROWN, following the course that Jack had charted starting in 1973. Jack's dream of building a world-class faculty and facility had been fulfilled! We had a great lunch, I met some of the newer faculty, and enjoyed catching up with some of my old buddies, who are now full professors instead of assistant professors, or emeritus professors instead of full professors! In all cases, I felt as though I was simply resuming conversations that had merely been dormant for 21 years. That says a lot about the stability and durability of the team that Jack and his successors built.

Toward the end of the afternoon, Jack had offered to show me all the new buildings. As we were driving around campus, he asked whether I had had any regrets about leaving academia. I told him that I had definitely missed some of the aspects of university life, most notably the daily interaction with bright people - peers, mentors, and students; but also that there were other aspects that I was overjoyed to have left behind - grading exams and administrative paperwork come to mind! But I had to say that, on balance, no, I had no real regrets. But, man, it sure was nice to be back there on that Friday after my 21-year "sabbatical", renewing ties to such a wonderful group of people! And, now that I'm officially an Adjunct Professor, I'm really quite happy to be connected with the Department once again.

Great Department and great History of Computing at Maryland, Jack! You have a lot to be proud of.

Chuck Rieger
July 3, 2003

1 Formation of the Computer Science Center

This paper traces the beginning of computing at the University of Maryland in the late 1940s at the University of Maryland through the first six years of the Department of Computer Science to 1979.

1.1 State of Computing in Universities in the United States in the 1940s–1950s

Before discussing the start of computing at Maryland, it is well to review the status of computing, and the introduction of computers at universities in the United States. As noted by Aspray[2], computer science started in American universities in the 1940s. Five universities played important roles in establishing computing: MIT, Harvard University, the University of Pennsylvania, Columbia University, and Princeton University. MIT had a long tradition in computing going back to the 1920s and 1930s with Vaneever Bush and the Differential Analyzer. The strong engineering capability at MIT led to the development of the Whirlwind computer, in 1949, under Jay Forrester. It was the first real-time computer. Harvard's entry in computing revolved around Howard Aiken, who, together with engineers from IBM led the development of the Mark I computer, installed at Harvard in 1945. The University of Pennsylvania, under the direction of John Mauchly, and J. Presper Eckert, led the team that developed the Electronic Numerical Integrator and Calculator (ENIAC), the world's first electronic calculator, completed in 1946 at the Moore School of Electrical Engineering at Penn. Columbia University and IBM agreed to establish the Watson Scientific Computing laboratory on the Columbia campus in 1945. Princeton University, influenced by the work of John Von Neumann at the Institute for Advanced Computer Studies started computer activities. All of these universities introduced computer courses into their curricula in the 1940s. Aspray considers 1945 to be the starting point for academic computing.

The 1950s was the start of the introduction of computers in the commercial market[3]. In 1951, the Ferranti Mark I and Univac I, were the the first commercial computers available. The Aberdeen Proving Grounds, which had sponsored the ENIAC computer had obtained the ORDVAC computer in 1952. IBM developed the 704, and Univac, the 1103 computer in 1956, and became the first commercial computers to use random access magnetic core memories. In 1959, the IBM 1400, 7070, and 7090; and the DEC PDP I were developed.

In the 1950s, with the availability of computers, computing was introduced at other universities. The University of Illinois, the University of Michigan, and Purdue University developed strong programs in computing. Other prominent computer science programs were developed at Stanford University in the early 1960s, and at Carnegie Mellon University in 1965. As noted by Aspray[4],

> The first doctoral program with the name "computer science," was not formed until the 1960s, and it was not the until the 1980s that the National Science Foundation gave the same institutional status of computer science as it confers upon traditional scientific disciplines such as physics, mathematics, or chemistry.

The first Ph.D. in computer science was awarded in 1965 to Richard Wexelblat by the University of Pennsylvania[5]. The designation of computer science as a distinct discipline within the NSF came during the period 1980–1982. The Computer Science Section of the NSF was under the Division of

[2] "Was Early Entry a Competitive Advantage? US Universities That Entered Computing in the 1940s," William Aspray, *IEEE Annals of the History of Computing*, Volume 22, Number 3, July–September 2000, pp. 42–87

[3] See Appendix IX of the *Encyclopedia of Computer Science*, Fourth Edition, Anthony Ralston, Edwin D. Reilly, David Hemmendinger, Editors, Nature Publishing Group, 2000, London, UK, pp. 1961–1975.

[4] See the previous footnote

[5] See the monthly column by J.A.N. Lee, "looking.back," *IEEE Computer*, October 1996

Mathematics at the time. The Advisory Committee to the Computer Science Section believed that it was important that the CS Section become a Division since computer science was a discipline in its own right, was increasingly important, and needed independence to flourish and meet its potential. The issue was brought to the NSF administration, was discussed within the NSF and it was decided that the CS Section would be made a Division[6].

1.2 Introduction to Sections

There are three major sections to the paper. The first covers the period before the start of the Computer Science Center (CSC) on February 1, 1962; the second the period 1962-1973 when the CSC started and had both computer service and academic functions; and the third period 1973-1979 that discusses the first 6 years of the start of the Department of Computer Science. Two major entities are covered: the Computer Science Center and the Department of Computer Science. The focus of the paper is on events that occurred in the Computer Science Center that impacted on the Department of Computer Science. Hence, only part of the history of the Center is covered. The two entities are intimately related. Events that happened prior to the formation of the Department are of critical importance. Wherever an event started in one period and extended to the next period, I have mainly chosen to present the entire history in the period in which it started so as not to break the continuity. This will become apparent when discussing the first computer purchased for the Center, the Center building construction, and other events.

Section **??** describes the beginning courses that taught about computers, and the events that led to the formation of the Computer Science Center and the hiring of the first Director of the Computer Science Center, Dr. Werner C. Rheinboldt on February 1, 1962. It also describes Rheinboldt's work between August 1961 when he was hired as a consultant to the University until the date that he was hired as Director.

Section **??** discusses the objectives of the Computer Science Center and how those objectives were met. The objectives, developed by Rheinboldt, and approved by the administration, were to:

1. Provide centralized high-speed computing service and programming assistance to all research activities of the University;

2. Build and administer an interdisciplinary educational program in computer sciences; and

3. Build and conduct a research program in computer sciences.

I discuss the computers selected for the Center, the work done to prepare a building to house the Center, develop a staff to run the computer, and hire faculty to start research and education programs. In addition to developing three degree programs: Master of Science, Doctor of Philosophy, and Bachelor of Science, I discuss the unique contribution made at Maryland to the development of a world-wide curriculum in computer science under the auspices of the Association for Computing Machinery (ACM). Dr. William F. Atchison, who succeeded Rheinboldt as Director of the Center in 1966, was Chairman of the ACM Curriculum Committee, Rheinboldt who was a founding

[6]Professor Jack Minker was Chair of the Advisory Committee on Computing to the Computer Science Section of the NSF during the period 1980–1982. He recalls that, as Chair of the committee, he accompanied Kent Curtis, the Director of the C.S. Section, to discuss, with top administrators at the NSF and with two prominent mathematicians, the issue of making Computer Science a Division within the NSF. The mathematicians did not support a split of computer science from the Mathematics Division. Minker noted the difficulty of finding an individual who would be acceptable to both mathematicians and computer scientists. To illustrate his point, he proposed that an applied mathematician who was also a distinguished numerical analyst and computer scientist be appointed the Director. However, the mathematicians would not consider an applied mathematician as head of the Mathematics Division. Minker believes that this diminished their arguments, and convinced the NSF administrators to make computer science a separate division.

member of that committee, and Associate Professor Earl J. Schweppe, the first professorial faculty member hired by Rheinboldt in the Center, who became a member and secretary to the committee, all played major roles in the development of a world-wide curriculum for computer science.

Section **??** discusses the formation of the Department of Computer Science in July 1973 and the selection of Dr. Jack Minker as the first permanent Chairman in 1974. I describe the problems faced by a new department and the growing number of students that had to be handled when the Bachelor of Science Degree, approved in 1973, was initiated in 1974. The history is terminated in 1979 when Minker completed his five (5) year tenure as Chairman and returned to research, teaching and service in the Department.

Several appendices are listed following the main text:

1. Appendix 1 - List of Computer Science Courses Offered in 1973;
2. Appendix 2 - Chronology of Significant Events up to 1979;
3. Appendix 3 - List of Faculty in the Computer Science Center, 1962-1973;
4. Appendix 4 - List of Faculty in the Department of Computer Science, 1973-present;
5. Appendix 5 - List of Personnel in the Computer Science Center in 1968.
6. Appendix 6 - List of Equipment in the Department of Computer Science Laboratory as of July 1979.
7. Appendix 7 - List of Doctoral Students, 1973–1979

1.3 Computing at Maryland Before 1962

This section discusses the state of computing in the University before 1962. It discusses computer usage during the late 1940s-1962 time period, the introduction of the first computer courses on campus, the steps leading to the formation of the Computer Science Center, and the hiring of Professor Werner C. Rheinboldt as Director, and Mr. John Menard as Assistant Director.

1.3.1 Computer Usage

The use of computers for research and administration started in the late 1940s/early 1950s at the University of Maryland. As happened at many universities, the computing activities arose in many different departments. As noted in an undated memorandum by Werner C. Rheinboldt (circa 1962)[7], Director, "The Computer Science Center at the University of Maryland,"

> The lack of a central computing center on the campus has not prevented the build-up of a substantial computing effort for the research projects of a large number of faculty members. ..., these computing efforts have made extensive use of the machines available in the area, but they were often hindered by these inadequate or inconvenient arrangements. ...

The report noted that the most substantial computing projects were being undertaken by the Physics Department in connection with their high-energy nuclear physics projects (involving bubble-chamber, counter and nuclear-emulsion experiments). Other computing included calculations in

[7]The seven (7) page undated document by Werner C. Rheinboldt, "The Computer Science Center at the University of Maryland," may be found in the Menard collection in the University of Maryland Archives, Hornbake Library.

space physics, plasma-physics, quantum-field theory, astro-physics and solid-state physics. Molecular physicists were also using computers. An accurate figure of the time used per week for these computations is not known. As noted below, there were some computers on campus, but none were adequate for research. Computer time was obtained outside the University on machines, one of which was an IBM-7090.

Scientists in the Institute for Fluid Dynamics and Applied Mathematics were also using computers. The Fluid Dynamics group's work included the problem of waves in a plasma, structure of shock waves and other computations. The Applied Mathematics group (together with the Mathematics Department) developed an extensive theory for finding eigenvalues of boundary value problems for partial differential equations.

A large project within the Chemistry Department dealt with the analysis of crystallographic structures.

The Social Science Departments were conducting statistical studies using various computers.

The College of Agriculture had a number of efforts including one from the Department of Animal Husbandry on genetics effects in poultry breeding.

The Engineering Departments had numerous projects. These were done on the IBM-1620 computer within the Engineering College and using outside computers.

In the School of Medicine on the Baltimore campus, several statistical studies of problems in Psychiatry and Obstetrics and Gynecology were using various computers as were other medical activities on that campus.

There were several computers on the College Park campus:

1. An IBM-1401 auxiliary satellite computer used for administrative work.

2. An LPG 30 computer used for space research in the Department of Physics.

3. An IBM-1620 computer in the College of Engineering used both for research and teaching.

None of the three computers was particularly useful for research or scientific computation. The IBM-1401 was used for administrative work and was essentially used as a printer. The LPG 30, although considered as 'general purpose,' and used for space research, was hardly adequate for scientific computation. The IBM-1620 was used in the College of Engineering for some limited work in research, and for assembly language coding in the course EE 131, *Electronic Digital Computers*, (see Section **??**). Hence, effectively, there was no computer support for research on campus until a centralized computer facility was started and an IBM-7090 was acquired in 1963 (see Section **??**).

1.3.2 Computers and Education

In addition to the above computing activities, courses concerning computers were being introduced in various departments: Mathematics, Electrical Engineering, Business Administration, and Chemical Engineering.

The first course that discussed the use of computers for calculations was taught in the Fall 1948 semester by Dr. Harry Polachek, who was a part-time Associate Professor in the Mathematics Department. Dr. Polachek[8] worked at the Naval Research Laboratory and was responsible for their

[8]Jack Minker sent a letter to Dr. Polachek in October, 2002 asking about any remembrances he may have had of the courses he taught at Maryland. Unfortunately, in a response received from Dr. Polachek's daughter, Mrs. Linda Brokaw, he learned that Dr. Polachek died February 23, 2002. Dr. Polachek worked at the Naval Research Laboratory on mathematical and computational solutions to Naval problems. In the early 1950s he was Chief, Applied Mathematics Division, Naval Ordnance Laboratory, White Oak, Maryland, which acquired, housed and utilized, the second computer owned by the U.S.Navy. He received the following awards: *U.S. Navy Meritorious Civilian Service Award, 29 December 1951; U.S. Navy Distinguished Civilian Service Award, 3 November 1960; and the Department of Defense Distinguished Civilian Service Award, 19 April 1961.*

computing activities. He taught a course, Numerical Analysis Math 135 for undergraduates, and a course, Advanced Numerical Analysis, Math 235. Part of the course was devoted to computational issues. The catalog description for Math 135 that describes computational issues reads,

> Survey of high speed calculators; applicability of numerical techniques. Evaluation of errors in extended calculations; round-off and truncation errors. ...

On a final examination for Math 235 he asked the following question,

> In a recent article in the Bulletin of the AMS (Nov. 1947) J. von Neumann and H. Goldstine define the concepts of digital computers and pseudo-operations[9]. Discuss these concepts, and prove *in detail* the following inequalities. ....

Dr. Polachek was intimately familiar with computer developments and, although there is no record of what he taught, it is clear from the catalog description above, and the question he asked on the final examination on Math 235, that he discussed computational issues for digital computers in his courses. He taught the first computer course on numerical analysis at Maryland.

Perhaps the earliest course on programming was introduced by the Mathematics Department in the spring 1955 semester (January 1955). The course, Math 156, *Programming for High Speed Computers* was taught by Assistant Professor David M. Young, Jr[10] After his Ph.D. at Harvard, where his thesis advisor was Professor Garrett Birkhoff, he worked at the Aberdeen Proving Grounds (APG) for a year and then taught at the University of Maryland from 1952-1955[11]. Dr. Young's course was primarily about numerical analysis. The students would take field trips to APG to use the Ordvac computer on which they did programming projects in machine language—Fortran did not become available until 1956. There were about 30 students in the course. He was assisted by Charles H. Warlick[12] who was a graduate student at Maryland and had previously worked with Dr. Young at APG.

The catalog description for Math 156, *Programming for High Speed Computers*, read,

> Prerequisite - Math 21 (Calculus) or equivalent
> General characteristics of high-speed automatic computers: logic of programming, preparation of flow charts, preliminary and final coding; scaling, use of floating point routines, construction and use of subroutines; use of machines for mathematical operations and for automatic coding. Each student will prepare, and if possible, run a problem on a high speed computer.

The Electrical Engineering Department hired a lecturer, Dr. Yaohan Chu, to teach the first hardware-oriented courses on campus. Dr. Chu became a Professorial faculty member of the Electrical Engineering Department and the Computer Science Center in the 1960s. In the fall 1957

[9] John von Neumann and H.H. Goldstine, "Numerical Inverting of Matrices of Higher Order," Bulletin of the American Mathematical Society, Nov. 1947, 1021–1099.

[10] Dr. Young is very well-known for his work in numerical analysis and spent most of his career at The University of Texas at Austin becoming the Ashbel Smith Professor of Mathematics and Computer Sciences. In addition, he was the Director of the Computation Center, 1958–1970, and the Center for Numerical Analysis, 1970–1999. Some of his honors include Fellow of the American Association of the Advancement of Sciences and the ACM Award for Outstanding Contribution to Computer Science, 1990.

[11] Personal e-mail correspondence from David R. Kincaid to Jack Minker, 8/29/02. Dr. Kincaid talked to Dr. Young as requested by Minker and sent the information to him. The email is contained in the Minker list of emails concerning the history of the Department in the Minker collection in the University of Maryland Archives, Hornbake Library.

[12] Dr. Warlick also spent most of his career at The University of Texas at Austin and became the Director of the Computation Center, 1970–1996.

semester (September 1957), he taught the first course, EE 130, *Electronic Analog Computers*. No analog computers existed on campus at that time. The analog computer course was offered only twice, as the course on digital computers that he introduced in 1958 was more popular. He taught from his own notes, since no text existed on the subject.

The catalog description for EE 130, *Electronic Analog Computers*, read,

> Prerequisites - EE 101 (Engineering Electronics), Math 64 (Differential Equations for Engineers)
> Principles of electronic computers of the analog type. Analog computing components, operational amplifiers, d-c amplifiers, instrument servos, multipliers, and function generators.

The course, EE 131, *Electronic Digital Computers*, introduced by Chu in the spring 1958 semester (January 1958), was the first course on campus to teach the organization of digital computers. Dr. Chu does not recall the number of enrollees in the first offering, but estimates that there may have been about 20-30 students. There were no suitable text books available and so he started to write a digital computer design book in 1960 which was published two years later by McGraw Hill. The first course covered mostly logic design and later, additionally, when computers became available on campus he introduced the students to assembly language programming[13]. The students used an IBM-1620 computer which was installed in a separate room under the direct control of the Dean of Engineering.

The catalog description for EE 131, *Electronic Digital Computers*, read,

> Principles of electronic computers of the digital type. Digital computer operations, basic computing and control circuits, logical design, arithmetic unit, memory systems and control units.

Shortly after, there were a number of directly computer-related courses introduced in several departments, some of which are as follows:

1. Business Administration 101, *Integrated Data Processing* for Internal Control, a bridge between accounting principles and the handling of large columns of data in business and government operations.

2. Business Administration 102, *Electronic Data Processing Systems*, a continuation of B.A. 101, concerned primarily with the electronic digital computer and its use as a business data processor.

3. Business Administration 103, *Office Automation and Management Problems*, administrative problems experienced in introducing computers systems and the effect of office automation upon management and organization applied to case situations.

4. Chemical Engineering 100, *Seminar*, consisted of lectures and laboratory periods and introduced students to the principles of electronic computing and especially the use of the IBM-1620.

[13] In a personal e-mail from Dr. Chu to Jack Minker on August 29, 2002, he discussed both courses, EE 101 and EE 103, contained in the Minker emails regarding the Department history in the University of Maryland Archives, Hornbake Library.

All of the above courses numbered between 100 and 200 were upper level undergraduate and lower level graduate courses. In addition to these courses, several departments incorporated computers into their courses: Mathematics, Economics, Business Administration, Chemical Engineering, Electrical Engineering, Physics, Public Administration, Agriculture, Education, Psychology, and Sociology.

1.4 Toward a Centralized Computing Activity 1961 to 1962

1.4.1 Hiring a Director for a Computer Center

As noted above, there was a fair amount of computing on campus before 1960 in support of research and teaching. Several departments were using computers both on and off campus at places in the Washington, D.C. metropolitan area such as the National Bureau of Standards, Aberdeen Proving Grounds, the Naval Ordnance Laboratory, the Naval Research Laboratory, the David Taylor Model Basin, the National Security Agency, and the Goddard Space Flight Center. This computing activity led some faculty members and chairs of departments to advocate the development of a centralized computing activity. It is unclear who precipitated the idea to have a central computing activity, but John Toll, the Chair of the Physics and Astronomy Department, Dr. Monroe Martin, Director of the Institute for Fluid Dynamics and Applied Mathematics (IFDAM), and others were involved in these discussions[14].

The first official action by the University of Maryland administration to consider a central computing activity came in October 1957 when President Wilson E. Elkins appointed a committee consisting of university faculty and administrators to study the need for a Data Processing Center or a Computer Center. Dr. John Toll, Chairman of the Department of Physics, was Chairman of the committee. The committee reported to President Elkins in February 1958. On September 30, 1959, at a meeting of the Board of Regents, it was requested that in the 1960-1961 budget a new project be requested.

> The necessary funds for the establishing a Data Processing Center that will serve the research activities throughout the University. This project is a budget request in general funds of $65,582 for the 1960-61 fiscal year, and approximately $45,000 each year in the foreseeable future in order to allow the University to establish this center for the rapid computation of research data in the expanding research program.

The budget was accepted by the Board[15].

The funding by the Board was clearly not enough to start a Center. Furthermore, no action was taken by the University from February 1958 to September 1959 to develop a computer Center. From September 1959 it took until late 1960/early 1961 to initiate a search for a Director of a Center. Other state universities, such as the University of Illinois, the University of Texas, Syracuse University, and the University of California at Los Angeles, had already started to form computer centers in the early 1950s. Before the University contemplated a computer center, IBM, in the early 1950s, had an active 'university program' (under Dr. Jim Kearns) and ran periodic computing center director meetings at their education centers in Endicott and Poughkeepsie. There were usually some 25-30 computer directors at each meeting and around 1960 the discussions were

[14] In a personal conversation with Dr. John Toll, on August 14, 2002, he could not remember who exactly was involved, but mentioned Dr. Monroe Martin, Director of the Institute for Fluid Dynamics. His personal papers for that period of time have not been indexed at the Hornbake Library, and he could not recall the details. In a phone conversation with Dr. Martin in November 2002, Jack Minker asked him if he was on the Toll Committee. Dr. Martin did not remember, but thought he might have been on leave at the time.

[15] Board of Regents, Vol. 15, September 30, 1959, pp. 222-15–223-15.

turning toward the need for educational programs in the field, and to upgrading their first computer systems.

Although I tried to contact many individuals who were at Maryland during the period 1940-1960, some had no remembrances, others were deceased, and little documentation was found. Dr. Thomas B. Day[16], who came to the Physics Department at Maryland in 1957, when asked about the origins of the Toll Committee, speculated that:

> I would assume that Toll went to Dean Charles Manning and persuaded him we (Physics) were going into experimental high energy physics (HEP); and must have good compute-power to rapidly attract a good group. There was also interest in solid state, and nuclear physics; not to mention the Institute of Fluid Dynamics and Applied Math, where several physics-like people were doing computer-needy computations. Manning liked Toll and Physics, and encouraged the small department to get big/better. (When I came as research associate in fall 1957, there where about 10 faculty. When I left in 1970 to become Vice Chancellor, there were about 100. And Manning backed us all the time. He had a good rapport with Hornbake.) ... My further guess is that in 1956/57 Toll was trying to recruit George Snow to start HEP–while Snow did some theory, his interest then was in the new field of elementary particles, and particularly bubble chamber experiments. It was a big gamble for a small department like UMCP Physics to get into this area. And it was well known that it couldn't be done without good computing. I remember Dick Ferrell (solid state) helping Johnny to get Snow; and Dick knew we needed computers. He was probably the most influential Full Professor then, although Hornyak, nuclear experiment, was also[17].

Two documents by faculty at Maryland advocated a central computing activity in early 1961[18]. A document dated May 1, 1961, concerning computer activity at the University of Maryland was a nine page memorandum, written by R. Esch of the Institute for Fluid Dynamics. The document does not specify to whom it was addressed. The document discusses Preliminary steps, Choice of a computer and computer cost, Financial setup, Service organization, and Academic program. The memorandum foresaw a Director for the center, someone who had a background in numerical analysis, and the development of service courses, a Master's degree and eventually a Ph.D. degree in computing.

Another memorandum of 5 pages was apparently written by Dr. Abraham Sinkov[19]. It is undated, but from its content, it is clear that the document must have been written before 1962.

[16]Dr. Thomas B. Day came to the University of Maryland in 1957 as a Research Associate in Physics. From 1970-1978 he was Vice-Chancellor for Academic Planning and Policy at Maryland and then served as President of San Diego State University from from 1978-1999, where he is now President Emeritus. His reminiscences are contained in two email messages to Jack Minker, dated November 21, 2002 and November 22, 2002, and are included in the list of email messages on this history contained in the Minker collection in the University of Maryland Archives, Hornbake Library.

[17]I tried to contact some of those mentioned in Dr. Day's remembrances. Unfortunately, George Snow had died, attempts to reach Hornyak, who apparently is ill, were not successful, and Dick Ferrell did not recall what had transpired.

[18]The documents are contained in John Menard's files of the Computer Science Center. One document, dated May 1, 1961, was by a R. Esch with no recipient noted. Dr. Esch appears to have been a visiting faculty member in IFDAM. A second memorandum, unsigned, undated and unspecified as to the recipient of the document contained a note on the memorandum in Rheinboldt's handwriting that states, "Memorandum written by Dr. Sinkov about Computer Science Dept." These are contained in the Menard collection in the University of Maryland Archives, Hornbake Library.

[19]Dr. Sinkov was Technical Director at the National Security Agency (NSA) and regularly taught a course (Math 156), on computer use and applications. The NSA had many computers to assist in their work in code breaking.

It discusses the need for computing at Maryland, and the "... establishment in some schools of an academic entity specializing in the field of computer science." It further lists broad areas of possible course coverage:

1. Machine Design
2. Programming
3. Machine Languages
4. Numerical Methods
5. Operations Research
6. Information Retrieval

Organizations in Washington, D.C. that had computer activities are listed (see listing in first paragraph of this section) and an inter-university arrangement on a Data Processing Institute was outlined.

Whether or not the memorandums by Esch and by Sinkov caused further action is not clear. There were, undoubtedly many faculty members who were concerned that the university was not moving sufficiently fast to develop a computing capability to support research and education.

In late 1960, early 1961, the University initiated a search committee, to find a Director of a Computer Center[20]. Dr. Monroe Martin was Chairman of the search committee[21]. It is likely that the memorandums by Esch and by Sinkov were discussed with the search committee. The date on the Esch memorandum of May 1, 1961 gives credence to this conjecture, since, as noted below, the committee to search for a Director of a Center was functioning in May 1961. In addition, Sinkov was apparently a consultant to the search committee and the memorandum probably represented his comments to them.

The committee interviewed many individuals, including Professor Werner C. Rheinboldt. Dr. Martin, who had brought Dr. Rheinboldt from Germany in 1956 to be a Post Doctoral Fellow in IFDAM, and was Chairman of the search committee, wrote to Rheinboldt and inquired as to his interest in becoming Director of a new computer center at Maryland. Rheinboldt had been at Maryland as a Post-Doc from 1956-1957. He then moved to the National Bureau of Standards from 1957-1959, where he became involved with computing, and then became the Director of the Computer Center at Syracuse University in 1959. Although he was content at Syracuse, Rheinboldt decided to consider the position and visited the University the week of May 14, 1961. In a letter to Professor Monroe Martin dated May 20, 1961[22], Rheinboldt thanked him for his hospitality and invitation to lecture in IFDAM. He further stated,

[20]The members of the search committee were: Professor Monroe Martin, Director of the Institute for Fluid Dynamics and Applied Mathematics (IFDAM), Professor Leon Cohen, Chairman of the Mathematics Department, and Professor John Toll, Chairman of the Physics Department.

[21]A Draft of a History of IFDAM and its successor, named the Institute for Physical Science and Technology (IPST), of December 22, 1999, by Dr. Ruth Kastner, states that Martin informed her in a personal interview which she taped, that he was Chairman of the search committee. The tape of the interview is available in the Monroe Martin Collection, University of Maryland Libraries, Hornbake Library. The Kastner Draft History of IPST is in the Minker collection in the University of Maryland Archives, Hornbake Library. Permission to listen to the Martin tape was granted to Jack Minker by Dr. Martin's daughter, Mary Helen Goldsmith on November 27, 2002. The tape was interesting, but contained no new revelations concerning the Director search. The permission appears in the Minker collection in the University of Maryland Archives, Hornbake Library.

[22]The letter appears in the Dr. Lee Hornbake collection of papers in the University of Maryland Archives, Hornbake Library, Box 606.

> I have been working on some proposals for computer installations at your University and, if all goes well, I will be sending them to you some time this coming week. The idea of installing a computing center of that size at the University of Maryland would certainly be an intriguing challenge and I shall continue to give it my warm and interested consideration[23].

The matter of a computer center was again brought to the attention of the Board of Regents on June 15, 1961[24]. The University made a request of the Board of Regents

> ... strongly urging that a computing center be established with the purchase or rental of a machine having the capacity of an IBM 650.
>
> The University asking budget for 1959-1960 and again in 1960-1961 presented this need as a "New Program." The 1960-1961 request led to the appropriation of $65,582 to be supplemented by $35,000 from the National Science Foundation in order to initiate the operation of the center.

In the same Board of Regents minutes cited above, in Vol. 17, it states that an intensive search was made during the Fiscal Year and that many persons were interviewed. It was reported that the Committee had chosen an "outstanding young man," and had received his informal concurrence that he would join if a computer of adequate size were purchased.

During Rheinboldt's interview in May 1961[25] he spoke to a

> ... very determined group of faculty members ... I became convinced that the only way to proceed was to start big right away. I have to give credit to John Toll, Monroe Martin, and the two Vice-Presidents (Hornbake and Kuhn) that they agreed with my assessment. This is what finally convinced me to accept the job.

On August 24, 1961, Dr. Hornbake announced that Werner C. Rheinboldt had accepted the position of Director of the Computer Center[26]. On September 29, 1961, President Elkins recommended the Board of Regents approve

> The appointment of Dr. Werner C. Rheinboldt as Director of the University of Maryland Computation Center and Research Associate Professor of the Institute for Fluid Dynamics, ...

The Board approved the appointment.

A photograph of Rheinboldt taken in the 1960s or 1970s appears in Figure **??**.

1.4.2 Director-Designate Rheinboldt's Activities, August 1961 - February 2, 1962

eRheinboldt started to work on the establishment of a Computer Center starting when he was hired as a consultant in August 1961, after he had been appointed Director-Designate of the Center. He was a consultant up to the date he started as Director on February 1, 1962. During this six month period he focused on several tasks:

[23] Letter from Werner C. Rheinboldt to Dr. M.H. Martin, dated May 20, 1961,contained in Box 606, of the Hornbake Collection in the University of Maryland Archives, Hornbake Library.

[24] Board of Regents, Vol. 17, Minutes of the meeting of June 15, 1961, pp. 107-17 through pp. 109-17.

[25] Personal e-mail communication from Werner Rheinboldt to Jack Minker, September 7, 2002, in the Minker collection, the University of Maryland Archives, Hornbake Library.

[26] Memorandum from R. Lee Hornbake, dated August 24, 1961, Re: Computation Center, in the Hornbake collection, University of Maryland Archives, Hornbake Library.

Figure 1: Werner C. Rheinboldt, First Director of the Computer Science Center.

1. Planning for a New Building
2. Determining a Computer to Purchase
3. Writing Proposals for Research
4. Developing Relations with the Medical School at Baltimore

Rheinboldt considered writing proposals to support the Center after he had accepted the position of Director. Since he had contacts at NASA, he decided to approach them with the prospect of writing a proposal to them. His contacts with NASA had been through Goddard (where he knew someone there from the National Bureau of Standards and was introduced to others by colleagues in IFDAM). At the request of the Goddard people he recalls writing a fairly brief and informal proposal of what he would like to get going as part of the Center at Maryland and submitted it to them. He estimates that this was probably some time in October 1961.

Also, in October 1961, Rheinboldt visited Maryland as part of his consultant activities to start the planning for the new computer center. He invited John Menard to accompany him hoping to lure him to Maryland, to involve him in the planning process, to meet the people at Maryland, and to familiarize him with the physical layout of the campus and facilities. They met with Dr. Hornbake, Dr. Martin, Dr. Cohen and Dr. Toll. On that trip they reviewed a number of possible locations for the computer center. Menard made sufficient notes so that upon his return to Syracuse he was able to analyze the pros and cons of each location and to draw up some preliminary sketches of computer rooms, unit record rooms, user work areas, office layouts, mechanical rooms, and other details.

On the return trip to Syracuse they discussed[27] a number of issues. According to Rheinboldt[28], on that trip they discussed his contacts with NASA, and his views on developing research and educational components of the Center. All this suggested to Menard that the broader view of the new Center must be reflected in a suitably broader name and came up with 'Computer Science Center'. Rheinboldt recalls that he liked that idea from the outset. They also discussed the need to write a proposal to IBM for funding beyond the 60% educational discount allowance. Rheinboldt subsequently wrote and submitted the proposal to IBM. With the help of Dr. Emanuel Piore at IBM White Plains and Dr. Jim Kearns, the IBM National Education Representative, they succeeded in obtaining a $300,000 grant with no strings attached.

In a message to Dr. Ruth Kastner, who was writing a history of the Institute for Physical Science and Technology (IPST), referring to the IBM grant, Rheinboldt, who had been a member of IPST, wrote[29],

> At the same time, I had established contacts with the nearby Goddard Space Center and, after many discussions, succeeded in getting a grant[30] for "Computer-Oriented Research in the Space-Related Sciences" with the aim of establishing besides the computing facility also a research program in, what we might now call, applied computer science. This proved to be a significant modification of the original plans for the center and was

[27] Personal e-mail communication from John Menard to Jack Minker, dated July 21, 2002 in the list of email messages regarding this history in the Minker collection, University of Maryland Archives, Hornbake Library.

[28] In a personal communication to Jack Minker dated September 7, 2002. In the email messages of the Department history, the Minker collection, University of Maryland Archives, Hornbake Library.

[29] Rheinboldt's letter was in an e-mail message to Ruth Kastner, dated October 23, 1999, and is contained in an e-mail sent to Jack Minker by Dr. Kastner on August 29, 2002, contained in the Minker collection, University of Maryland Archives, Hornbake Library.

[30] Although Rheinboldt discussed such a grant with NASA in October 1961, it was not until September 1962 when a proposal was written, and February 1, 1963 that such a grant was obtained.

reflected in the choice of the name "Computer Science Center". It was Monroe Martin who helped me to get the approvals for this from the University, notably Dr Kuhn, the then Executive Vice President and Dr. Hornbake the Vice-President for Academic Affairs.

In a personal communication from John Menard[31], he provided an interesting chronology of how the NASA grant evolved. A slightly edited version of Menard's remarks follows.

> What I want to address is the chronology of the grant activity. On April 26, 1962, Werner submitted a proposal to NSF for $758,674 in support of a 3-year project. I believe you have a copy of this proposal in the "Bible[32]" I loaned you in January. At this particular time several universities had submitted proposals for support of computer centers and computer equipment. NSF funded several of these and ran out of funds. They felt the remaining proposals were worthy of support and looked for ways to find additional funding. They called a meeting of the other government agencies and placed all these proposals on a table and invited these other agencies to look them over and select any that they might be able to fund. NASA picked our proposal off the table and said they were interested in funding it. Unfortunately, they did not have a program whereby they could give a direct equipment grant. We were then asked to rewrite it as a research proposal. We therefore rewrote the proposal for space oriented computer research and submitted that on July 10, 1962. A copy of this proposal is also in my "Bible". Werner was leaving for Europe and I had just arrived fulltime on July 1, so you can imagine how hectic those 10 days were and how frantically we worked. But this was not the end of the story. NASA came back to us again later in the fall and asked us to revise the proposal again. This revision was submitted on December 31, 1962. Again a copy is in the "Bible". You can imagine how hard we worked over the Christmas holidays to prepare, obtain University approvals, and submit this revision.

Rheinboldt also wrote to Dr. Kuhn[33], recommending the name "Computer Science Center," and specified three objectives for the new Center:

1. Provide centralized high-speed computing service and programming assistance to all research activities of the University;

2. Build and administer an interdisciplinary educational program in computer sciences; and

3. Build and conduct a research program in computer sciences.

Vice-President Kuhn and Vice-President Hornbake approved of this and advocated the name "Computer Science Center" to President Elkins. In a memorandum dated November 30, 1961 from Vice-President Kuhn to Rheinboldt, he reported that President Wilson Elkins had approved the name for the new computer activity to be the "Computer Science Center." Vice-President Kuhn noted that this would connote that a broader intent was intended for the Center than a service organization[34].

[31] e-mail message from John Menard to Jack Minker dated July 11, 2003, contained in the list of e-mail messages on this history is in the Minker collection in the University of Maryland Archives, Hornbake Library.

[32] The "Bible," referred to by John Menard is one of five notebooks that consists of valuable information retained by John Menard and is in his home. It is hoped that eventually these documents will be donated to the University of Maryland Archives and will be retained with the other documents in the Menard collection in the Hornbake Library.

[33] Personal message from Werner Rheinboldt to Jack Minker, dated September 7, 2002, in the e-mail messages in the Minker collection in the University of Maryland Archives, Hornbake Library.

[34] Box 606 of the Hornbake Collection at the University of Maryland Archives, Hornbake Library.

According to John Menard[35].

> It was the first such computing facility in the world to be named Computer Science Center.

Rheinboldt wanted Menard to join him at Maryland. He had sent Vice-President Hornbake a letter dated October 11, 1961 recommending Menard for the position of Assistant Director of the Center[36]. However, the University had not made a decision to offer him a position, which prompted Rheinboldt to write to Hornbake on December 16, 1961 urging him to make a decision to hire Menard[37]. Hornbake in a letter to Menard dated January 19, 1962 offered him the position. Although Menard was reluctant to leave Syracuse as he had just moved there and had purchased a house, he accepted the position on January 24, 1961 with the understanding that he would start on July 1, 1962. On February 26, 1962 he was retained as a consultant by Maryland to assist Rheinboldt with the establishment of the new center.

Determining a Computer to Purchase. As noted above, Dr. Emanuel Piore of IBM was instrumental in Maryland receiving a 60% reduction in cost for the IBM-7090 and a $300,000 grant. The meeting between Werner Rheinboldt and the IBM representatives from White Plains, Dr. Piore and Dr. Jim Kearns, took place some time either before or during October 1961. Dr. Piore apparently worked things out with Dr. Charles B. DeCarlo to whom Rheinboldt had written, to secure the favorable treatment. Rheinboldt's letter to Dr. DeCarlo, dated October 25, 1961[38], states that together with the members of the planning committee for the Center[39], they had concluded

> ... that, an IBM-7090 Data Processing System would be the most desirable and effective system for the installation in the planned Computer Science Center. The Administration of the University concurs with this conclusion and it is planned to recommend to the Board of Regents of the University at the earliest possible time that the IBM-7090 system - as described in the appendix to this letter - be placed in order.

Rheinboldt further requested support from IBM for the purchase, and wrote,

> In order to establish the planned Computer Science Center and to begin the educational and research programs of the Center as outlined above, the University of Maryland requests the consideration by the IBM-Corporation for support of the Center in the form of a grant-in-aid of $300,000 toward purchase of the IBM-7090 system in addition to the educational discount.

The support obtained from IBM for the purchase of the computer was critical since the Board had not authorized sufficient funds to acquire the IBM-7090. The Board of Regents approved the purchase of the IBM-7090[40].

[35] Personal e-mail communication from John Menard to Jack Minker, dated July 19, 2002, in the e-mail messages concerning the Department history of the Minker Collection, University of Maryland Archives, Hornbake Library.

[36] Letter from Rheinboldt to Hornbake, dated October 11, 1961, is in the private papers of John Menard.

[37] Box 606 of the Hornbake Collection at the University of Maryland Archives, Hornbake Library.

[38] Letter from Dr. Werner C. Rheinboldt to Dr. Charles B. DeCarlo dated October 21, 1961, in Box 606 of the Hornbake Collection in the Hornbake Library at the University of Maryland.

[39] The faculty members most instrumental in these planning efforts are: Dr. M.H. Martin, Director of the Institute for Fluid Dynamics and Applied Mathematics; Dr. L. Cohen, Chairman of the Mathematics Department; Dr. J. Toll, Chairman of the Physics Department; Dr. A. Patrick, Head of the Department of Office Management and Business Techniques.

[40] Board of Regents, Vol 17, January 26, 1962, pp. 262-17 through 263-17.

The proposal to start the Computer Science Center with the installation of the IBM-7090/1401 system was an interesting and difficult decision. Most universities were just moving to IBM-7070 or similar systems. The IBM-7090 was considered extremely large and powerful and many individuals believed it had far more power than appropriate for a University computing facility.

Planning for a New Building. It is not clear when the decision was made to construct a building for the new Center. However, it must have been discussed during the time Menard and Rheinboldt visited Maryland on October 1, 1961. As noted above, Menard was developing plans for a building following their visit. In a letter to Dr. DeCarlo of IBM, Rheinboldt, states[41],

> Plans for housing the Center have not yet reached the final decision stage. Possibilities exist either to convert an existing, separate building for the exclusive use of the center, or to build a new building altogether.

Rheinboldt further states,

> ... the University has to set aside funds to cover the following tentative expenses for the establishment of the Computer Science Center proper:
>
> | | |
> |---|---|
> | Building costs (incl. airconditioning (sic)), tentative estimate | $350,000.00 |
> | Installation cost of the Center | $60,000.00 |
> | Purchase cost of the IBM-1401 system | $81,000.00 |

The Board of Regents minutes of November 17, 1961[42] states that planning had been underway for some time and that the Board had set aside funds for the establishment of a computer center. The Building Committee had recommended the location of the building to be near the Glen L. Martin building. However, in the Board meeting of January 26, 1962 it was decided to change the location to the area between Jull Hall (Poultry) and Molecular Physics[43]. The change was caused by problems that might arise with tapes being demagnetized by the magnetic fields emanating from the Physics Department. This became the final site where the Center is now located. The decision to construct a building must have been made between October 25 and November 17, 1961. The Board minutes neither indicate that they approved the construction of a new building nor the allocation of funds to such a building. According to the remembrances of Menard[44], the Administration turned to creative funding and

> ... found the funds in the non-State part of its budget.

A contract was given to Alfred M. Rinaudot, A.I.A., Registered Architect who developed an architectural diagram for the ground floor plan on January 6, 1962[45]. He drew his plan using the material developed by Menard following their visit to Maryland in October 1961. Rheinboldt had reviewed Menard's plans. Rheinboldt visited with Mr. Rinaudot and Mr. George Weber, Director of Physical Plant of the University, to discuss the plans with them on January 11 and 12, 1962 and to coordinate with them. A photograph of the initial stage construction of the Computer Science Center is shown in Figure **??**.

[41] Letter from Dr. Werner C. Rheinboldt to Dr. Charles B. DeCarlo dated October 21, 1961, in Box 606 of the Hornbake Collection in the University of Maryland Archives, Hornbake Library.

[42] Board of Regents Minutes, Board of Regents, Vol 17, January 26, 1962, p. 193-17.

[43] Board of Regents Minutes, Board of Regents, Vol. 17, January 26, 1962, pp. 228-17 through 230-17.

[44] Personal e-mail message from John Menard to Jack Minker dated July 21, 2002, in the list of e-mail messages concerning the History of the Department, contained in the Minker collection in the University of Maryland Archives, Hornbake Library.

[45] A copy of the ground floor plan developed by the architect is contained in Box 606 of the Hornbake Collection in the Hornbake Library at the University of Maryland.

Figure 2: Initial Floor of Computer Science Center Building Construction, Centerville Hall on right, and Cambridge Hall on left, 1962, Courtesy of John Menard.

Menard relates the following information concerning his and Rheinboldt's involvement in the planning for the new building and their relationship with Vice-President Kuhn and the architect[46].

Menard and Rheinboldt considered many locations for the Center. One was within the Engineering Research Building. They developed a rough plan for the computer room and supporting rooms. These plans were discussed on campus and their plans were priced out to determine the feasibility of the location. They detailed the air conditioning load, electrical requirements plus access and egress to the facility of parking. Menard conjectures that the extensive mechanical and electrical requirements were probably deciding factors that caused the campus to decide to construct a new building.

Menard and Rheinboldt worked with Weber, and Bill Horsey, one of Weber's senior design and planning people. They in turn were working with the architect, Alfred M. Rinaudot, A.I.A., Registered Architect. (Mr. Rinadout died in 1963, shortly after they moved into the building.) Once the campus decided to construct a new building to house the Center, they were given the outside dimensions of the first floor and Menard and Rheinboldt filled in the rooms, hallways, etc. They did not follow the State practice of writing out, page by page, the requirements for each room and then let the architect dream up a configuration. Instead, they drafted, to scale, a complete layout of the building, just as an architect would have done. Rheinboldt took Menard's single line drawings and met with Rinaudot who turned them into double line drawings, adding features for the mechanical system and electrical wiring. The architect also adjusted the locations of walls to coordinate with the fenestration of the building. This determined the size of single and double offices and other utility rooms. Extensive details about the needs for air conditioning, special wiring, and electrical loads of the computer and unit record equipment were provided by Menard and Rheinboldt. The plans were then returned to them to locate electrical outlets, telephone outlets, switches. closets, storage, and other details.

Once they had designed the entire first floor plan, they priced it out to see if it was within budget. Dr. Kuhn called a meeting to discuss the status of the project which Rheinboldt attended.

[46]Personal e-mail from John Menard to Jack Minker, July 30, 2002, contained in the list of messages regarding the History of the Department in the Minker collection in the University of Maryland Archives, Hornbake Library.

Figure 3: Computer Science Center Building, November 1962, Completion of Bricking-in of First Floor, Centerville Hall in background, Courtesy of John Menard.

It was determined that the project was exceeding budget. Dr. Kuhn took his red pencil and drew a line across the drawing separating the plan into 1/3 and 2/3. He then stated that the 1/3 was to be future development that the plan needed to be redrafted to show how it would operate with only the 2/3 portion.

It was a huge challenge to fit all the essential features into 2/3 of the space. They redrew the plan and worked closely with the architect to assure everything would work. One of the hard fought battles involved the mechanical system. The tight budget did not permit a dropped ceiling to hide all the pipes in the ceiling for the hot water/chilled water system. Their request for a dropped ceiling to cover the pipes was denied. Menard reports the following incident,

> ... one day my insurance agent came to see me on campus and I brought him over to see the new building in construction. Upon entering the door he immediately exclaimed "What a wonderful submarine you have here." This event was reported to Dr. Kuhn and we then were granted the change order for the dropped ceiling.

The first phase of the building consisting of the basement and ground floor was completed in February 1963 in time for the computers to be installed. A photograph of the Center building, shown in Figure **??**, taken in November 1962 shows the completion of the bricking-in of the first floor of the building.

In reminiscences by John Menard[47], he recalls that on the day IBM turned over the IBM-7090 to the Center, Dr. Thomas B. Day of the Physics Department was in the computer room executing a program with John Bielec, the first operator, running the computer.

[47]Menard's reminiscences are contained in email messages to Minker concerning this history, contained in the Minker collection in the University of Maryland Archives, Hornbake Library.

In a memorandum to Dr. Hornbake, dated March 19, 1963, Rheinboldt[48] stated,

> ... after all the headaches and suspense the Computer Science Center finally moved into its new and permanent building last Friday.
>
> On that same day, IBM engineers finished their check-out of the IBM 7090/1401 Computer System - and while we are not completely settled yet - the operation of the Computer has already started.

The Friday before March 19, 1963 was March 15, 1963. A photograph of Rheinboldt and Menard taken at the IBM-7090 console in March 1963, possibly on the first day of operation of the IBM-7090 appears in Figure **??**.

The growth of the Center in terms of number of users, faculty, and staff increased significantly in its first year of operation so that in May 1964, Rheinboldt submitted a proposal to complete the building[49]. The proposal requested the inclusion of funds in the 1965/66 Capital Budget to cover the remaining three floors of the building. He justified the request based on:

1. Increased computer usage for research and education. 42 departments were using the computer for education purposes, and more were anticipated. The computer usage for education and research was 500 hours per month, approximately 16 hours every day of the week, and it was expected to be 24 hours a day by the end of the year, necessitating more computer power.

2. Educational use of the computer was growing, particularly since it was anticipated that both undergraduate and graduate programs would be initiated in the near future.

3. The Center had 6 active research groups in computer science and computer space-related scientific work. Those projects alone were growing rapidly and were in desperate need for offices and laboratory facilities.

It was necessary to approve the proposal for the 1965/66 Capital Budget so that the building could be completed by Spring 1967, three years from the date of the proposal. The proposal was accepted, and the building was completed in 1967.

The Space Science Building, which was contiguous with the Center building was dedicated on Wednesday, April 20, 1967[50]. Part of the CSC used the Space Science Center. Although the Space Science Building was dedicated in 1967, it was completed and occupied in October 1966[51]. The research faculty were moved there during the week of October 20, 1966, and the education faculty during the week of October 27, 1966[52]. The Space Science Center mainly housed the Institute for Fluid Dynamics and Applied Mathematics (IFDAM), subsequently renamed the Institute for Physical Science and Technology (IPST), the Astronomy Department, and the Meteorology Department. In 1968 the NSF approved $600,000 for additional construction, primarily for the fourth floor wing

[48] Rheinboldt's letter to Dr. Hornbake dated March 19, 1963 appears in the Minker collection in the University of Maryland Archives, Hornbake Library.

[49] Proposal to the Capital Improvements Committee of the University of Maryland for the Completion of the Computer Science Center Building, written by Werner C. Rheinboldt, Director, May 1964, is in the Minker collection in the University of Maryland Hornbake Library.

[50] Minutes of the CSC Policy Committee of March 20, 1967 in the Minker collection, the University of Maryland Archives, Hornbake Library.

[51] The completion and occupation of the Space Science Building is reported upon in the "Sixty Day Report" to the National Science Foundation, September 1967, in the Minker collection in the University of Maryland Archives, Hornbake Library.

[52] Minutes of the Meeting of the CSC Policy Committee of October 20, 1966, in the Minker collection, the University of Maryland Archives, Hornbake Library.

Figure 4: Rheinboldt and Menard at the IBM-7090 Console, March 1963, Courtesy of John Menard.

connecting the Space Science Center and the Computer Science Center[53]. The connecting wing construction contract was let by about May 1, 1969[54]. The completion of the fourth floor was not anticipated before May 1, 1969. The connecting wing was completed about July 1, 1970. The CSC was assigned the fourth floor of the connecting wing[55].

Computers and the Medical School at Baltimore. The Computer Science Center was intended to service both the College Park campus and the Medical School in Baltimore. The idea was to have a courier service between the Center and the Medical School. Dr. Entwisle of the Medical School was intimately involved in this activity together with Rheinboldt.

While he was a consultant, Rheinboldt met with William S. Stone, M.D., Dean of the Medical School in Baltimore, and several faculty members in Baltimore on November 18, 1961 to discuss plans for the Computer Science Center[56]. In his meeting, Rheinboldt found a wide interest in computer applications. He reported that the faculty members of the Medical School were very interested to establish a separate, small satellite Computer Center, compatible with the installation at College Park. He noted that the Medical School faculty had raised two points of doubt on whether the planned Center would indeed give adequate service to the Medical School. He proposed a study of the costs and advantages of a satellite system (an IBM 1401) in Baltimore. He then discussed the possible ways to fund the Medical Center, with one prospect being a proposal to the National Institutes of Health. In his response to Rheinboldt, Executive Vice-President Kuhn[57], stated,

> While I plan to keep an open mind on this subject, I am personally convinced that we should place all emphasis on establishing one major computer center for the University and avoid any satellite centers until the main center is in operation and is reaching a point at which it cannot adequately serve the needs of the various schools and colleges of the University.

On December 21, 1961, Dr. Entwisle sent Dr. Kuhn minutes of a meeting of a Data Processing Center Grant Request-Advisory Committee, held on December 7, 1961[58]. The attendees at the meeting discussed in rough outline the thoughts and plans with respect to a computation center in Baltimore and its relation to the Center at College Park. They noted that,

> In view of the facility being planned for College Park–IBM-7090, we would be limited to a choice of either one of two IBM machines for this Campus; namely IBM 1401 or 1405. Dr. Rheinboldt had indicated that the grant request should be for funds to purchase a digital computer rather than lease it because he has data to indicate that after a period of three years it is cheaper to purchase this item.

The advisory committee minutes also noted that Dr. Entwisle would visit the NIH regarding their plans for Baltimore and their reaction to the inclusion of funds in the amount of $100,000 to assist in the purchase of the IBM-7090 for College Park.

[53]See the minutes of the Executive Committee Meeting of June 6, 1968, in the Minker collection, the University of Maryland Archives, Hornbake Library.

[54]See the Minutes of the Executive Committee Meeting of February 27, 1969, in the Minker collection, the University of Maryland Archives, Hornbake Library.

[55]See the minutes of the Executive Committee Meeting, April 1970, in the Minker collection, the University of Maryland Archives, Hornbake Library.

[56]Letter from Werner Rheinboldt to Dr. A. Kuhn, Box 606 of the Hornbake Papers, University of Maryland Archives, Hornbake Library

[57]Letter from Albin O. Kuhn to Werner C. Rheinboldt, December 1, 1961, Box 606 in the Hornbake papers, University of Maryland Archives, Hornbake Library.

[58]Letter from George Entwisle, M.D. to Dr. Albin O. Kuhn, December 21, 1961, in the Hornbake papers, University of Maryland Archives, Hornbake Library

Rheinboldt, in an 18 page report, "Some Remarks on a Possible IBM-1401 Installation at the Medical School of the Baltimore University of Maryland", dated December 1961, presented details concerning a possible IBM-1401 at the Medical School[59]. In his report he addressed the concerns about a) undesirable delays in College Park service to the Medical School, and that b) because of distance, certain projects at the Medical School could benefit directly from the proximity of a small computer. Rheinboldt stated that,

> Personally, I believe strongly that point a) can be reduced to insignificance once a proper policy has been established governing the use of the computing facility in College Park and supplemented by appropriate safeguards. Moreover shortage of machine-time on an IBM-7090 is rather unlikely for several years to come.

He acknowledged the need for a small computer such as the IBM-1401 for the Medical School. He then provided all of the details necessary to determine whether or not it was advantageous to rent or purchase such a machine. He further stated that close connection between College Park and the Medical School,

> ... can in my opinion only be satisfied if the IBM-1401 is administratively a branch of the Computer Science Center. This administrative unity has also the advantage that the technical staff for the 1401 can be kept small and that there is less likelihood of duplication.

Shortly after Menard arrived on campus, the considerations to purchase an IBM-1401 were altered when work started on a proposal to the NIH for the Health Science Computer Center (HSCC) and the IBM-1401 was never purchased. Their thinking had shifted to the acquisition of an expanded IBM-1620 with magnetic tapes compatible with the IBM-7090 and with a good printer. The IBM-1620 had become the machine of choice for many small academic computing facilities. This would give the Baltimore faculty a better computing facility locally plus support the remote traffic to the IBM-7090 via magnetic tape. Thus, the proposal to NIH was revised to include an expanded IBM-1620 system. The proposal was funded in June 1964 as NIH-FR-153 for $296,000. A sizable space was made available in Howard Hall on the Baltimore campus. The space was renovated and the IBM-1620 and a printer were housed in the new HSCC. Approval was given to initiate the HSCC in June 1964.

Menard and Rheinboldt hired the staff for the HSCC. The first hire was Robert L. Jones, as Director of the HSCC in June 1964. Jones had worked for Menard in Syracuse while he was completing a special Master's Degree Program. When Jones accepted the position, they approached Jerry Michener to serve as Assistant Director and Systems Programmer. By this time, both Jones and Michener had completed their Masters at Syracuse and had found other employment. Jones had joined IBM in Syracuse. Since their relations with IBM were excellent they convinced IBM that it would be mutually beneficial to have IBM place Jones on a leave of absence while he served as Director of the HSCC at Baltimore. Michener had relocated to Washington, and the prospect of working with Jones, Menard and Rheinboldt made the position attractive to him and he accepted in January 1965.

The working arrangement between the HSCC and the CSC was to support the Baltimore campus remotely by preparing tapes in the HSCC, send them to College Park, process them on the IBM-7090, and return the output in the form of tape, cards and printouts. Since the tape drives on the IBM-1620 were compatible with the IBM-7090, the faculty in Baltimore could further process

[59]The Rheinboldt report, "Some Remarks on a Possible IBM-1401 Installation at the Medical School of the Baltimore University of Maryland", dated December 1961, is in the Minker collection in the University of Maryland Archives, Hornbake Library.

the tapes they received from College Park on the IBM-1620. They did not want to depend upon campus mail, so they purchased a van and hired operators to drive the van on the various shifts.

The success of the HSCC soon caused the need for an upgrading of the computer. In 1965 when Menard became Acting Director of the CSC, he, Jones, and Dr. Entwisle visited Dr. Bruce Waxman at the NIH and discussed a proposal for an equipment upgrade to an IBM-360/44 system. The proposal was written, submitted, and funded by the NIH.

In June 1965[60], Rheinboldt brought a potential problem to the attention of Dr. Hornbake. At an Advisory Committee meeting of the Health Sciences Center's first meeting, it was inquired whether a request from Dr. C. Klimt for expansion of his computer facility was in the best interest of the University. The request seemed to the committee to be an implication that Dr. Klimt's group would provide a "competent consultation" service of professional bio statisticians nowhere else available and it would conflict with the Health Sciences Center. The consensus of the committee was that the request for additional equipment of a general computing nature be denied and if possible be made available to the Health Sciences Computer Center to expand and provide more extensive service to Dr. Klimt's group and the entire Baltimore Campus. In his response, Dr. Hornbake agreed with Rheinboldt and noted that Dr. A.O. Kuhn was about to assume the overall administration of the Baltimore Campus and that the topic discussed would deserve his early attention.

In July 1965[61], Menard reported an agreement he had made with Dr. Klimt, Professor and Director, Div. of Epidemiology and Biostatistics, and Mr. Robert Jones, Director of the Health Science Center, to merge the two activities. This was in accord with the agreement made by Dr. Klimt to Dean Stone and which Dean Stone discussed with Dr. Kuhn. The details of the agreement were signed by Dr. Klimt, Mr. Jones, Mr. Menard, and Dr. Weinert, Assistant Professor, Division of Epidemiology and Biostatistics. Dr. Klimt confirmed the agreement in a letter to Dean Stone[62].

As the HSCC grew, it was inevitable that the two entities would be separated. This occurred in the Fall 1970 when the University changed to the Chancellor System and Vice-President A.O. Kuhn took over UMAB. The separation was amicable and the HSCC and the CSC continued to work closely together.

1.5 Summary of Computing: The Late 1940s to 1962

The significant events that occurred in the late 1940s and the 1950s were the initiation of courses in programming and computer organization, and the formation of a committee to consider developing a Center. In 1948, Dr. Harry Polachek, visiting Associate Professor in the Mathematics Department was probably the first faculty member to introduce the use of computational methods by computers in his classes. In 1955, Dr. David M. Young, Jr. of the Mathematics Department and in 1956, Dr. Yaohan Chu of the Electrical Engineering Department developed the first two courses in programming and computer organization, respectively. Dr. John Toll, Dr. Monroe Martin and others were responsible for initiating and chairing a committee in 1957 to determine the need for a computer center.

There were many significant events in the period 1960 to February 1, 1962. In late 1960 or early 1961, Dr. Monroe Martin was appointed as Chairman to search for a Director of a Center which led to the hiring of Werner Rheinboldt as Director and John Menard as Assistant Director of the Center. It also led to a decision to hire an architect to construct a new building for the Computer

[60]Letter from Rheinboldt to Dr. Hornbake, June 11, 1965, Box 606, Hornbake papers, University of Maryland Archives, Hornbake Library

[61]Letter from John Menard, Acting Director to Dr. Hornbake, July 28, 1965, Hornbake papers, University of Maryland Archives, Hornbake Library

[62]Letter for Dr. Klimt to Dean William S. Stone, July 12, 1965, Box 606 of the Hornbake papers, University of Maryland Archives, Hornbake Library

Science Center.

There were a number of key players who contributed to the development of a Computer Science Center before 1962. These individuals were: Dr. R. Lee Hornbake, Vice-President of Academic Affairs; Dr. Albin O. Kuhn, Vice-President of Administration; Dr. John Toll, Chairman of the Physics Department; Dr. Monroe Martin, director of the Institute for Fluid Dynamics and Applied Mathematics; Dr. Leon Cohen, Chairman of the Mathematics Department; Dr. Wilson H. Elkins, President of the University of Maryland; Dr. Werner H. Rheinboldt, Director-Designate of the Computer Science Center; and Mr. John Menard, Consultant to the Computer Science Center.

Vice-President Hornbake had the foresight to initiate a committee to investigate the needs for a computation center at Maryland. Starting in approximately 1957, he shepherded the process through the University system at every stage. He made sure the President and the Board of Regents were informed, coordinated with Vice-President Kuhn, approved the hiring of Werner C. Rheinboldt for Director of the Center and John Menard as Assistant Director, approved the construction of a new Building, approved the purchase of the IBM-7090, and worked with his counter part in the Medical School to provide for their needs.

Vice-President Kuhn was instrumental in the decision to construct a building and on deciding the size and location of the building. He also worked closely with Dr. Hornbake. In his absence he substituted for him and brought matters to the attention of President Elkins. As requested by Rheinboldt he asked President Elkins to approve the designation of the center to be the Computer Science Center. Vice-President Kuhn noted that this name was appropriate since,

> ... this designation implies the intent of the University to pursue a program which will lead to the training of persons in the science of computing.

He was involved in the entire process and coordinated closely and effectively with Dr. Hornbake.

President Elkins supported Hornbake's efforts to develop a computation center. He brought the matter to the Board of Regents on several occasions and was successful in obtaining their approval for the Center, the Director of the Center, and to provide funds for this new program. He approved that the name of the new center to be the "Computer Science Center."

Professor John Toll, Chairman of the Physics Department had the foresight to initiate discussions which led to his being appointed Chairman of a committee to study the need for a Data Processing Center or a Computer Center in 1957. His February 1958 report led to the initiation of funding for a center. He was also intimately involved in the hiring of Werner Rheinboldt as Director.

Professor Monroe Martin who may have served on Toll's 1957 (see footnote 9) committee and was Chairman of the committee to search for a Director. He had sponsored Rheinboldt as a Post Doctoral Fellow in his Institute, contacted him to apply for the position and invited him to meet the search committee and lecture in the Institute. He was instrumental in convincing Dr. Kuhn and Dr. Hornbake to provide a broad role for the Center as had been proposed by Rheinboldt, and to name it the Computer Science Center. Professor Leon Cohen was a member of the search committee for the Director, and supported Rheinboldt to become Director.

Dr. Werner Rheinboldt made major contributions before he became Director. He wrote reports that led to the purchase of the IBM-7090. He negotiated with Dr. Emmanuel Piore to obtain both an educational discount and a grant to help purchase the IBM-7090. He initiated contacts with NASA which later led to obtaining research funding, He worked with Menard to develop plans to be turned over to the architect for the building. He played a major role in obtaining equipment for the Medical School and for seeing that an effective working relationship existed between them and the Center. He developed the concept of a broad role in computing for computation, research, and education, accepted by Dr. Hornbake and Dr. Kuhn. It is impressive that in a six month period

he was able to accomplish so much while holding down a full time position at the University of Syracuse.

Mr. John Menard effectively supported Rheinboldt in many ways. He detailed the plans for the new building so that the architect could do his job. He came up with the idea to name the new center the Computer Science Center to reflect its role in computation, research, and education. He worked with Rheinboldt on the specifications for the IBM-7090.

2 Computer Science Center: 1962-1973

Whereas most departments of computer science in the United States arose out of either Engineering, Mathematics, or Physics Departments, the Department of Computer Science at the University of Maryland, College Park, arose out of the Academic Computer Center. As noted in the previous sections, two individuals, Dr. Werner C. Rheinboldt and John Menard played crucial and visionary roles in both the formation and naming of the Academic Computer Center to be the Computer Science Center, and the formation of the Department of Computer Science.

The Computer Science Center of the University of Maryland was established on February 1, 1962, as an interdisciplinary department not affiliated with any school or college of the University. It was intended to provide an all-university research and service facility for the faculty, the research staff, and the students of the University.

Rheinboldt and Menard were the first two persons involved in the development of the Academic Computer Center at the University of Maryland. Rheinboldt and Menard were hired from the University of Syracuse to start the Center. Rheinboldt arrived first on February 1, 1962 and was followed by Menard in June 1962. They were hired under the regime of the late President, Wilson Elkins and reported to the late Vice-President of Academic Affairs, R. Lee Hornbake. Rheinboldt was hired as the Director of the yet to be developed Academic Computer Center, and Menard as Assistant Director. Menard and Rheinboldt had a long association before coming to Maryland. They started to work together in 1957 at the then National Bureau of Standards in Washington, where Rheinboldt was Menard's supervisor. Rheinboldt then went to Syracuse University to direct the computer center there. Menard joined Rheinboldt shortly afterward. They then came to Maryland and brought a group of bright young computer people with them to form the core of computing at Maryland.

When they arrived at Maryland there were three computers on campus (see Section 1.1). Although computers were developed in the 1940s, they were still a novelty at most universities in 1962. Menard and Rheinboldt, had the responsibility of purchasing computer equipment and developing a computer center to support academic computing on campus. This was a formidable task, as they had to decide upon equipment for the Center that matched their budget, to hire, train, and develop a computer staff. In addition they had to oversee the construction of the Computer Science Center (CSC), on which construction was started in September 1962. Until the CSC was built, the Center was housed in Room 100 of the Shoemaker Building on campus. The IBM 1401 in the Main Administration was made available for use by the Center for support of computing on campus.

Rheinboldt's personal interests were never in having a strictly administrative position. As he noted in a personal message[63],

> From the outset I had mentioned in conversations with Monroe Martin and Leon Cohen that I wanted to be involved in the development of computer related educational programs and research. They were sympathetic, but, as expected in academia, could not offer easy solutions. I was heavily influenced by the discussions at the computing center director's meetings organized by IBM and when I made contact with NASA — which must have been some time in the late Summer of 1961 — my main point was the importance for basic research on computer related topics at universities and, hopefully, the development of associated educational programs.

In consonance with the above views, and his idea to 'start big' (see Section **??**), Rheinboldt, together with Menard were far-sighted and developed the following three objectives.

[63] E-mail message from Werner Rheinboldt to Jack Minker, contained in the list of email messages, dated September 7, 2002, in the Minker collection in the University of Maryland Archives, Hornbake library

1. Provide centralized high-speed computing service and programming assistance to all research activities of the University;

2. Build and administer an interdisciplinary educational program in computer sciences; and

3. Build and conduct a research program in computer sciences.

All of these activities were carried out expeditiously and with quality personnel. In the following I discuss each of these aspects.

An important personal event for Rheinboldt occurred on April 1, 1963 when he became a naturalized citizen of the United States of America[64].

2.1 Organization of the Computer Science Center

During the first few years of the existence of the Center, there was little need to consider a plan of organization. There were few faculty, and they all communicated easily with one another. However, the workload of the Center was increasing significantly each year. On September 18, 1963, Rheinboldt wrote to Dr. Hornbake, summarized the achievements of the Center, and noted the need for additional resources to support the Center. With respect to the accomplishments of the Center, it was noted that the following had been achieved:

1. Development of Center's service functions

   (a) Train programmers, operators, graduate assistants, and others.

   (b) Design, maintain and improve complex programming and monitoring systems needed for the support of the large scale equipment.

   (c) Assemble and test a large programming library and to disseminate the information.

   (d) Teach short courses to faculty on campus to permit them to utilize the computers.

   (e) Consult and assist faculty members on use of the computer.

   (f) Cooperate with faculty on computer related courses they were developing for their departments.

   (g) Handle the Center's increasing administrative workload.

   (h) Maintain contact with other large scale installations in the entire area.

2. Development of Center's research activities

   (a) Research in support of NASA grant

   (b) Numerical Analysis Research for NSF

   (c) Applied Mathematics Research for the Office of Army Research

   (d) Simulation of Cardiac-Arrithmyas for the NIH

   (e) Analysis of Chromosome Pictures for the NIH

3. Development of the Educational Activities

   - Modest progress was made due to the increased research load on the NASA effort

[64] Letter from Werner C. Rheinboldt to Dr. Hornbake, dated April 1, 1983, informed Dr. Hornbake that he had become a citizen of the U.S.

- Increase laboratory work by students in their courses in EE, Math, Business Administration and Sociology

By May 1964, it was necessary for Rheinboldt to recommend a revision to the administrative structure of the CSC. Menard and Rheinboldt had exclusively handled most of the administrative workload. Both had been involved in several research programs and Rheinboldt was teaching graduate courses in mathematics and advising graduate research students. Rheinboldt, in a letter[65] to Dr. Hornbake, made the following recommendations:

1. Mr. Menard's position be expanded from "Assistant Director" to "Associate Director."
2. The position of "Manager" of the Health Sciences Center be changed to "Assistant Director."
3. The position of "Chief of Operations" of the CSC be upgraded to "Assistant Director for Operations" at the CSC.
4. Change the position of "Deputy Assistant Director" to "Assistant Director for Administration."

The changes would relieve the workload for Menard and Rheinboldt, would make it easier to fill positions 2. and 3., and would permit higher salaries for the positions. Rheinboldt noted that the heavy burden carried by him and Menard made it imperative that a solution be found in a short period of time. Rheinboldt stated,

> In my own case, my health has not been good of late and my physician has seriously warned me to cut back on my administrative workload, and on the related burdens caused by insufficient staff to accomplish jobs extremely essential to the future of the Center. In addition I am left with practically no time for my own academic and research work.

The administration heeded his advice.

The letter of May 26, 1964 in which Rheinboldt mentioned the excessive workload and toll on his health and time for academic and research work may have been a cause for his stepping down as Center Director in 1965. Menard became Acting Director while a search was conducted for a replacement for Rheinboldt.

To obtain support and backing for what was needed in terms of faculty, staff, and computers, Menard proposed that the committee appointed to search for a new Director, headed by Dr. Monroe Martin, be used for this purpose[66]. This committee or possibly a subset of the committee served as the Computer Science Advisory Committee[67]. The Advisory Committee started in approximately April, 1965. The members of this committee were: Dr. Monroe Martin, IFDAM, Chair; Werner C. Rheinboldt, Computer Science Center; John Menard, Computer Science Center; Dean Donald W. O'Connell, Business School; and Dr. Garth Westerhout, Professor of Physics and Astronomy, and Professor Howard Tompkins, Electrical Engineering. The committee was essential, since decisions

[65] The letter from Rheinboldt to Dr. Hornbake, dated May 26, 1964, on a proposed internal revision of the CSC administration, may be found in the Minker collection in the University of Maryland Archives, Hornbake Library

[66] Material for this section comes from the personal collection of John Menard in a notebook titled, CSC Policy Committee. It is assumed that this material will ultimately reside in the Menard collection in the University of Maryland Archives, Hornbake Library. Individual letters copied from the Menard notebooks appear in the Minker collection, University of Maryland Archives, Hornbake Library.

[67] Personal email communication from John Menard to Jack Minker, dated 25 February, 2003, in the email collection of messages regarding the Department History, the Minker collection, University of Maryland Archives, Hornbake Library.

had to be made on both educational and promotion manners and there was only one Full Professor in the Center, Professor Rheinboldt.

The Advisory Committee was useful in many ways and contributed significantly to the CSC. The following are some of the more important recommendations they made:

1. They formed a Task Force on Computer Science[68] on October 13, 1965 to:

   > Determine the scope and content of an appropriate interdisciplinary graduate program leading to the degrees of M.S. and Ph.D. in Computer Science ....

2. They sent an undated memorandum to the Interdisciplinary Task Force detailing the Purpose and Topics for Faculty Group Discussions on a Possible Graduate Program in Computer Science shortly after the October 13, 1965 memorandum[69].

3. They responded to an inquiry from Professor Melvin Bernstein, of the University Senate on December 9, 1965, concerning courses that the Center had proposed[70].

4. They recommended that Research Associate Professor Azriel Rosenfeld be promoted to Research Professor on January 6, 1966[71]. Rosenfeld was hired in 1963 by Rheinboldt to supplement the research component of the Center. He had received his Ph.D. from Columbia University in 1957 in Mathematics and had been working in picture processing in industry.

5. They recommended that Dr. William F. Atchsion be hired as the next Director of the Computer Science Center and on June 16, 1966, Dr. Martin informed the Advisory Committee that Dr. Atchison had informally accepted the position[72]. Dr. Atchison formally accepted the position a few days later.

With the hiring of Dr. William F. Atchison as Director in 1966, Professor Martin indicated that the reason for the Advisory Committee's establishment no longer existed since a new Director had been appointed. However, Dr. Atchison believed that the Advisory Committee was still useful. Dr. Martin brought the matter to the attention of Dr. Hornbake[73]. Although no record was found of when the committee was dismissed, it was terminated shortly after the December 6, 1966 Advisory Committee meeting.

---

[68] Memorandum from M.H. Martin, Chair Advisory Committee to the Task Force for Design of an Interdisciplinary Graduate Program in Computer Science, contained in the Minker collection, the University of Maryland Archives, Hornbake Library. The members of the committee were:
Professor C.H. Cook, Department of Mathematics
Professor R.O. Durant, Information Systems Management
Professor R.G. Glasser, Physics and Astronomy
Professor W.C. Rheinboldt, Institute for Fluid Dynamics and Applied Mathematics
Professor E. Schweppe, Computer Science Center
Professor H. Tompkins, Chairman, Electrical engineering
Professor P. Wasserman, School of Library Science.

[69] Undated memorandum to the Interdisciplinary Task Force by Advisory Committee detailing their purpose is contained in the Minker collection, the University of Maryland Archives, Hornbake Library.

[70] Letter from Dr. Monroe Martin to Dr. Melvin Bernstein, December 9, 1965, in the Minker collection, University of Maryland Archives, Hornbake Library.

[71] Memorandum to Dr. R.L. Hornbake from M.H. Martin, dated January 6, 1966, regarding the promotion of Dr. Azriel Rosenfeld, in the Minker collection, University of Maryland Archives, Hornbake Library

[72] Memorandum to the Advisory Committee from M.H. Martin dated June 16, 1966, contained in the Minker collection in the University of Maryland Archives, Hornbake Library.

[73] Minutes of the Advisory Committee Meeting of December 6, 1966, in the Minker collection, the University of Maryland Archives, Hornbake Library.

It became clear that the Center had to rely upon its own faculty in addition to receiving advice from the Advisory Committee. Some time in 1965, the Computer Science Center Policy Committee was formed to address issues relevant to the education, research, and computing aspects of the Center. The initial members of the Policy Committee were: R.G. Glasser, J.P. Menard, A. Rosenfeld, E.J. Schweppe, and W.C. Rheinboldt, Chairman[74]. Robert Glasser had extensive experience with computers. He was a Lecturer in Physics from 1955-1961, then became a Part-Time Visiting Professor in Physics from 1961-1965, and was offered and accepted a half-time position in Physics and a half-time position in the Computer Science Center in 1965. His area of research was in applications of computers to physics. Earl J. Schweppe was the first computer scientist hired by Rheinboldt in 1962. His focus was on computer science education. His efforts in computer science education are discussed in Section **??**.

As additional faculty were hired, the Policy Committee was broadened to include all Professors and Associate Professors. In notes of the November 17, 1966 minutes it states:

> Membership in Policy Committee has a minimum requirement of 1/2 time during academic year and associate professor or better.

However, Dr. Jack Minker[75], who was a Visiting Member from September 1967 to June 1968 was invited to sit in and contribute to the meetings before he became a faculty member. This committee set up a number of committees which helped to direct the Center:

1. The Future Computer Needs Committee[76]. The committee was to form estimates of the future needs of the University for research and education and how the Center could best meet these needs. A resolution was passed by the Policy Committee on April 13, 1966 to set up the committee.

2. Graduate Assistantship Committee[77]. The committee was charged with reviewing and accepting students for teaching and graduate assistantships.

3. Colloquium and Seminar Committee[78]. The committee was responsible for inviting individuals outside the University to lecture in the Center.

4. Committee to Form a Master's Degree Program in Computer Science[79]. The committee was

[74]The earliest record of the Policy Committee is a memorandum of January 4, 1966 from J.P. Menard and W.C. Rheinboldt to Professors Glasser, Rosenfeld, and Schweppe, calling for a meeting of the Policy Committee, contained in the Minker collection, University of Maryland Archives, Hornbake Library.

[75]Dr. Jack Minker received his Ph.D. in Mathematics from the University of Pennsylvania in 1959. Before he came to Maryland he worked in industry for 17 years. He worked on computer applications, including computer simulation and databases. As Program Chairman of the National ACM 1967 Conference, he invited Dr. Atchison to be a member of his Program Committee. Minker decided to take a leave-of-absence from industry, where he was Technical Director of the Auerbach Corporation Washington Office. Atchison consulted his faculty who agreed to invite him to be a Visiting Professor.

[76]The members of the Future Needs Committee were:
R.G. Glasser, Assoc. Prof. of Physics and Computer Science, Chairman
Richard Austing, Assistant Prof. of Computer Science, Secretary
Al Beam, Sr. Computer Systems Analyst
T.B. Day, Prof. of Physics and Astronomy
Alan Marcovitz, Assistant Prof. of Electrical Engineering
James Stewart, Assoc. Prof. Chemistry.

[77]The members of the Graduate Assistantship Committee were: Richard Austing, Chairman, Y. Chu, J. Ortega, E. Schweppe.

[78]The members of the the Colloquium and Seminar Committee initially consisted of 5 faculty and was soon replaced by one faculty member, Rheinboldt, on September 19, 1966.

[79]The members of the Committee to Form a Master's Degree Program in Computer Science were: Drs. Y. Chu, R. Glasser, and E. Schweppe, who worked with Dr. W. Atchison.

discussed at the Policy Committee on October 12, 1966 and was formed on September 19, 1966. The proposal was submitted to the University at the beginning of February, 1967.

As early as December 14, 1965, the Policy Committee started to discuss the possibility of having a formal Faculty Organization Plan. However, it was not until June 13, 1967 when a Draft Faculty Organization of the Computer Science Center was developed. The Faculty Plan of Organization was adopted by the Center in October 1967[80]. As a consequence, on October 18, 1967,

> The Policy Committee dissolved itself in consequence of the adoption of the Faculty Plan of Organization. The following have been appointed to the Executive Committee: Atchison and Menard (ex officio). Chu, Edmundson[81], Ortega[82], Rheinboldt, Rosenfeld, and Schweppe.

The Center's Faculty Plan of Organization was approved on October 16, 1967. Briefly, the plan of organization discusses the Purpose of the plan; the Faculty Assembly, its membership, functions, officers, and meetings; Committees, including Executive Committee, Standing Committees, and Special Committees; Bylaws; and Adoptions and Amendments. The Minutes of the First Meeting of the Computer Science Center Faculty Organization[83] of October 16, 1967 state:

> A motion was made by Dr. Ortega and seconded by Mr. Menard that the Faculty Organizational Plan dated September 28, 1967 be accepted ....
>
> On the question, the vote was unanimous for adopting this organization plan.

Together with the plan of organization, two other documents were written to supplement the plan. These are: Bylaws and Rules of Procedure of the Computer Science Center Faculty Organization, and the Computer Science Center Policies on Appointments and Promotions to Professorial Ranks. These documents were generated approximately in March 1968[84].

The Faculty Organization Plan was sent to the University Senate who suggested that one item under functions be revised slightly. This was agreed upon, and the document was revised at the Second Meeting of the Faculty Organization[85]. The document on Appointments and Promotions to Professorial ranks was approved at that meeting. It was noted that:

> Professor Thomas B. Day, speaking as Chairman of the Committee on Appointments, Promotion and Salaries of the University Senate, stated that he thought that this plan is the best on campus.

The Plan of Organization of the Center, with small changes, remained in effect until the computer activities within the CSC was made a separate organization with the same name, and the Department of Computer Science was formed in July 1, 1973, as discussed in Section **??**.

[80] A copy of the 1967 Plan of Organization may be found in the Minker collection in the University of Maryland Archives, Hornbake Library

[81] Dr. H.P "Ed" Edmundson received his Ph.D. at the University of California in 1953. Before he came to Maryland he was known as a leading expert in Information Storage and Retrieval. Edmundson is now Professor Emeritus.

[82] Dr. James Ortega received his Ph.D. at Stanford University in 1962. He came to the Maryland as a Research Assistant Professor in 1964. Dr. Ortega was a leading researcher in numerical analysis.

[83] A copy of the minutes of the First Faculty Assembly are contained in John Menard's personal collection.

[84] The Bylaws and APT promotions documents may be found in the Minker collection, the University of Maryland Archives, Hornbake Library.

[85] Minutes of the Second Meeting of the Computer Science Center Faculty Organization, March 29, 1968, in the Minker collection, University of Maryland Archives, Hornbake Library.

2.2 Grant Support from Federal Agencies

The University did not provide sufficient support to purchase a major computer. It was necessary to obtain outside support for this purpose and to develop a research faculty in computing. Rheinboldt turned his attention to obtaining funding from outside agencies. He was successful in this effort. The future of computer science was enhanced greatly by several grants he obtained from IBM and from the Federal Government: one from the National Aeronautic and Space Administration (NASA), and two from the National Science Foundation (NSF). The IBM grant was discussed in Section **??**.

As noted earlier, the NASA grant was discussed with individuals from NASA in 1961. It was clear from Rheinboldt's discussions with NASA that they would not provide funds for a Computer Center, but would provide funds to enhance a research capability in the area of space science. The prospect of such a grant motivated Rheinboldt to develop a research capability as part of the Center's activities. He wrote a proposal to NASA, "Computer-Oriented Research in Space Related Sciences," dated July 10, 1962[86]. It requested $750,000 over 3 years. A revised proposal was submitted on July 10, 1962 for significantly greater funding. However, the final approved budget was for $700,000 distributed per year as follows: First Year $350,000, Second Year $235,000, Third Year $115,000. The proposal was granted and started January 1963, with Rheinboldt as Principal Investigator. The grant was continued for 10 years with total funding of $2,620,000. Some of the funding was used to hire staff personnel to provide programming support and operators. The grant contributed significantly to the expansion of research on campus, in the areas of science, engineering and computer science.

The first NSF grant, was obtained September 3, 1964 for "Expansion of Computing Facilities," approved for $200,000. The equipment grant made it possible for the CSC to expand the IBM-7090 to an IBM 7094 and to pay for the rental of an additional input/output computer, an IBM 1460.

The second grant, the "National Science Foundation Development Grant," submitted in August 1965,was approved in approximately May 1967[87] for $3.7 million. The grant provided support for chemical science, mathematics, fluid dynamics, computer science and physics. The NSF grant[88] came at a time when it was particularly beneficial in the development of the total computer science program. The computer science area was just starting on a program of expansion which greatly needed the financial support.

At the time the Science Development Grant was first received, there were only eight courses offered in the computer science educational area. There were no degree programs in computer science available. As noted below, the Master's Degree Program in Computer Science was started in September 1967 with 66 students registered for degrees. The Ph.D. program was initiated in Fall 1969, and the Bachelor of Science degree in September 1974. When the NSF Science Development Grant was received, the primary computing equipment on campus for the use of research and classes was an IBM 7094. Subsequently, the IBM 7094 was replaced by a 2 processor UNIVAC 1108 and a single processor UNIVAC 1106.

All of these developments contributed significantly to the total research efforts of the University, particularly in the area of science and engineering. The extent of development in the computer service, computer education, and research areas would not have been possible without the financial

[86] E-mail message from John Menard to Jack Minker, September 11, 2002, in the list of email messages concerning the Department History, in the Minker collection, the University of Maryland Archives, Hornbake Library.

[87] A copy of the NSF Science Development Grant Proposal of August 1965 is in the Minker collection in the University of Maryland Archives, Hornbake Library.

[88] Material on the impact of the NSF grant on the CSC is taken from a memorandum titled, "Impact of the NSF Science Development Grant in the Computer Area," dated August 9, 1973. The memorandum is in the Minker collection in the University of Maryland Archives, Hornbake Library.

support provided by the NSF Science Development Grant. With the help of this Grant, new faculty members were obtained, computer software systems were developed, graduate research assistants and programmers were added and the total entire computer complex was made possible. Both the additional computer power and the availability of additional computer courses and research work contributed to the development of the total campus effort in education and research.

2.3 Computer-Oriented Activities

2.3.1 Developing a Centralized Computing Facility

As noted in Section **??**, the first computer purchased for the Center was an IBM 7090/1401 system that was installed into the newly built Computer Science Center in February 1963. The system provided batch service and had a *large* core memory of 32K words. Today our desk PC computers have substantially more capacity than the first academic computers on campus.

It was necessary to hire a staff to handle the computer work. Before that could be done, it was necessary to have a plan of organization and a salary structure for the staff.

Developing a Staff Structure and Salary Scale When Werner Rheinboldt, the new Director of the Computer Science Center arrived on campus, he had to form a computer activity, where none had existed before. It was necessary to find space for a Center to hold computers, staff, administrators and faculty. It was necessary to determine how many staff, administrators and faculty were required. With respect to staff, it was necessary to determine the types, salary structure, and other aspects dealing with staff.

In a memorandum dated May 18, 1962, titled "Computer Science Center Proposed Staffing Pattern," written by Rheinboldt[89], he developed the details of what was required. Rheinboldt noted that,

> Computer centers making use of the modern, highly-developed and complex digital computer systems are increasing much more rapidly than is the personnel which has been trained to program and use them. There is an even greater gap in personnel trained to make proper and effective use of these computers in the overall solution of problems at hand and to develop the field of computer sciences as a whole.

Faced with these problems, he recommended staff requirements for

1. Administrative personnel: Director, Assistant Director, Secretary, Typist, Computer Program Librarian.
2. Research-Analysis and Research-Programming Personnel: Senior Computer-Research Analyst, Computer-Research Analyst, Senior Research Programmer, Research Programmer, Computer Systems Analyst.
3. Machine Operating Personnel: Computer Operations Supervisor, Digital Computer Operator.
4. Academic Personnel in the Computer Sciences.

For each position dealing with the computer operations, the nature of the work, the essential requirements of the work, the education and experience, and the salary range for the position was

[89]The memorandum of May 18, 1962, "Computer Science Center Proposed Staffing Pattern, by Werner Rheinboldt may be found in the Minker collection in the University of Maryland Archives, Hornbake Library.

detailed. A chart was provided giving the organizational structure of the Center. To develop these details, Rheinboldt received recommendations from Mr. George W. Fogg, Director of Personnel who referred frequently to information obtained from the Applied Physics Laboratory. In addition, Mr. Fogg made use of a national salary survey for digital computer personnel prepared by the Systems Development Corporation that covered 188 computer installations in all parts of the United States. It was noted that in 1962 there were already over 1,000 computer installations among them were 125 university computer installations.

The above requirements were based on the fundamental policy of the use of the Center's computing equipment as follows:

1. The operation of the computing machines is to be performed on a so-called "closed shop" basis. This means that the operation of these machines will be performed exclusively by trained personnel from the Center.

2. Programming and all related tasks, such as data handling, etc., is to be performed on an "open-shop" basis, i.e., the individual computer user performs by himself or with the help of his own staff all the tasks of problem analysis, programming, coding, data handling, etc.

With the start of the Fall Semester, September, 1962, there was a very large increase in the number of requests for specific information about the use of the equipment, the systems to be adopted by the Center and the procedure for gaining access to it. These requests came from nearly every department of the University. This led to a supplement to the above report, modifying some of the staffing positions, written during the Fall 1962. The modifications were as follows:

1. Delete the following two positions: Computer Operations Supervisor, Computer Program Librarian.

2. Insert the following two positions: Chief of Computer Users' Services, Chief of Computer Operations.

The new positions were detailed as described earlier.

First Staff Hires To hire personnel and equipment, Rheinboldt and Menard used funds from the NASA grant obtained in March 1963. They hired a staff of personnel to run the computer and to provide programming support. Charles Mesztenyi was hired in August 1962 to provide programming support. Mesztenyi was also one of those recruited from Syracuse University. Two computer operators were hired in December 1962, one of whom was John Bielic who subsequently rose to the position of Assistant Vice-President of Administration and is now retired. The second was Dave Keeter. Al Beam, hired to be Head of Systems, who has since left the University, and Ron Borgenicht was hired in 1964 to provide operations support. A list of staff in the Center, as of 1968, is given in Appendix **??**.

Leon Osterweil, who had a part-time appointment in the Center was awarded an ACM Fellowship grant of $1,000 by the District of Columbia Chapter of the ACM[90].

Menard and Rheinboldt also had the responsibility of starting computing at the University of Maryland in Baltimore at the Health Sciences Computer Center described in Section **??**.

[90] Reported in the Computer Science Center Newsletter 11 of August – September, 1967 in the Hornbake Collection of the University of Maryland Archives, Hornbake Library.

Rheinboldt Resigns as Director of Computer Science Center. In 1965 Rheinboldt requested release from his administrative responsibilities as Director of the Computer Science Center. Dr. Hornbake announced this decision on July 9, 1965[91]. In the announcement, Dr. Hornbake stated,

> He will continue with us as Research Professor on a joint appointment between the Center and the Institute for Fluid Dynamics and Applied Mathematics. In the relatively brief time since Dr. Rheinboldt came to this campus he has masterminded and supervised the development of the Center to a high level of excellence. His achievements have exceeded our most optimistic expectations.

In his memorandum, Mr. John Menard was appointed Acting Director of the Center.

In a memorandum to the faculty and staff of the Center, dated March 29, 1965, Rheinboldt stated[92],

> For a number of personal reasons I have decided to request the Administration of the University to relieve me of the administrative position of the Computer Science Center, if possible by July 1, 1965.

The University administration decided that the Academic Computer Center required a person with a Ph.D. to be Director. On March 25,1965 Dr. Hornbake wrote to Dr. Monroe Martin to advise him of Rheinboldt's request to be relieved of the Directorship of the CSC, if possible by July 1, 1965[93]. Hornbake asked Dr. Martin to chair a committee to screen nominees for the position of Director of the Computer Science Center; and that the persons addressed as cc's in his memorandum were to serve as members of the committee (Rheinboldt, Menard, Don O'Connell, and Garth Westerhout). This committee membership was later augmented with Howard Tompkins, Head of Electrical Engineering. The committee was first known as the Computer Science Committee. The first meeting took place on April 5, 1965. Following a national search, Dr. William F. Atchison, now deceased, was hired in 1966 to be the Director. Atchison had excellent credentials for the position. He was head of the ACM Curriculum Committee, which was developing a curriculum for computer science, and he was the Head of the Rich Electronic Computer Center at Georgia Institute of Technology, and a Research Professor in Mathematics and a Professor of Information Science. Dr. Martin advised his committee on June 16, 1966, that Dr. Atchison had informally accepted the position of Director of the Center, and that written confirmation was expected from him in time for presentation of his appointment to the Board of Regents at its June 17, 1966 meeting[94]. Atchison started as Director of the Center on September 1, 1966.

Under Atchison, Menard's responsibilities remained as they had been under Rheinboldt. He still was responsible for the computing aspects of the Center, reporting to Atchison. With Menard handling the service aspect, it permitted Atchison to devote much of his attention to developing a curriculum for computer science, to hiring faculty, and to the growing education aspects of the Center. The curriculum developed under Atchison for the Association for Computing Machinery became known throughout the world as Curriculum '68 and set the tone for academic computer

[91] Memorandum to Academic Deans, College Park and Baltimore Campuses and Department Heads, and Other Institute and Division Administrators from R. Lee Hornbake, July 9, 1965, in the Hornbake papers, Box 606 in the Hornbake Library.

[92] Rheinboldt's memorandum to the faculty and staff on his resignation is contained in the Minker collection, the University of Maryland Archives, Hornbake Library.

[93] Hornbake's memorandum to Martin dated March 25, 1965, is contained in the Minker collection in the University of Maryland Archives, Hornbake Library.

[94] Martin's June 16, 1965 memorandum to the CSC Advisory Committee regarding Atchison's acceptance as Director of the Center, is contained in the Minker collection in the University of Maryland Archives, Hornbake Library.

science courses throughout the world. The role of the University of Maryland in the development of Curriculum '68 is discussed in Section **??**.

2.3.2 Growth of Computing on Campus and Equipment

As noted in Section **??**, the first computers obtained by the Center, the IBM 7090/1401 were installed on March 15, 1963. The computer usage during the first year of operation made it imperative that the CSC upgrade their computers. Some 55 different departments were using the equipment by late 1964. The receipt of an equipment grant from the NSF on September 3, 1964, for $200,000 permitted the expansion of the IBM 7090 to an IBM 7094 and to pay for the rental of an additional input/output computer, an IBM 1460. Later in September 1964 the IBM 7090 was upgraded to an IBM 7094. An IBM 360/30 system was ordered in December 1964 to replace a second IBM-1401 purchased earlier. The IBM 360/30 was added in December 1965.

In a 3 page unauthored note, titled "Notes on a Total Computer Systems Approach to the Academic Computing Needs of the University," dated December 1964, from the Computer Science Center, it anticipates the saturation of the December 1964 facilities in 1965[95]. It called for a study and anticipated the future computer needs for the Center,

1. a large, flexible central facility with multi-processing capabilities; bulk, high speed storage (directly addressable), random access storage, priority interrupt system with realtime capabilities, teleprocessing features.
2. remote processing for both general and specialized needs ...

To meet these needs, the Center recommended to the University's Computer Needs Committee in 1966, that a UNIVAC 1108 be installed in 1967. Purchase of the UNIVAC 1108 was approved by the Board of Regents[96]. Remote access to the 1108 at the National Bureau of Standards (NBS) was arranged. The NBS 1108 was used to debug EXEC 8 and to make assemblies of EXEC 8 under EXEC 2. A system located at Baltimore Washington International was accessed for remote job entry via the UNIVAC 1004. A local user's organization was organized. The contract was written to specify the delivery of the Exec-8 operating system. The UNIVAC 1108 contract was prepared in late May, 1967, a purchase order was issued and a down payment was made[97].

The Future Needs Committee approved the recommendation[98] in their report dated September 7, 1967. The recommendation further specified the expansion of the UNIVAC 1108 to a dual processor system in 1968. The expansion was included in the 1969 CSC proposed expansion in its requested 1970/1971 Request Budget. It was again included in the 1971/1972 budget.

As noted in Section **??**, the Center received an NSF Science Development Grant in 1967. When the NSF Science Development Grant was received, the primary computing equipment on campus for the use of research and classes was an IBM 360/30. The IBM 360/30 was replaced with a unit processor UNIVAC 1108 with 131K memory. An additional IBM 1401 was also added. The UNIVAC 1108 was still a batch system, but in early 1968, the CSC staff modified the EXEC 8 operating system, to be able to introduce teletypes to obtain a remote job entry, on-line capability. In 1969

[95] The material in this paragraph comes from "Notes on a Total Computer Systems Approach to the Academic Computing Needs of the University," dated December 1964. No author is listed. The note is in the Minker collection in the University of Maryland Archives, Hornbake Library.

[96] The approval of the purchase of the UNIVAC 1108 was reported in the minutes of the Center Policy Committee Meeting of May 15, 1967. The minutes may be found in the Minker collection, the University of Maryland Archives, Hornbake Library.

[97] Minutes of the Center Policy Committee Meeting of May 23, 1967, contained in the Minker collection in the University of Maryland Archives, Hornbake Library.

[98] Letter to Chancellor Charles E. Bishop from William F. Atchison, dated April 28, 1972, appears in the Minker collection in the University of Maryland Archives, Hornbake Library.

the UNIVAC 1108 was converted to a dual processing system with 262K memory. The EXEC-8 command language modified by the UOM CSC staff gained wide recognition in the UNIVAC user community and in 1971/1972, it was accepted by UNIVAC as its standard operating system software. A number of UNIVAC 1004s, 9200s, and 9300s were acquired as remote batch processors around the campus and at other UOM campuses in 1970. The UNIVAC 1108 was fully paid off in July 1970.

In April 1973, the UNIVAC 1106 was installed to replace the IBM 7094. This occurred shortly before the split between the Center and the Department. The computer equipment at that time was adequate to meet the needs of the academic departments.

2.3.3 Loss of Computer Autonomy to State Administrators

One of the major problems that arose in the University and greatly affected both the Computer Science Center and subsequently the Department of Computer Science, was the loss of autonomy by the University to purchase computing equipment for research and educational purposes. The loss of autonomy came about one year after Dr. Atchison became Director of the Center, and served to distract both Atchison and Menard from their main activities.

On January 28, 1968, Delegates Cardin and Crawford of the Ways and Means Committee of the Maryland House of Delegates introduced Joint Resolution 3[99]. The resolution stated, in part,

> *Resolved by the General Assembly of Maryland*, That the Governor is requested to appoint a special commission to study the feasibility of making increased use of data processing techniques and to study and consider the possibilities for the establishing a centralized data processing center for all the departments and agencies of the State government and the University of Maryland. ...

One day before Resolution 3 was introduced, Atchison wrote to Dr. Hornbake and expressed his concerns[100]. Atchison stated,

> Attached is a copy of Joint Resolution No. 3 that has been read before the House of Delegates. If this passes it could have considerable bearing on the future operation of the Computer Science Center.
>
> This was sent to me by Mr. Arthur J. LaPenotiere, Data Processing Systems Coordinator, Department of Budget and Procurement, State Office Building. He called my attention to the fact that this has a bearing on the autonomy of the University. He also suggested to me that I should be a member of it. I indicated that I would be glad to do so.
>
> I would be glad to discuss this with you if you so desire.

In 1968/1969, the Computer Science Corporation was awarded a contract by the State of Maryland to study Automatic Data Processing in the State. The result of this study was a report[101], "State of Maryland Automatic Data Processing Survey Report," written by the Computer Science Corporation, dated August 1969. The report surveyed the use of computers within the government of the State of Maryland. The report focused on data processing, but included the educational use of computers throughout the State. One of the recommendations was to centralize the purchase of

[99] Resolution 3 may be found in the Hornbake collection at the University of Maryland Archives, Hornbake Library.

[100] Memorandum from Wm. F. Atchison to Dr. R. Lee Hornbake, dated January 30, 1968. The memorandum is contained in the the Hornbake Collection in the University of Maryland Archives, Hornbake Library.

[101] A copy of the report may be found in the University of Maryland Archives, Hornbake Library, in UPUB C 46, Box 4, of boxes from the Computer Science Center.

digital equipment at the State level. A bill was introduced and passed by the State Legislature to form an Automatic Data Processing group at the state level to review all purchases of computing equipment hardware and software in the State of Maryland.

Some time in 1969/1970, the State set up an ADP administrator's office under the direction of Mr. Charles B. Connell, State ADP Administrator. Mr. Connell set up meetings of Data Processing Directors throughout the State and personnel from the Computer Science Center were expected to attend those meetings. On March 12, 1970, Mr. Connell sent a letter to Dr. Atchison requesting copies of all contracts concerning computers, peripherals, consulting support, etc., and included a draft of a "Data Processing Policy Manual." This message was shared with Garth Westerhout, Professor & Director of Astronomy, who wrote to Dr. Walter B. Waetjen, Vice President for Administrative Affairs, expressing his concerns about the loss of autonomy by the University[102]. With respect to the draft Policy Manual, he wrote,

> ... if it applies to the Computer Science Center, will mean the end of Autonomy for the University. The manual requires: Centralized control of planning and utilization of statewide ADP resources; state master plan for management; prior approval of new equipment and of all changes; separate cost centers in the budget for ADP resources; all contracts or partnerships to be accomplished through the Dept. of Budget and Fiscal Planning.

Dr. Westerhout suggested that the University inform Mr. Connell that the letter was directed to the wrong person, but should have been sent to Dr. Waetjen, and to make it clear that the Computer Science Center representative to the Data Systems Directors was as a consultant or an observer.

The University's position was discussed by Thomas B. Day, then Vice-Chancellor Academic Planning and Policy, when he wrote to Atchison on 30 September 1970, concerning letters of Mr. Connell of September 24, 2002[103]. Dr. Day noted that,

> As mentioned in President Elkins' letter to Mr. Slicher of November 28, 1969, our interpretation of the term ADP as used in the basic statute, and the Governor's Executive order dated October 28, 1969, is that it <u>does not</u> refer to the computation done in performing the University's academic functions of teaching and research.

Dr. Day further advised Dr. Atchison that,

> Any official personal contact, or correspondence, from Mr. Connell or his staff should be referred to the Chancellor's Office for us to respond to officially. Until we can get these errors and interpretations cleared up, we do not want you (or Mr. Voltin) to respond, beyond politeness, to Mr. Connell's office. Every such response can be misinterpreted as a precedent showing College Park's acceptance of these errors, and that possibility should be avoided at all cost.

On October 1, 1970, Dr. Atchison wrote to Dr. Hornbake regarding a meeting of the Data Processing Directors[104]. The attendees were given a very large loose leaf notebook entitled "State of Maryland, Data Processing Standards Manual". Dr. Atchison stated,

[102]Letter dated March 23, 1970 from Garth Westerhout, Professor & Director of Astronomy to Walter B. Waetjen, Vice President Administrative Affairs. The letter appears in the Hornbake Collection in the University of Maryland Archives, Hornbake Library.

[103]The letter from Thomas B. Day to William F. Atchison of September 30, 1970, may be found in the University of Maryland Archives, the Hornbake Library, — of the Hornbake collection on the Hornbake Library.

[104]The letter from Dr. Atchison to Dr. Hornbake, dated October 1, 1970, appears in the Hornbake Collection in the University of Maryland Archives, Hornbake Library.

> I would particularly call your attention to policy 12-003 which was modified in part to appear to make an exception to Centers devoted to instructional activities and research. If however, in the last sentence of the policy statement, it is interpreted literally, all automation of information systems will have to be approved by the Secretary of the Department of Budget and Fiscal Planning, and this could severely hamper our operation in having to work with that office.

In addition, an Assistant Coordinator was assigned to cover the University of Maryland's Computer Science Center.

The controversy over whether or not the State ADP Administrator had jurisdiction over the Computer Science Center was not resolved for some time. The University continued to object, but were not successful until 1985 when autonomy was returned to the University. During this long period of time, it caused many problems for the Director of the Computer Science Center who had to spend countless hours convincing the State of the need for each computer item to be purchased. The Center had to complete a form BB4 to permit an item to be purchased. The Department of Computer Science was also impacted by the lack of autonomy, as explained in Section **??**. The word BB4 brings back dreaded memories to those University personnel involved in this controversy.

2.3.4 Computer Software Developments in the CSC, 1962–1973

In addition to being a service operation for academic computing, the CSC was involved in software development for the UNIVAC 1108[105]. The program developments were in support of both research and computer courses. A considerable amount of software was also developed for the IBM7090/94 system. Al Beam and his group implemented MAD under the IBM IBSYS system, which some at the University of Michigan were skeptical that it could be done. Beam also wrote a Multi Precision Arithmetic Package. Below we discuss the software developments for the UNIVAC 1108.efforts.

1. **APL**, a programming language implemented by the systems group under the direction of Patrick E. Hagerty[106]. APL 1100 users were able to dynamically change their workspace size and have workspaces anywhere from 16K bytes up to 256K bytes. A matrix inversion primitive, "Domino," was also developed, as well as a "shared variable capability for interprocess communication. A special print bar was developed for high speed printers with a new APL character set designed by Hagerty. UNIVAC produced the print bar and made it available to all their customers.

2. **Basic for the UNIVAC 1108** was developed by a team led by Al Beam who, at the time, was in charge of systems development for the CSC. This permitted computer courses to use this useful language.

3. **Computer Design Language (CDL)**, a hardware simulation modeling language for the design of computer hardware. The language was designed by Professor Yaohan Chu in 1965, and was implemented by Charles Mesztenyi in 1969 (see Section **??**).

[105] Material for this section was provided by Marvin Zelkowitz in an email message to Jack Minker, May 31, 2003, and is contained in the collection of email messages on this history in the Minker collection, University of Maryland Archives, Hornbake Library. Additional material is contained in the list of Technical Reports of the Computer Science Center and the Department of Computer Science. John Menard also contributed to this section.

[106] Assistant Professor Patrick Hagerty received his Ph.D. at Syracuse University in 1969. In addition to his professorial position, he was Assistant Director for Systems, concerned with software on the Center computers. He left Maryland in 1974.

4. **EXEC 8 for the UNIVAC 1108**. Exec 8 was the operating system designed, implemented, and marketed by UNIVAC for the 1108. The operating system provided remote job entry (RJE) and conversational timesharing (the ability to connect teletype machines and to obtain on-line capability with the UNIVAC 1108) capabilities. When it was received by the CSC staff, it was found to have many bugs and was unstable. The CSC staff helped to debug the operating system and provided many additions to EXEC 8. The CSC Operating System Tape was provided to sites throughout the world, essentially at no cost; the sites would send the CSC their blank tapes and the CSC would return them with the Maryland system copied on them.

5. **FORmula MAnipulation Language (FORMAL)**, a formula manipulation language implemented by Charles Mesztenyi and a team of programmers under his direction in 1971. FORMAL is an extension to FORTRAN for symbolic algebraic manipulation. Some of the members of the team were: Hans Breitenlohner, Ray Pardo, Robert Nunn and Joseph Yeh.

6. **Graph Algorithmic Language (GRAAL)**, a graph algorithmic language for describing and implementing applied graph algorithms. The language was developed by Werner Rheinboldt, Assistant Professor Victor Basili[107] and Charles Mesztenyi, and developed in 1972.

7. **Fortran Graph Algorithmic Language (FGRAAL)**, a Fortran extended graph algorithmic language for for describing and implementing applied graph algorithms. The language was developed by Werner Rheinboldt, Assistant Professor Victor Basili and Charles Mesztenyi in 1972. Also contributing to the implementation of FGRAAL were H. Breitenlohner and J. Yeh.

8. **Programming Language University of Maryland (PLUM)**, a programming language implemented by Assistant Professor Marvin Zelkowitz[108]. PLUM was an implementation of IBM's PLI for the UNIVAC 1108 (see Section **??**).

9. **RALF - Reentrant Algorithmic Language FORTRAN**, a Fortran and a MAD compiler for the UNIVAC 1108. Al Beam also led this development, which was used in scientific computing courses and in research.

10. **SIMPL**, a family of languages designed and implemented by Assistant Professor Victor Basili. Several versions were developed, SIMPL-T contained integer and string data while SIMPL-R also included real arithmetic, SIMPL X was a language for writing structured programs that was developed in 1973 (see Section **??**). SIMPL was used both for research and for computer science courses.

2.3.5 Vietnam War Controversy

During the late 1960s, due to the United States involvement in the Vietnam War, there was great unrest at many university campuses, including the University of Maryland[109]. A problem arose with students at the Computer Science Center, because Dr. Azriel Rosenfeld of the Center had a research grant from the Central Intelligence Agency. Grants at the University are not classified and results can be published in the open literature.

[107] Dr. Victor Basili received his Ph.D. from the University of Texas. He is currently with the Department and is a world leader in software engineering.

[108] Dr. Marvin V. Zelkowitz received his Ph.D. from Cornell University in 1971. He was concerned with the development of software, and currently is a leader in the area of software engineering at Maryland.

[109] A description of events on campus during this period are covered extensively in the Diamondback, the University of Maryland student newspaper.

In mid-July, 1969, students from the Students for a Democratic Society (SDS) stormed the CSC building at the front door (west). They were met there by the Associate Director, John Menard[110]. Fortunately for Menard, he had a group of veterans standing in front of him. One veteran asked Menard if he wanted all of the students to enter the building. Menard responded, "No." He and his friends then said that they would not let them enter. Menard later found out that the veteran was Robert Cox, who was then currently a member of the Maryland Fire and Rescue Institute of the University of Maryland.

After the group realized they would not be able to enter, Menard spoke to them and agreed to take a few students to meet the Director, Bill Atchison. The students had a short meeting in Atchison's office. They were upset at the CIA contract. Atchison explained that there was no classified work involved and all research on that contract was available in the public literature. The meeting went well, the students were satisfied with the response, and left.

At various times during this period, the National Guard was shoulder to shoulder around the CSC building and at other times as many as 80 National Guard were housed in the basement of the Computer Science Center. No damage was ever caused to the Center, nor were any faculty or students harassed by students against the Vietnam War.

2.4 Computer Science Department-Oriented Activities

The above material focused on activities that dealt with the start of the Center and primarily the acquisition of a director, faculty, a building, and computers. The remainder of this paper focuses primarily on the activities that led to the start of the Department of Computer Science, and to the activities in the Department's first 6 years.

The following subsections discuss the professorial faculty in the Center in Section **??**; the educational and degree activities that were started in the Center in Section **??**; and the research performed in the Center in Section **??** and how they became the foundation of the Department of Computer Science.

2.4.1 Recruiting Faculty

At the same time as Rheinboldt and Menard were developing an academic computing capability, they started to hire additional faculty to form an educational component in the Center. A listing of the professorial faculty and instructors in the Center is given in Appendix 3 for the period 1962-1973. Below is a discussion of those who played a major part in the education and research aspects of the Center.

Dr. Richard Austing[111], and Dr. Earl Schweppe, both of whom became active in computer science education were hired in the Fall 1963 at the professorial rank (Schweppe was a Lecturer in the Center from 1962-1963. Schweppe was recruited by Dr. Sinkov who had retired from the National Security Agency and had accepted a half-time position to help Rheinboldt start the Computer Center[112].). Schweppe also relates the following:

> In May or June of 1963, Abe–who was still consulting at NSA– came into my office at NSA and asked whether I would be interested in returning to academia. Although I

[110]Personal email message from John Menard to Jack Minker dated 23 July 2002, contained in the email messages to Jack Minker in the Minker Collection, the University of Maryland Archives, Hornbake Library.

[111]Dr. Richard Austing received his Ph.D. in 1963 from Catholic University. He was hired as a Research Assistant Professor in the Center. He served as Director of Education both in the Center and Department. He left the Department to become the Director of Computer Science Education at the Adult Education Center of the University.

[112]In private e-mail communication to Jack Minker on 16 July 2002, in the list of e-mail messages concerning the Department History, in the Minker collection in the University of Maryland Archives, Hornbake Library.

Figure 5: Azriel Rosenfeld, Lecturing on Picture Processing, Photograph by Ben Shneiderman, May 2, 1983.

> had originally planned to work at NSA for at least five years–they had more computers than almost anyone–the situation at Maryland he described sounded interesting and I agreed to give a talk there.

.

To start a research capability, in addition to Rheinboldt's research in Numerical Analysis, they hired Dr. Azriel Rosenfeld in 1964 on a permanent basis as a Research Associate Professor to start a group devoted to picture processing. A photograph of Rosenfeld, taken on May 2, 1983 by Ben Shneiderman appears in Figure **??**. Rosenfeld, now retired, started Maryland's efforts in picture processing and became the first Director of the Center for Automation Research at Maryland and developed one of the best picture processing groups in the world. Dr. James Ortega was hired in 1964 to enhance research in numerical computation, started by Rheinboldt. Ortega received his Ph.D. from Stanford University in 1962. The late Dr. Robert Glasser of the Physics Department also had an appointment in the Center. He was involved in the application of computers to problems in physics. He received his Ph.D. from the University of Chicago in 1954.

A number of faculty were hired in 1965. Asst. Prof. James Owings, who had an appointment

in Mathematics joined the Center part time and worked in the area of theory of computers. He returned to full time in the Department of Mathematics in approximately 1973. Asst. Prof. David L. Parnas joined the Center faculty in 1965 for a short while. He then returned to Carnegie Mellon Institute in 1966 where he had received his Ph.D. in 1965. Parnas was in the area of software engineering. Asst. Prof. John Pfaltz who did his thesis at Maryland in 1969 was in the area of discrete structures. He had been in the Center since 1964 as a research programmer. Dr. Victor Schneider was in the area of programming languages. He received his Ph.D. fro Northwestern University in 1966 and left the University in 1970. Dr. James Vandergraft, also a Maryland graduate in 1966, was in the area of numerical analysis. He became an Associate Professor in 1973 and decided to go to industry in 1975 or 1976, and is now deceased.

Prof. Yaohan Chu, who had been teaching in the Electrical Engineering Department, was given a half-time appointment in the Center in 1966. Chu started the research group in computer organization.

Dr. Jack Minker was hired by Atchison in 1967 as a Visiting Member and joined the faculty as an Assocate Prof. in 1968. He received his Ph.D. from the University of Pennsylvania in 1959. He started research groups in question-answering, information retrieval and databases. He subsequently was a founder of the field of deductive databases and developed a world-leading group in deductive databases, logic programming, and nonmonotonic reasoning. Dr. H.P. 'Ed' Edmundson, was also hired in 1967 as a Full Professor. He received his Ph.D. from the University of California in Los Angeles in 1953. Edmundson started the theory group.

Dr. Laveen Kanal joined the faculty in August 1970 as a Full Professor and started a group in pattern recognition. He received his Ph.D. from the University of Pennsylvania in 1960 and is now Professor Emeritus. He became recognized as a world leader in pattern recognition. Menard and Rheinboldt were influential in attracting Dr. Victor Basili, a new Ph.D. in computer science from the University of Texas in 1970. Basili was a member of the Syracuse group. Indeed, he was the first student Menard hired when he was at Syracuse. This came about since the young lady who Menard desperately wanted to hire turned him down. Basili then went to the University of Texas to receive his Ph.D. He applied to Maryland where his friends Rheinboldt and Menard were working. Rheinboldt and Menard's knowledge of Basili's capabilities were sufficient to convince the computer faculty to hire him. Although he started his research in programming languages, Basili later founded the world-renowned group on software engineering together with Marvin Zelkowitz who was hired in 1971 and then worked on compiler development. Zelkowitz received his Ph.D. from Cornell University in 1971. Dr. Michael Lay, received his Ph.D. from Ohio State University in 1972 worked in the area of systems and document retrieval. He joined the faculty as an Instructor in 1970, and became an Assistant Professor in 1972. Dr. Michael McClellan who received his Ph.D. from the University of Wisconsin in 1971, joined the faculty in 1970 as an Instructor, and became an Assistant Professor in 1971. McClellan worked in the area of symbolic computation. Both Lay and McClellan left the University for careers in industry in 1976 and 1977, respectively.

Dr. Ashok Agrawala, Dr. Ron Baecker, Dr. Robert Noonan, and Dr. Richard Hamlet joined the faculty as Assistant Professors in 1971. Agrawala received his Ph.D. from Harvard in 1971. He developed a well-respected group in computer systems and is currently a Full Professor in the Department. Baecker was a Visiting Assistant Professor from 1971-1972. He received his Ph.D. in 1969 from M.I.T. and worked in computer animation. Hamlet received his Ph.D. in 1971 from the University of Washington. He was promoted to Associate Professor in 1977 and worked on software testing, theory and programming languages. Hamlet left the University in 1984 for a faculty position on the West Coast. Noonan received his Ph.D. in 1972 from Purdue University and worked on programming languages. He left the University in 1977 for a faculty position at the College of William and Mary.

Dr. David Mills received his Ph.D. from the University of Michigan in 1971. He became an Assistant Professor in 1972 and worked in the area of computer systems. He left the University in 1977.

2.4.2 Educational Activities

This section discusses the education program started in the Center including the efforts to develop a curriculum in computing on a national basis, led by Dr. William F. Atchison. The introduction of computing courses through the Center and the start of the degree programs for the Master of Science, Ph.D., and Bachelor of Science degrees in that sequence, is discussed.

Curriculum 68. It was clear in the early 60s that, if the field of computer science were to flourish, there was a need for a curriculum to be developed. There was no recognized curriculum in computer science anywhere in the world before the 1960's. To remedy this situation, the Association for Computing Machinery (ACM) formed a committee in 1962 to develop such a curriculum as a subcommittee of the Education Committee. The Curriculum Committee became an independent committee of the ACM in 1964. Professor William F. Atchison, who was then at Georgia Institute of Technology, was named Chair of the ACM Curriculum Committee (ACC). A photograph of Atchison, taken in 1981 by Ben Shneiderman is shown in Figure **??**. Members of the committee were drawn from many universities throughout the United States and Canada[113]. Research Professor Werner Rheinboldt was a founding member of the ACC. Assistant Professor Earl J. Schweppe, who became a faculty member of the CSC, attended a meeting of the ACC at the behest of Rheinboldt, and was invited to become both a member and the Secretary of the ACC. The ACC was charged with developing a set of courses, an outline of topics to be covered in the courses, and a sequence of courses leading to undergraduate and graduate degrees in computer science.

The ACC issued its first report, *An Undergraduate Program in Computer Science — Preliminary Recommendations*, **Communications of the ACM**, Volume 8, Number 9, September 1965, pp. 543–552. The report, as noted in the title was preliminary in nature. The authors recognized that there were related efforts to discuss computer curricula, notably by the Committee on Undergraduate Program in Mathematics (CUPM), which paralleled their efforts, but was oriented toward mathematics students, not toward the emerging field of computer science. The report discussed their objectives, computer science as a discipline, implementation of the report, and future work of the committee. A table summarizes the conclusions of the report and consists of the courses in 5 areas: basic courses, theory courses, numerical algorithms, computer models and applications, and supporting courses. With respect to these 5 areas, listed are those that are required, highly recommended electives, and other electives. Catalog descriptions were provided for each course and descriptions of computer science curriculum courses — outlines and references.

[113] Members of the ACC were:
William F. Atchison, University of Maryland (Chairman)
Samuel D. Conte, Purdue University
John W. Hamblen, SREB and Georgia Institute of Technology
Thomas E. Hull, University of Toronto
Thomas A. Keenan, EDUCOM and University of Rochester
William B. Kehl, University of California, Los Angeles
Edward J. McCluskey, Stanford University
Silvio O. Navarro*, University of Kentucky
Werner C. Rheinboldt, University of Maryland
Earl J. Schweppe, University of Maryland
William Viavant, University of Utah
David M. Young, Jr., University of Texas
* Dr. Navarro was killed in an airplane crash on April 3, 1967.

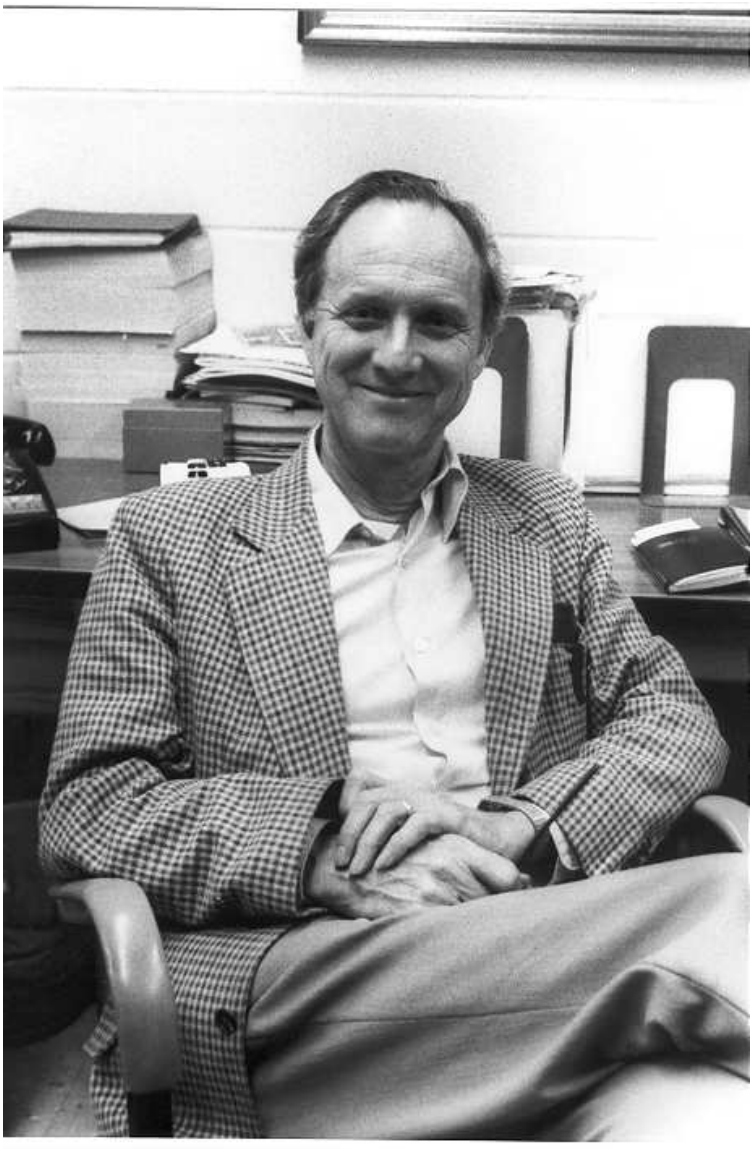

Figure 6: William F. Atchison, Chair ACM Curriculum Committee, 1981, Photograph by Ben Shneiderman.

Schweppe was a major contributor to this report. When he was hired as a faculty member in the Center, Rheinboldt assigned him the responsibility to work on the education component of the Center goals. As part of his responsibility he wrote a report[114], *A Proposed Academic Program in the Computer Sciences*, and presented it at an ACM meeting in Philadelphia. As reported by Schweppe and Rheinboldt[115], they state,

> Our work in course development here at Maryland has contributed substantially to the ACM committee's work and, in fact, the national committee has accepted with only minor modification, much of what we have done. In turn, we have benefited immensely from our contacts through the committee with others working on these problems.

Atchison and his ACC Curriculum Committee, with a few new additional members, continued their work on the development of a computer curriculum. In 1966 Atchison moved to the University of Maryland to become the Director of the Computer Science Center. Rheinboldt had stepped down as Director so that he could devote more of his efforts to research and teaching. Both he and Schweppe continued as members of the committee. When he came to Maryland, Atchison enlisted other Center faculty in this important effort. Professor H.P. Edmundson, Associate Professor Jack Minker, Instructor George Lindamood, and Professor James Owings who had a joint appointment with Mathematics provided input for various parts of the curriculum that was being expanded from the 1965 report. Professor Yaohan Chu served as a consultant to the ACC as did George Lindamood. Lindamood was among the first programmers who joined the Center. He was a research programmer from 1963-1965, became an Instructor from 1965-1971, during which time he introduced some of the first courses taught in the Center (see Section **??**) and received a M.A. degree in 1964. He left the University in 1971 for a career in government. Chu contributed to courses on computer organization and Lindamood contributed to courses on numerical analysis, and both contributed to the course on computers and programming.

The output of this work was a comprehensive report, *Curriculum 68 — Recommendations for Academic Programs in Computer Science*, **Communications of the Association for Computing Machinery**, Volume 11, Number 3, March 1968, pp. 151–197. This report has been recognized by most computer scientists as the most important document on computer science curriculum development ever published on the subject. The abstract of the report states,

> This report contains recommendations on academic programs in computer science which were developed by the ACM Curriculum Committee on Computer Science. A classification of subject areas in computer science is presented and twenty-two courses in these areas is described. Prerequisites, catalog descriptions, detailed outlines and annotated bibliographies for these courses are included. Specific recommendations which have evolved from the Committee's 1965 Preliminary Recommendations are given for undergraduate courses. Graduate programs in computer science are discussed, and some recommendations are presented for the development of master's degree programs. Ways of developing guidelines for doctoral programs are discussed, but no specific recommendations are made. The importance of service courses, minors, and continuing education in computer science is emphasized. Attention is given to the organization, staff requirements, computer resources, and other facilities needed to implement computer science educational programs.

[114] A copy of the unpublished paper written by Earl Schweppe may be found in the Minker collection in the University of Maryland Archives, Hornbake Library.

[115] Letter to Dr. Hornbake from Dr. Schweppe and Dr. Rheinboldt, 1965 November 8, Box 606 of the Hornbake Collection, University of Maryland Archives, Hornbake Library.

The major contributors to the curriculum report from Maryland were Atchison, Rheinboldt and Schweppe. Atchison was the Chairman and driving force who made sure that the committee ran smoothly, that they were receiving information from the right people, and generally shepherding the report. Schweppe, as Secretary, worked closely with Atchison and helped to pull together the various efforts throughout the country, recorded all of the recommendations, was in touch with all committee members, publishers, and experts in the field of computer science. Schweppe wrote publishers requesting copies of every book that existed in computer science. He had an entire wall of books that, most likely, constituted all computer science books in print at that time. Rheinboldt was a member of the Curriculum Committee, and contributed a number of courses and their curricula for scientific computing and applications, as well as content to the main body. Much of the editorial work was done by Schweppe, assisted by Lindamood. The other Maryland faculty members contributed in the development of specific courses: Yaohan Chu, Harold P. Edmundson, Jack Minker, and James C. Owings, Jr. Typing was done by Mrs. Mary Schweppe, supported by Pat Autry and Eleanor Waters. Mrs. Schweppe also edited, corrected and provided comments to improve the text, as well as to track down references for the literature related to each course.

All members of Atchison's Curriculum Committee made significant contributions to the effort as did many other individuals. There is no doubt, however, that the three faculty from the University of Maryland, Atchison, Rheinboldt and Schweppe, played key roles in its development. In addition to helping to define the curriculum, Maryland's unique role was in coordinating the entire effort.

Because of his work on computer science education, Atchison was given a number of distinguished awards:

1. ACM Distinguished Service Award, 1973
2. IFIP 1974 Special Award in Appreciation for Services as Chairman of WG 3.1 1968-1974
3. Chester Morrill Memorial Award from the Chesapeake Division of the Association for Systems Management, 1975
4. ACM Special Interest Group on Computer Science Education (SIGCSE) Award for Outstanding Contributions to CS Education, 1981
5. Distinguished Alumni Award from Georgetown College for work in Computer Science and Mathematics, 1982

Schweppe presented a paper at **ACM '90**, held in Washington, D.C. in 1990, titled *On the Genesis of Curriculum 68, DRAFT*. Some material in this section was taken from that unpublished paper, made available to the author by Schweppe[116]. The paper made available to Minker and contained in the University of Maryland Archives, although incomplete, and only a Draft, is valuable for those who wish to know know how the committee worked, primarily during the period 1964 to 1968, how it organized itself, and made use of a wide variety of consultants. The particular people who worked on the various courses and the more general aspects of the report are listed. Some of the philosophy which guided the committee is also included. The paper is important for historical reasons and this author hopes that Schweppe will complete his paper and publish it in a journal.

Start of the Education Program. As noted in section **??**, Rheinboldt and Menard came to Maryland with the intention to start degree programs in computer science. This effort was started in 1963 when Schweppe was hired in August of that year.

[116]The DRAFT paper written by Earl Schweppe, *On the Genesis of Curriculum 68* is contained in the Minker collection in the University of Maryland Archives, Hornbake Library.

Schweppe was placed in charge of a group to develop an academic program in computer science. This led to a 1964 report, *A Proposed Academic Program in the Computer Sciences*[117], written by Schweppe, with contributions from Rheinboldt, Menard, Richard H. Austing and James Ortega. Also contributing to the report were Professor Howard E. Tompkins and Alan B. Marcovitz of Electrical Engineering. The report listed all courses that used the computer that were offered at Maryland in the 1963-1964 academic year. There were a total of 18 courses with 3 offered by Business Administration, 1 by Chemical Engineering, 1 by Chemistry, 1 by Civil Engineering, 1 by Education, 1 by Electrical Engineering, 3 by Mathematics, 1 by Mechanical Engineering, 4 by Psychology, and 2 by Sociology. A total of 452 enrollees were recorded in the fall semester, and 582 in the spring semester.

The report proposed that,

> This program would begin with the offering of an undergraduate major and expand toward the establishment of a master of science degree and then a doctoral program as rapidly as staff and other conditions could be developed.

A number of courses were sketched. It is of interest to note that this was not the way degrees in computer science evolved at Maryland. The first program introduced was a Master of Computer Science, followed by a Ph.D. degree and finally an undergraduate B.S. degree in computer science. The sequence of the initiation of the degree programs was based on the the fact that the CSC was not an educational department so it could not offer an undergraduate degree. However, all graduate degrees were offered through the Graduate School, regardless of which group provided them. Thus the degree programs started with the M.S. and then the Ph.D. The M.S. was offered first since it would attract students to the program who could then move to the Ph.D. program. The undergraduate B.S. program was proposed and immediately received prompt approval when the Computer Science Department was established following a reorganization of the University of Maryland faculties (see Section **??**).

As noted in section **??**, computer courses were introduced at the University of Maryland as early as 1948 in the Mathematics Department by Associate Professor Harry Polachek, and in September 1957 in the Electrical Engineering Department, by Dr. Yaohan Chu on analog computers. Chu also taught the first course on the organization of electronic digital in the spring 1958 semester at which time he started to develop a textbook on the subject, "Digital Computer Design Fundamentals," (482 pages), published in 1962 by McGraw Hill.

Beginning in the fall of 1965, the Computer Science Center began the first education courses in computer science by offering six basic courses. Two graduate or advanced undergraduate courses were introduced.

First Courses Offered in Computer Science Center The Computer Science Center started its formal courses in computers in the fall 1965. The catalog of the University of Maryland lists 6 formal courses in computer science offered for the first time in the fall/spring semesters, 1965-66. The courses were:

1. C.S. 12, Introductory Algorithmic Methods (3 credits) for students not majoring in Mathematics, the Physical Sciences or Engineering, 2 lectures and one 2 hr. lab.

2. C.S. 20, Introductory Algorithmic Analysis (3 credits), Prerequisite, Math 20 (Calculus I) for students in Mathematics, Physical Sciences or Engineering, 2 lectures and one 2 hr. lab.

[117]The report, *A Proposed Academic Program in the Computer Sciences* may be found in the Minker collection in the University of Maryland Archives, Hornbake Library.

3. C.S. 21, Numerical Analysis Lab I, (1 or 2 credits) 2 hrs. lab, Prerequisite Math 21 (Calculus II).

4. C.S. 22, Numerical Analysis Lab II, (1 or 2 credits) 2 hrs. lab, Prerequisite Math 21 (Calculus III).

5. C.S. 100, Language and Structure of Computers (3 credits) 2 lectures and 2 hrs. lab, Prerequisite C.S. 12 or C.S. 20.

6. C.S. 110, Special Computational Laboratory (1 or 2 credits) 2 hrs. lab, Prerequisite C.S. 12.

The courses C.S. 12, C.S. 20, C.S. 21, and C.S. 100 were introduced in the Fall 1965 semester.

There were two versions of the introductory course, C.S. 12 and C.S. 20. C.S. 12, Introductory Algorithmic Methods, was geared to students outside the physical sciences. C.S. 20, Introductory Algorithmic Analysis, was for students in mathematics, engineering, and physical sciences [118]. The principal differences were only in the origin of the programming assignments. MAD, an adaptation of ALGOL 58 from the University of Michigan, was the programming language for both courses, chosen largely because it afforded a programming style that the faculty believed was closer to what eventually became "structured programming" (a la Dijkstra) than did FORTRAN.

Knowing that the Computer Science Center would formally start offering courses in the fall of 1965, Rheinboldt worked with Dr. Howard Tompkins, then chair of EE, to offer a "pilot" or "beta" version during the spring 1964-65 semester. It was called EE 102, and there were two sections, one taught by Edward Miller, an Instructor in EE, and one taught by Lindamood who does not remember whether they taught the MAD language or the FORTRAN language, but thinks they may have taught FORTRAN.

Lindamood also taught the first course in assembler language programming, CMSC 100, Language and Structure of Computers. The course covered the logical basis of computer structure, machine representation of numbers and characters, flow of control, instruction codes, arithmetic and logical operations, indexing and indirect addressing, input-output, pushdown stacks, symbolic representation of programs and assembly systems, subroutine linkage, macros and recent advances in computer organizations. Students were expected to do computer projects. Lindamood developed his own fictitious computer, MBC, the Make-Believe Computer. Part of his reasons for introducing the MBC were that, (a) he wanted students to have a simplified machine with a limited instruction repertoire that they could comprehend, and (b) so that students could develop an intuitive feel for what was being done in hardware and what was being done in software. His programming assignments were (1) to write programs in octal without benefit of an operating system and permitted students to manipulate control switches; (2) to redo the previous assignment using an assembler; (3) to introduce the idea of an octal dump as a debugging tool; (4) and to redo the third assignment on an IBM 7094. As noted by Lindamood, he sort of

> "bootstrapped" the students into the 7094, which seemed better pedagogically than trying to jam them into some small part of the 7094 to start out.

An interesting discussion as to the rationale for the above courses, appears in a proposal written by Earl J. Schweppe to the U.S. Commissioner of Education[119]. There is no evidence that the

[118] Some of the material described below, is adapted from information provided to Jack Minker in an e-mail message dated October 3, 2002, by George Lindamood, who was an instructor in the CSC, involved in teaching some of the courses discussed. The email message is in the Minker collection of email messages concerning this history in the University of Maryland Archives, Hornbake Library.

[119] A copy of the Curriculum Improvement Proposal, submitted to the U.S. Commissioner of Education, titled "Research and Development Supporting University Level Education in Computer Science," dated 1965 August 30, is included in the Minker collection in the University of Maryland Archives, Hornbake Library.

proposal was funded. For example, in discussing the rationale for the courses C.S. 12 and C.S. 20, the proposal states,

> Although many introductory college level courses in computing have consisted primarily of instructions in the mechanics of coding programs in some particular language. ... such courses should more properly emphasize the art of computing and the general principles of problem solving. Therefore we have chosen the idea of an algorithm to be the central concept in our introductory courses, C.S. 12 and C.S. 20. Such an approach, we feel, not only centers the students' first contacts with computers toward those aspects of computing which permit greatest transfer to and from the students' other experience.

Following the initial courses offered by the Computer Science Center, as the faculty grew, new courses were introduced in the areas of discrete structures, file processing, data and storage structures, generalized data management systems, information processing systems, computer organization, systems programming, structure of programming languages, compiler writing, logic and algorithms, theory of computation, formal language theory, and combinatorics and graph theory. By the time the Department of Computer Science was formed in 1973, there were a total of 25 different undergraduate courses offered. These courses are listed in Appendix 1.

The impetus to start formal degrees in computer science and computer systems engineering started in October 1965. At that time, the Computer Science Advisory Committee[120] of the University set up a Task Force to study how the University might establish an interdisciplinary graduate program in computer science. The Task Force recommended, a Master's Degree Program in Computer Science, and an interdisciplinary graduate program in Computer Systems Engineering. The Computer Science Advisory Committee had endorsed this recommendation. The interdisciplinary program was proposed to be developed jointly and sponsored by the Computer Science Center and the The Department of Electrical Engineering.

The Task Force[121] assigned to this effort completed their "Report of the Task Force for Design of an Interdisciplinary Graduate Program in Computer Science," October 31, 1966. They performed a thorough study of computer science education at other universities. Their report summarizes the state of computer science at 56 schools and shows that a large number of new Computer Science graduate programs were established during the two years preceding the report and several were being established. Based on information from the universities surveyed, from the Association for Computing Machinery Curriculum Committee and their own discussions, the Task Force attempted to design an interdisciplinary graduate program in Computer Science.

[120] The members of the Computer Science Advisory Committee were:
M.H. Martin, Chairman (Institute for Fluid Dynamics and Applied Mathematics)
J.P. Menard, (Computer Science Center)
D.W. O'Connell (Business and Public Administration),
W.C. Rheinboldt (Institute for Fluid Dynamics and Applied Mathematics, and Computer Science Center)
H.E. Tompkins (Electrical Engineering)
Gart Westerhout (Physics and Astronomy)

[121] The "Report of the Task Force for Design of an Interdisciplinary Graduate Program in Computer Science," was written by:
C.H. Cook (Mathematics)
R.O. Durant (Economics and Information Systems Management)
R.G. Glasser (Physics and Computer Science Center)
W.C. Rheinboldt (Institute for Fluid Dynamics and Applied Mathematics and Computer Science Center), Alternate - J.M. Ortega
E.J. Schweppe, Secretary (Computer Science Center)
H.E. Tompkins, Chairman (Electrical Engineering)
Paul Wasserman (School of Library and Information Services), Alternate J.M. Perrault)

The specific recommendations of the Task Force that pertain to Computer Science were as follows:

COMPUTER SCIENCE PROGRAMS

1. The Computer Science Center should offer, under the Graduate School, a Master of Science degree program in Computer Science, beginning in September 1967. The faculty of the Computer Science Center should prepare a detailed proposal for this program to be submitted to the Graduate Council as soon as possible in the fall of 1966.
2. The establishment of a Ph.D. program in Computer Science should be acknowledged as an early goal, depending principally upon the growth of the faculty resources of the Computer Science Center.
3. Consideration of the possibility of an undergraduate major program in Computer Science should be deferred at this time, without prejudice.
4. Provision of suitable Computer Science courses at the undergraduate and graduate levels for students in other majors should continue to be an important part of the educational program of the Computer Science Center.

The report describes the reasons underlying the recommendations and is the basis for the specific proposals that followed to initiate programs M.S., Ph.D., and B.S. degrees in Computer Science. These efforts are discussed below.

Master of Computer Science Degree (M.S.) The first degree program in computer science at Maryland was the Master of Science Degree which started in September 1967. Following the recommendations of the Task Force discussed above, a document, "Proposal to initiate a Graduate Program in Computer Science leading to the MASTER OF SCIENCE DEGREE" was submitted to the University by the Computer Science Center. The report proposed the following actions be taken.

> ... That a graduate program in computer science leading to a Master of Science degree be approved to begin operation in the school year 1967-1968. b) That eighteen new advanced undergraduate courses in computer science be approved so that offerings from them can begin in the fall of 1967. Those courses are CMSC[122] 102, 140, 166, 200, 215, 225, 230, 235, 240, 245, 258, 263, 266, 280, 285, 263, 266, 280, 285, 290, 295, and 399. Three of these courses–CMSC. 102, 166, and 263–would be cross listed with the School of Library and Information Services.

Work on this plan was initiated in October 1965 by the Computer Science Advisory Committee and was subsequently refined and placed in final form after the arrival of Dr. Atchison in September, 1966. The Computer Science Center faculty, under the Director, William F. Atchison, was proposed as the organization to develop and administer the master's degree program. The financial support of the program was to be handled out of the then existing educational budget of the Center through the Office of the Vice President for Academic Affairs, then Dr. Hornbake. Academic aspects of the program would be handled through the office of the Vice-President for Graduate Studies and Research. An announcement of the degree program dated May 27, 1967 stated[123],

[122] The names of the courses are listed in Appendix 1.

[123] Box 606, Hornbake papers, Hornbake Library, Announcement titled Graduate Program in Computer Science (Master of Science Degree), May 22, 1967.

> The faculty complement available and approved for 1967 is adequate to handle the student load which has been forecast. The rate of expansion for the next several years is projected to be three faculty members per year. With the addition of three floors to the present building (already funded), the space needs have been anticipated.
> ... Throughout the manuscript a doctoral program was forecast for the near future with the Master's offering a lead-in to the more advanced program.

The Master of Science Degree was approved by the Faculty Senate and students were enrolled in the M.S. program in September 1967. As noted by Rheinboldt[124],

> It represented, at that time, the first such program in the Washington, DC area.

At the June 21, 1967 meeting of the CSC Policy Committee it was announced that the Board of Regents approved the M.S. degree [125]. When the program was announced, over 100 students applied for the M.S. degree. However, only 18 were approved, some conditionally.

The initial requirements for the degree were to complete approximately 6 graduate courses with a grade of B or better and to write a thesis. The requirement for a thesis was retained, but liberalized in 1971 by the so-called "Minker Committee," to permit students to pass a qualifying examination. See Section **??** for a discussion of the "Minker Committee." The first M.S. degree in computer science at the University of Maryland was granted to J. Gary Augustson on June 7, 1969. Mr. Augustson wrote a Master's Thesis titled, *Experiments with Graph Theoretical Clustering Techniques*, under the direction of Dr. Jack Minker.

Doctor of Philosophy (Ph.D.) Degree in Computer Science. The Computer Science Center wrote a "Proposal for a Ph.D. Program in Computer Science" on December 5, 1968 and revised February 26, 1969 to the Faculty Senate[126]. The Faculty Senate approved the Ph.D. program in the spring of 1969, and the Ph.D. program in Computer Science started in September 1969.

The proposal listed requirements for students to enter the program, a wide range of courses available at the graduate and undergraduate levels and five areas in which students may specialize: *theory and metatheory, information processing, computer systems, numerical analysis, and applications*. The faculty debated about the degree requirements.

Although the Ph.D. program started in the spring 1969, and some requirements listed, there were, however, no details provided as to the specific requirements for becoming a Ph.D. Beginning with 1970, a number of faculty were hired over the next 2 years who had Ph.D.s in computer science, which resulted in expansion of topics that were now "computer science." To make the requirements precise, the so-called *Minker Committee*, chaired by Professor Jack Minker[127], spent many weeks discussing the requirements. There were many issues debated. The primary issue was whether or not a Ph.D. candidate should be proficient in all of the 5 areas listed above, or a subset of these topics. The Committee decided that the emphasis should be on breadth of knowledge and selected a four-out-of-four option, omitting the *applications* area. In 1972, this requirement was relaxed to a 3 out of 4 criterion. A second issue was what would happen if a student failed 1 or more of

[124] Rheinboldt's remark appears in the IPST History Draft, by R.E. Kastner, contained in the Minker collection, University of Maryland Archives, Hornbake Library. Rheinboldt was contacted by Kastner for her history since Rheinboldt was a member of IPST, as well as the CSC.

[125] The minutes of the CSC Policy Committee of June 21, 1967 may be found in the Minker collection, University of Maryland Archives, Hornbake Library.

[126] A copy of the "Proposal for a Ph.D. Program in Computer Science," December 5, 1968 may be found in the Minker collection, University of Maryland Archives, Hornbake Library.

[127] Some members of the committee were: Professor H.P. Edmundson, Professor Robert Glasser, Assistant Professor Ashok Agrawala, Assistant Professor Victor Basili, and Assistant Professor Marvin Zelkowitz, and others, including students. No documentation was found that lists all the members of the committee.

the examinations. The Committee was unforgiving and insisted that all examinations had to be passed on one sitting. Again, this criterion was relaxed in 1972 and students were permitted to take only those examinations they had not passed on a second attempt. A third issue was language proficiency. It was decided that a student had to be proficient in a language other than English, but that the Ph.D. advisor would determine the language and the proficiency required.

In addition to the Ph.D., the Committee offered a second option for the M.S. degree. The initial requirement was that students had to complete a scholarly thesis. The additional option permitted students to take the qualifying exams offered for the Ph.D. However, the passing threshold was lowered. The M.S. qualifying examination was based on the courses, CMSC 150, Data Structures; CMSC 411, Systems; and CMSC 311, Programming Languages. This was called Part I of the Ph.D. Comprehensive Exam.

The requirements for the Ph.D. degree were as follows (Note: the course numbers listed are as existed at the time. Course numbers have changed over the years.):

> A) Supporting work. Students are required to take their supporting work in courses numbered 100 and above (undergraduate level courses), with at least 8 credits in courses numbered 200 and above (graduate level courses). These courses must cover one or two coherent fields of knowledge which constitute a unified program in conjunction with the student's area of specialization within computer science. One of these fields may be a different area of specialization within computer science ..., but at least 9 credits of supporting courses must be outside of computer science.
>
> B) Comprehensive examination. A student must pass a comprehensive examination covering the first four of the five Areas of Specialization, including material in 10 specific courses listed. This is a written examination; in the event of failure, it may be taken a second time without special permission.
>
> C) Candidacy examination. The student must pass an oral candidacy examination covering the contents of at least three 200-level (graduate level) courses relating to the student's area of specialization. The student shall submit copies of his dissertation proposal to the members of the examination committee at least two weeks prior to taking the examination. His dissertation advisor will normally be the chairman of this committee.
>
> D) Foreign language requirements. The faculty has approved that the foreign language requirements may be fulfilled under any of the four options approved by the Graduate Council. In accordance with the requirements of the Graduate Council for a Ph.D. program, a detailed proposal for meeting these requirements is being submitted to the Foreign Language Committee of the Graduate Council for their approval and the approval of the Council.
>
> E) Programming Competence. Before he is admitted to candidacy, the student's proficiency in computer programming must be certified by the faculty.

The document listed sample curricula, projected enrollment, available and required support, relation to other programs at Maryland, compared the program with other universities, provided detailed descriptions of courses, and contained the vitae of the faculty and letters of endorsement from related departments.

Dr. Gordon VanderBrug, who was among the first seven students who took the examination, captures the tenor of the Committee recommendations in his remembrance of the first examination[128].

[128]Private e-mail communication to Jack Minker from Gordon VanderBrug, 10 July, 2002, contained in the Minker

> I was one of seven people that took the prelims in Sept of 1970, the first time they were offered. I recall realizing how intently the composition of the tests was based on a process of compromising within the faculty, except that the first time the test were given I do not think there was a whole lot of compromising actually done. Computer Science was so new, and there was little agreement on the kinds of proficiencies that should be demonstrated by its students. The theoretical/mathematical people had one view, while the computer system types had quite a different view. As a result we took four tests (automata and language theory, numerical analysis, data structures/programming languages/AI, computer systems) and had to pass all four tests to pass the exam. If one did not pass all four tests one had to take them all over again. I was one of three that did pass the prelims the first time, I believe having the highest grades in automata, numerical analysis and programming languages and the lowest passing grade in computer systems. In fact, I think to this day that you folks set the threshold in the systems test at my grade. The very next time that the prelims were given the requirement to pass all or nothing was relaxed.

The requirements for the Ph.D. were very detailed and, as VanderBrug intimates, in a sense restrictive. In addition to requiring that students pass four written examinations in one sitting over a few days, it was uncompromising in that if a student passed three of the four examinations, he or she was required to *repeat all four examinations in one sitting if taken again.* It is fortunate that the faculty came to their senses and revised this restriction by the time the following Ph.D. examination was offered. These requirements have evolved over the life-time of the department and relaxed so that in the 1990s no written examination is required, but students must pass their graduate courses with grades the greater majority of which must be A's and no grade lower than a B. The strict requirements were, perhaps, an attempt to assure that this new discipline would be an appropriate one in rigor as were other departments in the division.

In May 1973, the Computer Science Education Sub Committee, chaired by Jack Minker revised the requirements for the M.S. and Ph.D. degrees to be applicable to the newly formed Department of Computer Science[129]. Four documents were prepared:

1. Proposed Degree Requirements
2. Proposal for the Comprehensive Examination
3. Proposal for the Ph.D. Preliminary Examination
4. Proposal to Permit Additions and Deletions to the Comprehensive Examination.

The memorandum codified the degree requirements for the new Department and liberalized the requirements for the Comprehensive Examination. The changes to the previous documents on these subjects were minor. The major change was to allow students who did not pass all three examinations on one sitting to take only the examinations they did not pass on a second sitting, but were not required to repeat all examinations.

The Education Program Curriculum Committee reviewed the memorandum and, with minor changes approved it[130].

email collection of this history, in the University of Maryland Archives, Hornbake Library

[129]Memorandum by Jack Minker, Chair of the CSESC, titled, Requirements for Advanced Degrees in Computer Science, May 8, 1973, in the Menard collection in the University of Maryland Archives, Hornbake Library.

[130]Memorandum from the Educational Program and Curriculum Committee Meeting, dated May 25, 1973, in the Menard collection of papers in the University of Maryland Archives, Hornbake Library.

In August 1973, Daniel H. Fishman became the first student in the Department to complete all requirements for the Ph.D. degree. The first Ph.D. degrees were granted to Daniel H. Fishman and David Milgram on December 22, 1973. Dr. Fishman's thesis was directed by Professor Jack Minker and was titled, *Experiments with a Resolution-Based Deductive Question-Answering System and a Proposed Clause Representation for Parallel Search.* Dr. Milgram's thesis was directed by Professor Azriel Rosenfeld and was titled, *Web Automata*.

Undergraduate Degree in Computer Science. The Computer Science Center developed a proposal to initiate a Bachelor of Science degree in computer science in the spring of 1973. The proposal was developed by the Undergraduate Program Committee[131] of the CMSC Education Steering Committee. The report, under the chairmanship of Dr. Richard Austing, stressed the need for well-trained personnel in the computer field, particularly in the general Washington, D.C. area. It also stated that,

> ... there are no B.S. degree programs in C.S. anywhere in the area closer than Pennsylvania State University and the University of North Carolina.

The proposal was in accord with the spirit of the College Park Campus to keep to a bare minimum specific course requirements in the degree program. The requirements for students were as follows:

> Only two courses, both at the freshman level, need be taken by all majors and the first one of these may be omitted by any student who has suitable programming background obtained in high school or in a programming course offered by another department. Beyond the freshman level, the student has a choice of courses in computer science, provided at least 30 credit hours are achieved, of which at least 24 credits are at the 3-400 level (note: suitable for juniors or seniors). The student's choice of courses outside of computer science is limited only by Division and University requirements; prerequisites; and the need to fulfill a specific goal after graduation.

Students intending to major in computer science had to achieve an average grade level of at least B in all freshman and sophomore level courses. The document also anticipated that a Computer Science Honors Program would be initiated in time for incoming freshmen to participate in it during their senior year.

The courses and their credit hours offered and approved for credit in the B.S. program, where 100, 200, 300, and 400 level courses denote freshman, sophomore, junior, and senior level courses, are listed in Appendix 1.

The report also included the pre-requisites for each course, example curricula, supporting courses in other departments, catalog descriptions of the courses, and outlines and references for proposed or new courses.

The proposal was delayed by the Programs Curricula Committee (PCC) of the University Senate to assure that there was no duplication with programs in other departments. In particular, a letter from a faculty member in Electrical Engineering questioned whether the program duplicated efforts

[131] The members of the Undergraduate Program Committee consisted of:
Assistant Professor R. Austing, Chair,
Assistant Professor A. Agrawala,
Assistant Professor R. Hamlet,
S. Kaisler (student),
R. Nagel (student),
Assistant Professor R. Noonan, and
Associate Professor J. Vandergraft.

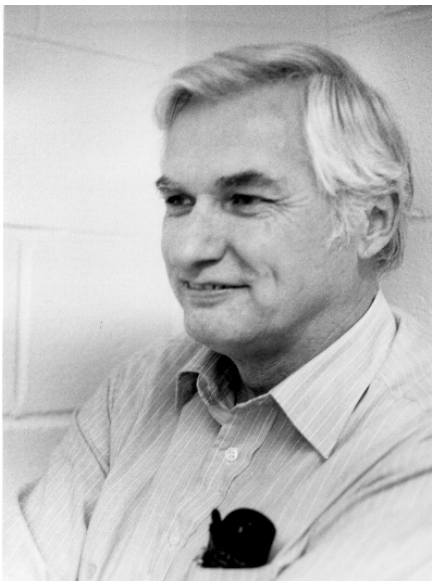

Figure 7: Richard Austing, Director of Education, Photograph by Ben Shneiderman, 1986

that already existed in that department. A letter was submitted to the PCC in response to their request and approved unanimously by the faculty. The PCC approved the proposal and the Senate voted to accept the B.S. Degree in Computer Science on May 3, 1973.

Education Administration As the computer science curriculum and student enrollments became larger, it was clear that special attention had to be paid to this activity. It could not be handled adequately by the Director or the Associate Director of the Center. In 1967, Director Atchison appointed Dr. Richard Austing Director of Education. He was given a secretary and a prominent office so that he would be accessible to students. In addition, it was necessary for faculty to coordinate courses among themselves and to prepare the Ph.D. Comprehensive Examination. This gave rise to Field Committees for Theory, Numerical Analysis, Systems, Programming Languages, and Artificial Intelligence. The Field Committees started at approximately the same time as the Ph.D. degree program was approved.

Austing was responsible for finding individuals who could teach some of the lower level courses for which there were not sufficient faculty. In addition, he was responsible for assigning rooms and assuring that related courses in different Field Committees were not given at the same time. He was responsible for advising undergraduate students, and coordinated the activity of reviewing graduate student applications, admitting students into the graduate program, and offering them Teaching Assistantships. As the program grew over the years, this became a demanding job that he handled capably and efficiently. Austing remained in charge of the education program until around 1992 when he stepped down from the position.

There was concern that courses and instructors be evaluated. The faculty wanted to assure that students were well-trained, that faculty prepared adequately for their courses, and students were content with the material. Under the Education Committee, a Course and Evaluation Committee was formed. In November 1972, the Committee designed a form to be completed by students to provide useful information about courses[132]. The forms were to provide students helpful information in selecting courses and teachers. The forms were also useful in evaluating Assistant and Associate

[132] A draft of the evaluation form is contained in the minutes of the Education Committee of November 17, 1972 contained in the Minker collection in the University of Maryland Archives, Hornbake Library.

Professors and in making tenure decisions. To assist new faculty in their teaching, a tenured faculty member was assigned to attend one or more sessions of the new faculty. The report of the faculty member went only to the individual who was reviewed, and was neither available to the Chair or other faculty members. The intent was to assist the new faculty members, not to make them concerned. As the individual neared promotion, faculty members who attended lectures of junior faculty made their reports to the Chair and the members of the APT Committee.

2.4.3 Research Activities

Research Conducted in Center. Research in the Computer Science Center started shortly after Rheinboldt arrived. The main focus of his research was in numerical analysis and scientific computation. When Azriel Rosenfeld was hired, he started research in image and picture processing. As research faculty in computer science were hired during the period 1962 through 1972, a vibrant research activity was developed in several areas of research in digital computing: numerical analysis, image processing, computer architecture, computer systems, theory of computing, information retrieval, artificial intelligence, pattern recognition and programming languages. A brief description in work in each of these areas follows:

Research in Numerical Analysis The group in numerical analysis consisted of Rheinboldt, James Ortega, and James Vandergraft and their students. They were world-renowned for their research in numerical analysis.

Ortega and Rheinboldt collaborated for several years with their students concerning the numerical solution of nonlinear systems of equations in finitely many unknowns. The work covered both theoretical aspects and applications. They studied theoretical aspects of the various general-purpose iterative methods of broad classes of nonlinear equations in R^n, the development of corresponding computer programs, and the compilation of a critical survey of the existing literature in this field. In applications they studied specific restricted classes of mappings occurring in different applications and of those iterative processes which have certain desirable properties for the particular class. This work culminated in the book *Iterative Solution of Nonlinear Equations in Several Variables*, published by Academic Press in 1969. This book was in print for almost 30 years and then reissued in 2000 as a SIAM Classic in Applied Mathematics.

Ortega, Rheinboldt, Vandergraft and their students made contributions to the

1. Application of partitioning and tearing concepts.
2. New approach to analytic continuation by varying dimensions and its applications to nonlinear elliptic boundary value problems.
3. Numerical solution of polynomials in several variables.
4. Numerical experimentation with algorithms.

Research in Image Processing The group was led by Azriel Rosenfeld who had many students. E.S. Deutsch was a member of the group. Over the years, Rosenfeld developed, a world-class group in picture processing and computer vision.

Rosenfeld recognized that pictures to be analyzed are complex, it is impractical to pre-specify a set of classes to which each one of them can be assigned; the pattern-recognition for each picture becomes one of description rather than classification. His research in this area consisted of work in:

1. Development of equipment for computer input and output of high resolution, continuous tone pictures.

2. Study of general-purpose methods of segmenting a given picture.

3. Investigation of generalizations of linguistics to pictorial objects such as arrays of symbols and more general classes of graph-structured data.

4. Critical survey of generalizations of the field of picture processing by computer, leading to the preparation of a textbook (the first in this field), *Picture Processing by Computer*, 1969.

5. The first of many surveys on picture processing, "Picture Processing by Computers," *Computer Surveys 1*, September 1969.

Research in Information Retrieval and Artificial Intelligence The group in this area consisted of Jack Minker and his students.

Minker and his students were doing work in document retrieval systems, and question-answering systems. In document retrieval, graph theoretical cluster techniques were employed to automatically generate thesauri. A vehicle for the study of alternative clustering methods was constructed. The system consisted of:

1. The SMART system, developed under the direction of Prof. Gerard Salton at Harvard University;

2. The Augustson Clustering system, developed by J. Gary Augustson at Maryland, that had alternative methods to obtain clusters of related terms in documents;

3. The ZIMM system, developed by Barbara Zimmerman for part of her Master's thesis at Maryland, designed to take the output of the SMART system as input to the Augustson Clustering system. The obtained clusters permitted each SMART query to be expanded to include clustered terms. The expanded queries could then be submitted to retrieve documents. Recall/precision graphs could be drawn using the SMART system for both the expanded and the unexpanded queries.

In question-answering systems, theorem proving techniques were used to deduce data in databases, that was not stored explicitly. This was the start of research in deductive databases at Maryland.

Research in Pattern Recognition The group in this area consisted of Laveen Kanal and his students Kanal's group developed an interactive time series analysis package (GITSAP) to handle seismic wave forms such as for nuclear explosions or earthquakes, and the analysis of medical data. They also developed MIPACS, the Maryland Interactive Pattern Analysis and Classification System. Models were also developed for error behavior of digital channels. An interactive graphic statistical package was also developed.

Research in Computer Systems The group in this area consisted of Yaohan Chu, Michael Lay, Ashok Agrawala, and David Mills.

Chu was involved in research on a *Computer Design Language, CDL.* In the early days of computing, computers were commonly designed in terms of logic gates, which are too low a level to read and understand easily. CDL was one of the first high-level hardware languages to permit designers to directly describe computer elements (such as registers, memory, micro-operations, clocks), execution sequences, and micro-programs.

An article on CDL, "An Algol-like Computer Design Language," was published in the the October 1965 issue of ACM Communications. It was later published as a special issue on "Hardware

Description Languages" (December, 1974) in IEEE's COMPUTER. Chu was the special editor and a contributor.

A software simulator was constructed by C.K. Mesztenyi, senior programming staff at the Center. Chu revised language elements so as to ease the software construction and to evaluate the simulator. This simulator was reported in Technical Report 68-72 in March, 1969.

Research in Programming Languages The group in this area consisted of Vic Basili, Dick Hamlet, Bob Noonan, and Marvin Zelkowitz.

Basili was involved with the development of a family of languages, SIMPL. Two versions were developed, SIMPL-T contained integer and string data while SIMPL-R also included real arithmetic. SIMPL-R had the power of FORTRAN, but contained a control structure that led to well-developed structured programs that were easier to debug than their FORTRAN equivalents.

Zelkowitz was involved in the development of a programming language, PLUM (Programming Language University of Maryland), a load and go PL/1 compiler for the UNIVAC 1108. It was probably the fastest compiler on the 1108 in that it compiled about 10,000 statements per minute. Programs went into immediate execution without calling the collector. PLUM contained many diagnostic capabilities and effectively monitored many error conditions that most other compilers were unable to monitor.

Hamlet was involved in high level systems implementation languages and in software testing. Noonan's primary focus was in the area of proving correctness of computer programs.

2.5 Summary of Activities in the Computer Science Center: 1962-1972

The starting years of the Computer Science Center were exciting. Rheinboldt's vision of developing a computation center, a research organization, and an education component were largely fulfilled. The computation center, had to develop a staff, purchase a computer, oversee the building of the Computer Science Center, and write proposals for research and equipment. Rheinboldt handled all of these activities with great success. He was supported ably by John Menard. In a short period of time a computer was purchased, a staff was hired, and the Center was placed in operation.

The Center handled the increasing load generated by the availability of a computer on campus to handle research and education. New computers were added, culminating with the UNIVAC 1108. The Center staff ran the computers effectively and implemented new software and made it available to users.

The loss of autonomy to purchase computer equipment, which forced the Center to have the purchase of every item related to computers be approved by Sate Administrators was a serious impediment to running the Center. It was not until 1985 that this restriction was eliminated.

The resignation of Rheinboldt in 1965 to permit him to return to full time as a faculty member and to permit him to focus on his research was a loss to the University. However, the University was able to hire Bill Atchison who ran the Center ably when he was hired as Director of the Center.

The education component of the Center saw the introduction of an M.S. and a Ph.D. degree. The B.S. degree was introduced at the start of the Department of Computer Science as discussed in the next section. George Lindamood and Earl Schweppe played important roles in the introduction of the first 6 computer science courses offered at the University under the aegis of the Center, as did Edward Miller who was in the Department of Electrical Engineering. Earl Schweppe played an important role at the start of the degree programs. He was chair of the committee that wrote the proposal for the M.S. degree that was approved, and of the Ph.D. program. Bill Atchison was the driving force in the development of a world-wide curriculum in computer science as presented in the paper on Curriculum '68. This important paper had the imprimatur of Atchison, Schweppe, and

Rheinboldt. Bill also shepherded the M.S. and Ph.D. proposals through the University. Rheinboldt also played a major role in these programs.

Support from the government agencies: NASA and the NSF were crucial to the development of the computing, research, and education components of the Center. They supported the purchase of computers, and provided funds for research, which benefitted not just the Center, but all of the sciences at Maryland. Research in the Center was enhanced by the addition of new faculty, and vibrant research areas were formed in numerical analysis, programming languages, picture processing, artificial intelligence, databases, and systems. The education and research programs were significant and led to the Department of Computer Science, discussed in the following section.

3 Formation of the Department of Computer Science

This section discusses the formation of the Department of Computer Science and the first six years of its existence[133].

Departments of computer science were formed in the 1950s. A list of computer science degree programs is contained in a 1967 report in the Communications of the ACM[134]. The report lists 20 departments of computer science that had degree programs (4 B.S, 4 M.S., 1 Ph.D., 6 M.S.& Ph.D., and 5 B.S. & M.S. & Ph.D. programs). Those who had all three degree programs were: Columbia University, Massachusetts Institute of Technology, Purdue University, Princeton University, and Yale University. The same report noted that other degree programs were planned to be instituted for 1968-1969. Some programs were expanded, while others were new programs. There were a total of 93 departments of computer science listed as existing or proposed by the 1968-1969 time period. Of these there were a total of 14 that offered all three programs. There were a total of 17 that offered at least a doctoral program. In addition, computer science degrees were offered in Information Science, and with Options in: Mathematics, Electrical Engineering, Applied Science, Linguistics, Systems and Communications Science, Quantitative Analysis, Systems Engineering, Machine Computers, Systems Analysis, and Statistics. In 1980, the National Academy of Sciences issued a report that evaluated the quality of Ph.D. programs in the United States[135]. A total of 58 doctoral programs were evaluated. There were several other doctoral programs that were not evaluated, some did not meet the criteria for inclusion (that a university had awarded at least 5 doctorates in computer science during the FY1976-78 period), others chose not to respond, and others failed to report the information required by the committee. Thus at the time the Department of Computer Science at the University of Maryland was formed, there were well over 100 departments of computer science in existence.

There are three major subsections: Section **??** discusses the steps taken to start the Department of Computer Science, while still a part of the Center; Section **??** discusses the activities within the Department during the period 1973–1979; Section **??** discusses the internal and external review of the Department, started in 1978 and completed in 1979.

3.1 Toward a Department of Computer Science

As early as May 1964, there was an effort to start a Department of Computer Science. Rheinboldt, in a letter[136] to Dr, Hornbake on May 25, 1964 wrote,

> that it would be of interest to the University to establish a program independently of the Computer Science Center in a separate department in the College of Arts and Sciences.

[133] Material in this section is reconstructed mainly from remembrances of the author and some material such as Annual Reports of the Department and The Departmental Review. Minker, who was Chairman for most of the period discussed, left all departmental material with the department administration when he stepped down as Chairman in 1979. Unfortunately, some time during the 1980s and 1990s, the department administration was short of space for retaining files. Without consulting the faculty, or inquiring about filing the material in University archives, the files were destroyed. Thus material from the start of the Department was destroyed. Minker asked faculty who were in the Department during that period if they had retained their departmental files, but with some exceptions, they destroyed most of their files. The material in this section (Section **??**) has been reviewed by many faculty who were at Maryland during the period 1973-1979. Those faculty who reviewed Section **??**) are: Ashok Agrawala, Yaohan Chu, Larry Davis, James Reggia, Chuck Rieger, and Marvin Zelkowitz.

[134] "U.S. Institutions Offering Degree Programs in Computer Science, Data Processing, and Related Programs," *Communications of the ACM, Vol. 10, No. 10, October, 1967, 675-676.*

[135] See web site: http://www.nap.edu/openbook/0309032997/html/59.html, "An Assessment of Research-Doctorate Programs in the United States: Mathematical and Physical Sciences."

[136] The letter to Dr. Hornbake is contained in the Minker collection in the University of Maryland Archives, Hornbake Library.

Rheinboldt stated that he had asked Dr. Earl Schweppe to write a proposal that was presented to Dean Manning on May 23, 1964. Dean Manning gave a very sympathetic hearing and accepted Rheinboldt's suggestion that Dr. Schweppe be considered for the chairmanship of the proposed department. Following Dean Manning's suggestion, Schweppe, Chairman of the Educational Programs Committee prepared a "Proposed Asking Budget for the Fiscal Year - 1965–1966 To Finance the Proposed Computer Sciences Department[137]," and together with a letter submitted it to Dr. Hornbake on June 2, 1964. Dr. Hornbake responded to Dr. Schweppe on June 15, 1964[138]. He had read through the proposed asking budget and a paper in the *Communications of the ACM*, Vol. 7, No. 4, as well as several related letters. Dr. Hornbake described the process that had to be undertaken to authorize any program of significance. It had to be sent to a Senate Committee for action, if approved sent to the Board of Regents by President Elkins. This procedure was necessary since, he noted,

> The proposed budget $196,022 (plus the department chairman's salary) for 1964–1965 compares in size with the support needed for a new college and exceeds substantially the financial support available to most existing departments. Any move in the direction of a project of this scope must have much more than a casual review and casual support.

No progress was made toward developing a department of computer science until the middle of the 1970s. On September 18, 1970, William F. Atchison, Center Director wrote to Acting Vice-Chancellor for Academic Planning and Policies[139]. In this letter, Atchison discussed

> ... the possible emergence of computer science as a separate academic department or entity.

Atchsion described the various ways in which computer science academic entities exist in universities throughout the country. He summarized his position as follows:

> In summary let me say that I distinctly prefer a separate school or college of computer science (or computer and information science). A second choice would be as a department in a science college, if such a college were properly constituted. Existence as a distinct department within a division of mathematical science would be a livable third alternative.

Finding an academic home for computer science education and research functions was envisioned at an early date in the Center's history by Rheinboldt. Indeed, in a memorandum to Dr. Hornbake in 1964, in which he discussed the philosophy underlying the proposed introductory courses (see Section **??**), he stated,

> In this connection, I wonder whether I might suggest again that you consider the appointment of an interdisciplinary committee to investigate the question of the academic home for this proposed program. It appears that we ourselves cannot resolve the existing differences of opinion and I believe it might be very valuable if a committee of interested faculty members of the University consider the entire question more independently.

[137] The Schweppe proposal and a letter to Dr. Hornbake on June 2, 1964 is contained in the Minker collection in the University of Maryland Archives, Hornbake Library.

[138] Dr. Hornbake's letter to Dr. Schweppe, dated June 15, 1964 is contained in the Minker collection in the University of Maryland Archives, Hornbake Library.

[139] A five page letter from Atchison to Acting Vice-Chancellor Thomas B. Day of September 18, 1970 is in the Minker collection in the University of Maryland Archives, Hornbake Library.

No action was taken to consider a separate department of computer science until the 1971 Academic Year.

Atchison's letter was undoubtedly in response to the formation of a committee in the 1971 Academic Year to consider a major reorganization on campus under the direction of Vice-Chancellor Thomas B. Day. The committee discussed the various options mentioned by Atchison. The merging of computer science with information science was attractive to the faculty within the Center. However, the Library School was strongly against this option. The report, when completed and approved by the Faculty Senate, recommended that the academic functions of the Computer Science Center should be administered in the educational portion of the University and should be separated from the service function of the Center. The Academic portion of the Center was reborn as the Department of Computer Science (CSD) and was placed in the Mathematical, Physical Sciences and Engineering Division (MPSE)[140] The Computer Science Center would remain as an independent unit without an academic component. The reorganization of the university was approved by the Board of Regents on June 23, 1973. Effective July 1, 1973, the Department of Computer Science and the Computer Science Center became separate and distinct units.

The Plan of Organization developed was a departure from what is now the conventional organization of most universities. In the plan devised, the individual in charge of the College Park Campus was called the Chancellor. Under the Chancellor the academic entities were called Divisions. The heads of Divisions were called Provosts. The individual in charge of all academic entities was the Vice-Chancellor of Academic Affairs. There were two different Chancellors of the College Park Campus during the time 1973-1979. The first was Dr. Charles J. Bishop under who the reorganization plan was developed and carried out. His Vice-Chancellor of Academic Affairs was Dr. George H. Callcott, was previously a Professor of History in the Department of History. Chancellor Bishop left the University to become President of another university, and was replaced by Dr. Robert L. Gluckstern, who had been in a high administrative position at the University of Massachusetts, and was a Professor of Physics. The Vice-Chancellor for Academic Affairs under Gluckstern was Dr. Nancie Gonzalez, a Professor in the social sciences. The Division in which the new Department of Computer Science was located was the Mathematical, Physical Sciences, and Engineering Division (MPSE). The MPSE Division consisted of the Mathematics Department, the Physics and Astronomy Departments, the Department of Computer Science, the Department of Meteorology, the Department of Geology, and all departments in the Engineering School. Dr. Joseph Marcello was the first Provost of the Division. Dr. Marchello was previously a Professor in the Department of Chemical Engineering. Dr. Marchello left the University in 1978 to become President of Missouri State University. He was replaced in 1978 by Professor Frank Kerr, who had been Chair of the Astronomy Department.

A considerable amount of work was required to effect a split of the Center into an academic department and a computer service organization. In anticipation that the recommendation would be approved, Atchison, Director of the Center, requested that Minker and Rheinboldt identify all questions that had to be resolved regarding a planned CSD. They submitted a plan on March 1, 1973 that covered a tentative organization; responsibilities of principal administrative units, faculty and relationship to the CSD, staff needs, budget planning, general questions, and actions, plans and dates[141]. Approximately two weeks after the preliminary report, on March 12, 1973, Vice-

[140] A copy of the reorganization report recommendations of the Day Committee report to Chancellor Bishop may be found in the "Report To The College Park Campus Senate from the Organization Committee," dated January 4, 1972. The report may be obtained from the Campus Senate office and also is contained in the Minker collection: and a microfilm of this plan is in the Marylandia collection in Hornbake: MD MFILM LD52.9.C6N46 1976, in the University of Maryland Archives, Hornbake Library.

[141] No copy was found of the Minker-Rheinboldt Report. However, in a memorandum by Wm. F. Atchison, dated May 23, 1973, he announced that the Plan of Organization and Bylaws for the Department of Computer Science was

Chancellor for Academic Affairs, George Callcott, appointed a study committee to recommend how the split between the CSC and the CSD could be effected. He charged the Ad Hoc Committee of Atchison (Chairman), Austing, Menard, Minker and Rheinboldt to perform this task and to report back to him within one month.

The Ad Hoc committee submitted their report to Vice-Chancellor Callcott on April 12, 1973[142] The report made the following recommendations:

1. A separate CSD be established as part of the MPSE Division, effective July 1, 1973.

2. The CSC continue as a separate service and academic unit reporting to the Vice-Chancellor of Academic Affairs.

3. Effective July 1, 1973, budgets be assigned to the Department and Center as specified in the report.

4. A search committee be appointed to search for a chairman of the Department to be assigned as early as possible. The search committee should be charged with seeking out the best possible person for the position.

5. To retain close cooperation between the CSC and the CSD, several faculty members be given joint appointments in the Center and the Department.

6. The Center and the Department be housed in the same building 086 (Computer Science) and the fourth floor of the connecting wing between buildings 086 and 224 (Computer Science and Space Science). The Center and the Department will establish suitable arrangements between one another for the joint utilization of the space and jointly operated facilities.

7. The central administration staff on the fourth floor of building 086 be vacated as soon as possible to establish needed departmental offices and for the growth of the departmental laboratory facility.

The report also developed an organization of the department[143], where the Chairman had reporting to him an Elected Council, and the Appointments, Promotion and Tenure Committee. Reporting to the Council were the Faculty, Staff and Student Assemblies; the General Committee on Education Affairs; the General Committee on Departmental Affairs; and the General Committee on Human Relations and Welfare. The report further specified the budget for the CSC and the CSD; allocated space to the two groups; specified the faculty who would move to the CSD or have joint appointments between the organizations.

Vice-Chancellor Callcott reviewed the report carefully and on April 16, 1973 commended the report and accepted it in its entirety.

The Computer Science Center and the Department of Computer Science were formally split on July 1, 1973. John Menard was appointed Director of the Computer Science Center. Bill Atchison was appointed Acting Chair of the Department of Computer Science, effective September 1, 1973.

approved by faculty, staff, and students with the following votes: Faculty 13-3-2; Staff 6-0-0; Students 8-0-0. The memorandum and a copy of the Plan of Organization dated May 1, 1973 are contained in the Minker collection, the university of Maryland Archives, Hornbake Library.

[142]The Master Copy of the report, and related documents, of the Ad Hoc Committee for the study of *the Establishment of a Separate Department of Computer Science* with a covering letter from Dr. William F. Atchison is in a folder titled, CALLCOTT, in the Minker collection, the University of Maryland Archives, Hornbake Library.

[143]A copy of the "Plan of Organization of the Department of Computer Science," May 1, 1973, is in the Minker collection, University of Maryland Library, Hornbake Library.

The plan of organization for the University specified that there would be no Research Professors permitted in departments. This had an unfortunate consequence in that the two strongest researchers in the Center faculty were Research Professors Rheinboldt and Rosenfeld. Neither Rheinboldt nor Rosenfeld rightly wanted to lose their positions as Research Professors, and chose not to be in the Department. Hence, their official "homes" were with the Center. In addition the bylaws of the Department precluded individuals who were not in the Department to vote on such important committees as the Education Affairs or the Appointments Promotion and Tenure (APT) committees.

The Bylaws of the Department called for the Education Committee to consist of all teaching faculty, including instructors. There were also subcommittees that consisted of the following five Field Committees: Information Processing (artificial intelligence and databases), Numerical Analysis, Programming Languages, Systems, and Theory of Computing. These committees were responsible for assuring that graduate and undergraduate courses in their areas were taught, and for preparing the comprehensive examinations for the doctorate and master programs and were a continuation of what had existed within the Center.

3.2 Department of Computer Science 1973-1979

This section discusses the Computer Science Department (CSD) during the period 1973–1979. Section **??** discusses the selection of the Acting Chair for the first year of the CSD, and the first permanent Chair. Section **??** discusses how the CSD was developed into a research-oriented department and some of the new faculty who were recruited who made this possible. Section **??** describes the major impact that the start of the undergraduate bachelor degree had upon the faculty of the CSD and upon computer science education. Section **??** discusses the development of the CSD Laboratory and the impediments placed by the State Administration's needing to approve all computer equipment. Section **??** discusses the extensive service that members of the faculty provided to scientific organizations at the international and national levels. Section **??** discusses some of the activities within the CSD during the period 1973–1979.

3.2.1 Determining a Department Chairman

On May 21, 1973, the Center had a meeting of the Professorial faculty where they discussed the question of a chairman for the Department[144]. It was proposed that a secret vote be taken on two questions. The first was who the faculty would support for an interim chair. All Full Professors were on the ballot. Three faculty received approximately the same number of votes supporting their candidacy: Atchison, Minker and Rheinboldt. A second vote was taken to determine who would be acceptable as permanent chairman. Minker and Rheinboldt had the largest number of faculty supporting them, while Atchison also had support. Atchison stated that he would consider being Acting Chairman, but was reluctant to be considered for permanent chair. Neither Minker nor Rheinboldt expressed interest in the Acting Chair position. Minker stated that he would consider being permanent chairman if no one else could be found for the position. Rheinboldt indicated that he would consider the position under certain conditions if it were offered to him, but he did not specify the conditions.

The results of the votes were reported to Dr. Marchello, Provost of the MPSE Division. Dr. Marchello appointed Dr. Atchison as Acting Chairman starting September 1, 1973, and formed a committee to do a national search. The result of the one year national search was that one outside candidate was considered acceptable, but he withdrew. Rheinboldt had not applied for the

[144]Minutes of the meeting of May 21, 1973 may be found in the Minker collection in the University of Maryland Archives, Hornbake Library.

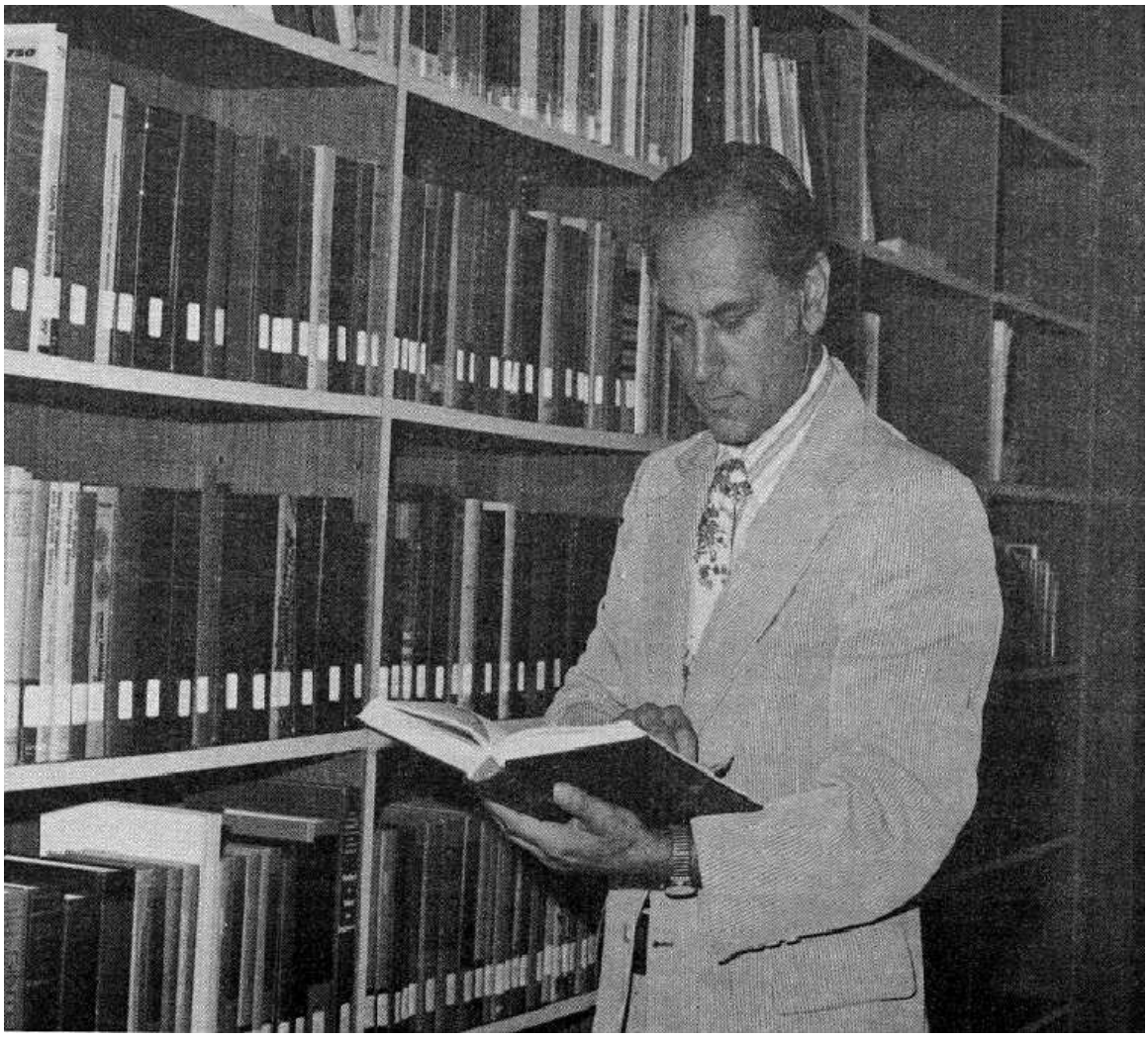

Figure 8: Jack Minker, First Permanent Chair, Department of Computer Science, photograph taken in 1978.

position, and would only accept the position under certain conditions. When these conditions were not met, he no longer wished to be considered for the position. Marchello met with Minker in the spring 1974, and informed him that he wanted him as the chairman. Minker was still reluctant to take the position. Marchello discussed the situation with him and stated that the external search had failed, there were no others in the new Department whom he believed would be able to do the job, aside from Rheinboldt, who was no longer interested in the position, and that if Minker did not accept the position of chair, he would have no other option but to withdraw his support from the CSD and give it to other departments in the Division. Minker realized that Marchello meant what he said and that he had no other option but to accept the responsibility as chair. He became the first permanent Chair of the Department of Computer Science on July 1, 1974. A photograph of Minker is shown in Figure **??**.

Although Minker had not sought the chairmanship of the Department, he was determined to do an effective job. In considering the needs of the Department, he determined that there were a number of priorities that he would like to focus on.

1. Develop a Research-Oriented Department and Hire Research-Oriented Faculty

2. Stabilize the Education Program

3. Develop a Department Laboratory

The following sections discuss how these objectives were met.

3.2.2 Developing a Research-Oriented Department

Develop a Research-Oriented Faculty. Minker's primary concern was to solidify research in the Department so that Maryland could become a world-leading research department in computer science. The senior faculty were performing high level research, and there was an excellent group of young faculty. However, Minker believed the young faculty were not meeting their research potential. Because of the growing needs in the Center and the work entailed in setting up a new department, many of the young faculty were asked to do excessive amounts of service. Teaching a two course load per semester, and doing a large amount of service, did not leave much time to do significant research. Furthermore, many of the junior faculty had assumed that through service and excellence in teaching, they would attain promotion. In 1973, Minker sent a memorandum to the Executive Committee making the point that the junior faculty were overburdened with administrative tasks[145]. No action was taken on this until Minker became Chairman in 1974 and made it clear to the entire faculty that service and excellence in teaching would not be sufficient reason to be sent forward for tenure or promotion. Promotions would be based primarily on excellence in research and teaching. He spoke individually to each of the young faculty and assured them that they would be asked to do only a minimum amount of service. If they were asked to do anything that they considered to be excessive, they could decline the service request without penalty. He kept this promise during his tenure as Chairman. The research efforts of the young faculty increased significantly. Young faculty such as Agrawala, Basili, Hamlet, and Zelkowitz formed strong research activities and flourished in this environment. The education within the Department was not hindered by the emphasis on research. Minker read the evaluations of the faculty as made by the students each semester, and was pleased that the ratings for almost all faculty were better than average. Those who were not doing an effective job met with Minker to discuss their teaching, and improvements were noted.

The loss of Rheinboldt and Rosenfeld was a major problem for the research in the Department since they were the two strongest researchers in computer science. Minker spoke individually to both Rheinboldt and Rosenfeld and asked if they would give their permission for their research to be included with the Department's research. He further stated that although they may not have an official vote in promotion and tenure decisions, he would inform them of the APT decisions and, before he made his decisions, he would consult with them and ask and take their views into account. Both Rheinboldt and Rosenfeld agreed to this arrangement. Minker also told them that he would try to change the bylaws to permit them to have voting rights in the Department. Unfortunately, although he tried twice, because of some technicalities, he failed to push this vote through successfully. The faculty were all aware of this arrangement with Rheinboldt and Rosenfeld and did not object. Rheinboldt was an invaluable source to whom Minker called upon for advice in difficult situations throughout the time he was Chairman. He was always available and provided sound advice.

Research Performed in the Department from 1973–1979 When the Department started in 1973, there were five major areas of research: Artificial Intelligence and Data Bases, Numerical

[145] Undated memorandum written in 1973 by Jack Minker to the Executive Committee concerning junior faculty. In the Minker collection, University of Maryland Archives, Hornbake Library.

Analysis, Programming Languages, Systems, and Theory of Computing. Two new areas were introduced, one related to AI: deductive databases; and the other related to programming languages: software engineering. The research performed in these areas and in the development of software tools partly in conjunction with the CSC are described below.

Programming Languages and Software Engineering. In the area of programming languages and software engineering, at the start of the Department, there were five researchers: Assistant Professor Victor Basili, Assistant Professor Marvin Zelkowitz, Assistant Professor Robert Noonan, Assistant Professor Richard Hamlet, and Assistant Professor Pamela Zave. Basili, Noonan, and Zelkowitz were working in programming languages. Noonan was concerned with certification of programs.

Basili originally worked with Rheinboldt on languages for numerical analysis (FGRAAL, a FORTRAN variant). That put him in contact with ICASE and NASA/Langley, which led him into thinking about the issues of how to develop software reliably. Zelkowitz, originally worked on a load-and-go PL/I compiler, PLUM, which had the ability to collect statistics from each compilation and execution. This led to an interest in how to measure the progress of software development over time. After some discussions with NASA/Goddard managers in 1976, the Software Engineering Laboratory (SEL) was created by Basili and Zelkowitz. The SEL was the backbone of experimental software engineering research at Maryland for 25 years until late 2001.

Hamlet was interested in testing programs. His goal was to use formal models as a method for automatically building test sets for testing a program and built various systems for generating such tests. He built a tool somewhat like a mutation test, which automatically generated syntactically correct variants of a program to check whether the modified program gave the same or different results from the original program.

With less time needed to do service in the department, Basili, Hamlet and Zelkowitz's research started to blossom. In 1975, Harlan Mills, who had a full time position at IBM in the Washington, D.C. area, and was known for his work in software engineering, agreed to become associated with the Department and spent time working with Basili and Zelkowitz. They developed a group that has become one of the leading research groups in software engineering in the world and remains, to this date, one of the stronger research groups in the Department. Mills was associated with the Department in many capacities while he lived in the Washington, D.C. area. His association terminated when he retired to Florida. Mills died January 8, 1996.

In 1975 a new faculty member, Assistant Professor John Gannon, was hired to augment this group. Gannon received his Ph.D. in 1975 from the University of Toronto. He became a Full Professor in the Department and was Chair of the Department from 1995 until his untimely death in 1999. Gannon's research, like Hamlet's was concerned with formal methods for software development. Gannon was the more theoretical of the pair. He was looking at practical models of program correctness. He worked with various methods such as formal axioms, then term rewriting systems, and later model checking. The goal was to use formalism as a practical way to develop source programs.

In 1976, the Department hired its first woman faculty member, Assistant Professor Pamela Zave. Zave received her Ph.D. in 1976 from the University of Wisconsin. Zave worked partially in systems and partially in programming languages. She worked on developing a design tool for real-time processes and on developing a formal definition of processes. Zave subsequently left the University for a career in industry.

Two important books were written during this period. Harlan Mills published his book, "Structured Programming: Theory and Practice," and Marv Zelkowitz and John Gannon published their book, "Principles of Software Engineering and Design."

Numerical Analysis. Probably the strongest group in the Department in 1973 was that of Numerical Analysis. Professor Werner Rheinboldt and Professor James Ortega were two of the world leaders in numerical analysis. This group was supplemented by Associate Professor James Vandergraft. Unfortunately, there were no members of this outstanding group remaining in 1979. Ortega left in 1973 to start and become Director of NASA-ICASE, Institute for Computer Applications in Science and Engineering at Langley. Rheinboldt was offered an endowed Chair at the University of Pittsburgh in 1978. Attempts by Minker to get the University of Maryland upper administration to do something to retain this outstanding scientist went to naught as the University had nothing comparable to offer this distinguished scientist. Vandergraft decided to work in industry and left in 1976. In 1976 Vandergraft published a book, "Introduction to Numerical Computations."

Fortunately, we were able to make two key hires in numerical analysis. Associate Professor G.W. (Pete) Stewart was hired in 1974. Stewart received his Ph.D. in 1968 from the University of Tennessee. He was one of the outstanding young faculty in numerical analysis. He strengthened the already strong numerical analysis group. Stewart completed work on the LINPACK project, a collaborative three year project to develop definitive software for linear systems. Other software included a system for solving the three dimensional Helmholtz problem and a package for finding eigenvalues of a large sparse general matrix. In addition to the software developments, Stewart published the book, "The LINPACK User's Guide and Sparse Matrix Proceedings," as culmination of the effort. Stewart was awarded the distinguished F.L. Bauer Prize in 1998 for his work in numerical analysis. A second key hire in this area was Assistant Professor Dianne P. O'Leary, who came to Maryland in 1978. O'Leary received her Ph.D. in 1976 from Stanford University. She was considering going to the then National Bureau of Standards. To lure her to Maryland, Minker spoke to the Director of the then Institute for Physical Science and Technology (IPST), formerly known as the Institute for Fluid Dynamics, Professor Joseph Silverman, to determine if they would support Dr. O'Leary. Since IPST was intimately concerned with numerical analysis, Professor Silverman offered her a half-time research appointment in IPST for three years. Dr. O'Leary accepted the offer with the joint appointment and became the second woman computer scientist hired at Maryland and the first to be tenured. Research performed by Dr. Stewart and Dr. O'Leary, augmented by other numerical analysis in Mathematics (Dr. John Osborn) and the Institute for Physical Science and Technology (Dr. Ivo Babŭska), kept the Department and the University among the best groups in numerical analysis in the world. Minker was especially pleased that Dr. O'Leary was hired. She wrote an excellent thesis, and was a strong numerical analyst. The fact that she was a woman was a secondary bonus. Minker believed that women were underrepresented in computer science and were at least as capable as men. Indeed, Minker's late wife Rita[146], was one of the early women programmers in computing.

Artificial Intelligence (AI) and Databases At the start of the Department, there were three dominant areas in AI: picture processing, pattern recognition, and theorem proving/deductive databases. In 1974, Assistant Professor Charles (Chuck) J. Rieger III was hired to expand the research to cognitive processing. Assistant Professor Hanan Samet was hired in 1975 and worked in the combined area of AI and programming languages.

Picture Processing. This research was headed by Professor Azriel Rosenfeld. During the period 1973-1979, Rosenfeld co-authored a book with A.C. Kak, "Digital Picture Processing," which is still in print (second edition, 1982) and has been translated into Japanese and Chinese; in 1989

[146]Rita G. Minker had worked on the Bell Relay Machine at Bell Laboratories from 1949–1951, on the RCA BIZMAC computer from 1952–1953, and on the IBM 1620 and other machines at the National Institutes of Health from 1964 until she retired in early 1988 and died on October 11, 1988.

it was chosen as a Citation Classic by the Institute for Scientific Information. He also authored a monograph on "Picture Languages." He was actively engaged in research and advised 15 Ph.D. students who received their degrees during the 1973–1979 time period. Research in image understanding included work on the extraction of cartographic information from aerial photographs; this included terrain classification by texture analysis, detection of linear features such as airfields, development of advanced image segmentation techniques, and study of hierarchical region representation for cartographic databases.

Theoretical analysis of image analysis including statistical image modeling and the theory of cellular computation were developed. A class of "mosaic models" for images, based on random geometry concepts, was developed, and work on time series models for images was initiated. Image recognition by various types of augmented cellular array processors was investigated, and a theory of graph-structured cellular processors was also developed.

In the area of developing intelligent systems for computer vision, cooperative processes for iterative probabilistic classification and matching were developed. A transportable image processing software package that facilitated the transfer of software among image processing researchers at different universities was developed.

Rosenfeld's image processing group was among the leading groups in the world in image processing. Rosenfeld won many awards for his research in computer vision over the years. Prominent among these awards are the: 1985 Emanuel Piore Award, Institute of Electrical and Electronics Engineers; 1988 K.S. Fu Award, International Association for Pattern Recognition, 1988; and 1995 Harry Goode Memorial Award, IEEE Computer Society.

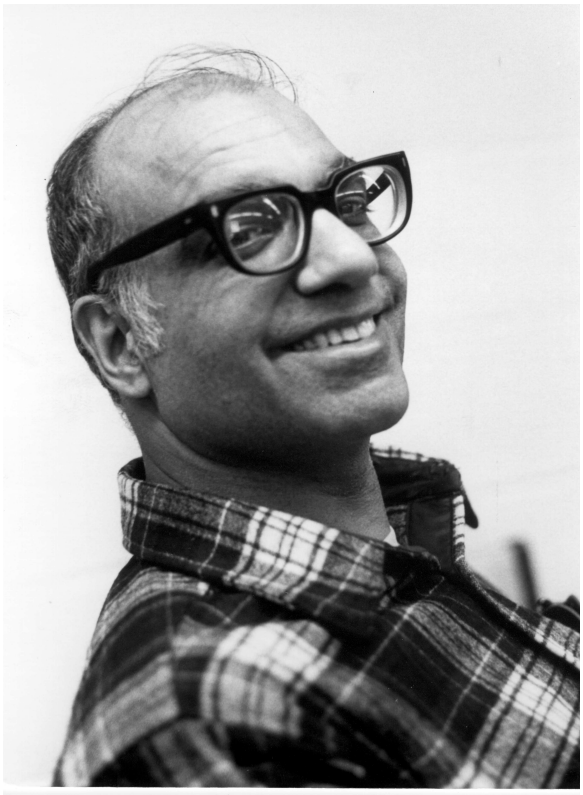

Figure 9: Laveen Kanal, Director, Pattern Recognition Group, Photograph by Ben Shneiderman, 1981.

Pattern Recognition. The research was headed by Professor Laveen Kanal. A photograph of Kanal, taken in 1981 by Ben Shneiderman is shown in Figure **??**.

He and his students were involved in a number of research efforts on

1. modeling patterns of errors in communication channels with memory;
2. developing the Maryland Interactive Pattern Analysis and Classification System (MIPACS) which then was picked up by Prof. Edzard Gelsema of the Netherlands and further developed over many years as ISPAHAN and distributed to several universities and research institutes;
3. developing a Time Series Analysis Software system, TSAP, which was then moved to a Graphical Interactive Time Series Analysis Package (GITSAP), on the PDP 11/45;
4. applying problem solving methods of AI to pattern classification;
5. applying uncertain reasoning to diagnostic classification;
6. developing linguistic-statistical and AI search methodology for waveform analysis and classification;

Kanal's research group in pattern recognition was considered among the best in the world. He received the 1992 K.S. Fu award, of the International Association for Pattern Recognition and the 1996 Contributions award from the Sigma Xi chapter of the University of Maryland.

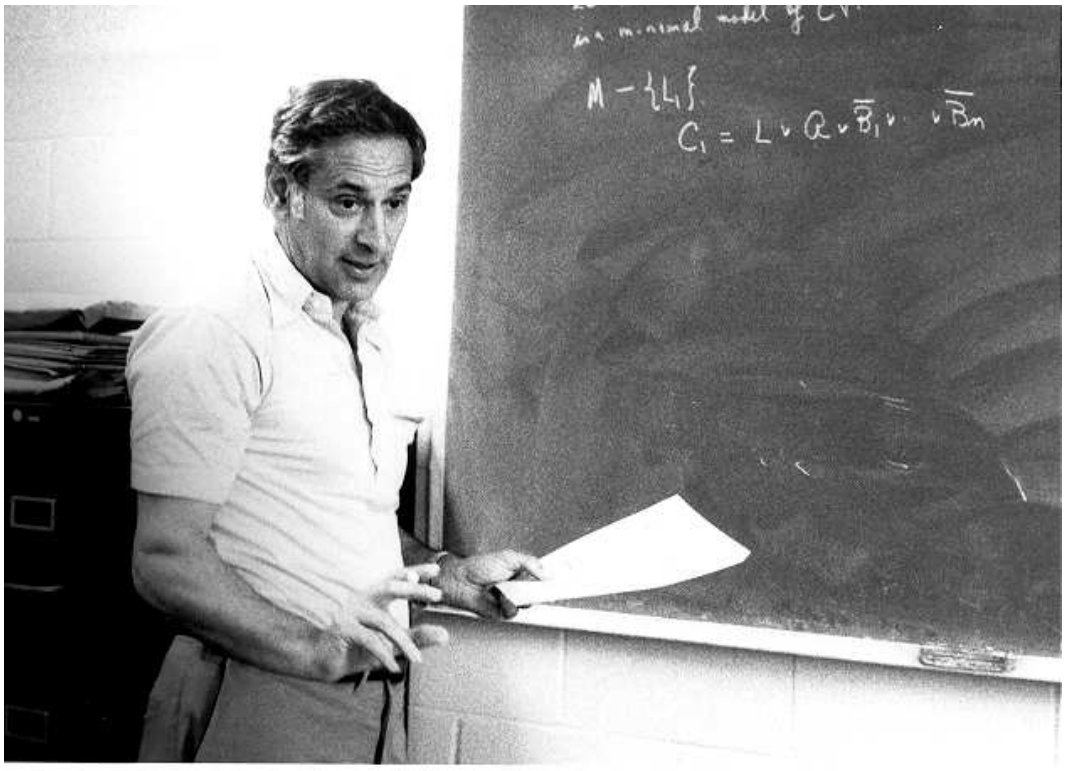

Figure 10: Jack Minker, Lecturing on Deductive Databases, Photograph by Ben Shneiderman, 1981.

Automated Theorem Proving and Deductive Databases. This research group was headed by Professor Jack Minker. Barry Jacobs, who received a Ph.D. from the Courant Institute in 1975 and John Grant, who was an Associate Professor at Towson State University and who received his Ph.D. from the Courant Institute in 1970 were in the group. Professor Grant is still at Towson State University and is an Adjunct Professor at Maryland where he continues to do research. Dr. Jacobs left to work in government.

Work in theorem proving led to the development of a new inference system, LUST resolution (Linear Resolution with unrestricted Selection function based on Trees) which is complete and sound. The inference system generalized SL resolution developed by Kowalski for automated theorem proving problems. LUST resolution incorporated a bookkeeping system which permitted both the answer and the reason to be extracted from the proof graph without backtracking. Work was also conducted in semantic control when interpreting Horn-clauses as procedure definitions.

In deductive databases an experimental relational system was developed that permitted implicit data to be deduced. The user was able to retrieve not only the answers, but the reasons leading to the deduction. Both natural language and voice output were provided for the answers and reasons. Minker helped to organize a workshop on Logic and Data Bases in Toulouse, France, and co-edited a book, "Logic and Data Bases," which made a major impact on the field of deductive databases.

Minker's research group in reasoning over deductive databases was considered among the best in the world. A photograph of Minker, taken by Ben Shneiderman in 1981, is shown in Figure **??**.

Cognitive Processing and Parallel Computing Chuck Rieger, who in 1975, was awarded the prestigious *Computers and Thought Award*, given to the most promising young researcher in artificial intelligence by the American Association for Artificial Intelligence was in charge of research in cognitive processing. He received his Ph.D. in 1974 from Stanford University, and came to Maryland in 1974. Chuck became Associate Professor in 1979, but got the urge to be an entrepreneur and left to form his own company in 1982. He is currently an Adjunct Professor in the Computer Science Department. Together with his students in the area of cognitive modeling, he developed new models of human problem solving and language comprehension. Developments included the following: The use of dependency pointers in a general purpose problem solving system allowed more intelligent bookkeeping of the domain environment during plan synthesis. A semi-automatic digital designer was able to design some simple circuits involving propagation of inferential knowledge within the circuit. New control mechanisms were developed for a word expert parser enabling the parser to cope with conceptually rather complex sentences in context. Work in neurological modeling resulted in a proposed frame-like system for neurological localization. Extensions to LISP made possible the development of more complex AI models, and made Maryland LISP competitive with other LISP systems in the AI community.

The use of AI programming languages in an automatic manufacturing environment was investigated jointly with Assistant Professor Hanan Samet. A number of then current languages such as SAIL, LISP, MICROPLANNER, and CONNIVER were compared using a single example. A combination of SAIL and LISP was determined to best meet the requirements.

AI and Programming Languages Hanan Samet's research was a combination of artificial intelligence and programming languages. He received his Ph.D. in 1975 from Stanford University. He is currently a Full Professor in the Department. He is considered a world leading expert in geometric data structures. The main focus of the work was the application of AI techniques to the problem of program verification. In particular, he focused on the problem of proving the correctness of compilers. His approach could not prove that all programs would be correctly translated. Instead, each high level program that was input to the compiler was proved to be correctly translated to

the corresponding assembly language program. The notion of correctness was one of algorithmic equivalence. Verification was achieved by obtaining a normal form for the high level program by tree transformations and a normal form for the low level program by symbolically interpreting the low level program. The former required the use of a novel on-line algorithm for deducing equalities which resulted in a solution to a well-known unsolved problem known as the uniform word problem. These techniques were implemented for LISP as the high level language and DEC-10 assembly language as the low level language. Although the approach had to be applied to each program translated by the compiler, it could be used for proving the correctness of the bootstrapping process.

Computer Systems The computer systems group, consisting of Assistant Professors Ashok Agrawala, Yaohan Chu, Larry Dowdy, Virgil Gligor, and Satish Tripathi, performed research in computing and networks, analysis and evaluation, specification techniques, and high-level microcomputer systems. Agrawala received his Ph.D. from Harvard University in 1970 and is currently a Full Professor in the Department and the Director of the Maryland Information and Network Dynamics Lab (MIND) Laboratory, a joint effort between the Department of Computer Science Center and the University of Maryland Institute for Advanced Computer Studies. Chu is now Professor Emeritus after having an outstanding career at Maryland. Larry Dowdy received his Ph.D. from Duke University in 1977 and is now a Full Professor at Vanderbilt University. Virgil Gligor received his Ph.D. from UC Berkeley in 1975. He is currently a Full Professor in the Department of Electrical Engineering at the University of Maryland. Tripathi received his Ph.D. from the University of Toronto in 1979. He became Chair of the Department of Computer Science at Maryland from 1988–1995. He is currently Dean of the Engineering College at the University of California at Riverside.

In distributed computing and networks, design problems such as the maintenance of consistency in distributed databases, deadlock detection and recovery, and the evaluation of communication technologies were investigated and a variety of solutions were proposed.

Workload models of computer systems were developed employing clustering techniques. Benchmark studies were conducted involving multivariate stratified sampling and job mix analysis. Various queuing models were constructed to evaluate system overhead. Predictive models were constructed, validated and applied to actual systems.

A system specification technique based on functional specification of asynchronous processes was studied. Areas of attention were the specification of requirements (including performance and resource requirements as well as functional ones), design and simulation of distributed application systems, and the abstract semantics of the transformations on specifications that occur during design.

Work on high-level microcomputer systems was to create an interactive direct-execution computer architecture which could accept direct - one or more high-level programming languages and could be implemented using then current available microprocessor and other LSI devices.

Theory of Computing Research in theory of computing was performed by Professor H.P. (Ed) Edmundson, Richard Hamlet, Chul Kim, and Matthew Hecht in: models of computation, formal languages, analysis of algorithms, and program correctness. Chul Kim received his Ph.D. from Penn State University in 1975. Matthew Hecht received his Ph.D. from Princeton University in 1973. Kim and Hecht left the University.

In models of computation several investigations were initiated. One study concerned the tradeoffs between the complexity of a machine used to compute a function and the complexity of the encoding needed to compute a function and the complexity of the encoding needed to encode the arguments of the computed function as strings on the tape of the machine. For example, it was

shown that the multiplication function is not computable by a finite state machine if the arguments are encoded by their Gödel numbers.

An investigation of various proof systems was tailored to proving properties of programs such as termination, partial correctness, and total correctness. One such system is a natural-deduction-style proof system, called ND, in which nontrivial properties of recursive and iterative programs often may be proved easily. It was proved that ND subsumes the Hoare axiom system. Since no nontrivial proof system for reasoning about programs can be logically complete, to measure the power of such a proof system it is necessary to isolate a subclass that the proof system is capable of proving all true properties of this subclass. The monadic programs are those that use no recursion and have only one variable. It was proved that ND is complete for the subclass of monadic programs.

Software Tool Developments A number of efforts were made to develop software tools in the Department both for educational and research purposes.

Zelkowitz developed PLUM, a load-and-go PL/I compiler for the UNIVAC 1108. In addition to providing a tool for programmers who used the CSC UNIVAC 1108, it was used as one of the languages in CMSC 330, Programming Languages, in the late 1970s.

Basili developed SIMPL-T, as a family of compilers. SIMPL-T, which was used as a beginning programming language in the first two CMSC courses, CMSC 110, Elementary Algorithmic Analysis and CMSC 120, Intermediary Algorithmic Analysis in the late 1970s. The language had a syntax that was easy to parse, and had a flexible compiler design. The syntax was similar to that of Algol or Pascal. It had simple data structures for integers, reals and strings, and good diagnostic tools. At the time it was introduced to our courses in the mid-1970s, the only competition was Fortran or MAD which had no structure. Pascal had not yet been widely used. As Pascal use grew in other CS departments in the late 1970s, Maryland, in the early 1980s adopted Pascal as the beginning language as it had more features than SIMPL-T, and was being used widely throughout the country. However, our faculty believed SIMPL-T was a better first-course language for its time.

Hamlet and Zelkowitz developed SIMPL-XI (SIMPL-11) as a systems programming language based upon the SIMPL-T structure. It was used for operating system design and used to develop operating systems on the PDP/11 in CMSC 415, Systems Programming, in the late 1970s.

Research Successes The result of focusing on research and recruiting outstanding young faculty contributed to the Department being highly ranked in a 1980 report by the National Academy of Science study on computer departments in the United States. The National Academy of Science report[147] ranked the Department of Computer Science twelfth in the United States. In the Computer Research Association's (CRA) Taulbee report of computer science departments, the Department was ranked thirteenth, among all departments of computer science in the United States and Canada[148].

[147]See web site: http://www.nap.edu/openbook/0309032997/html/59.html, "An Assessment of Research-Doctorate Programs in the United States: Mathematical and Physical Sciences."

[148]See the web site www.cra.org/statistics/survey/94, "1993-1994 CRA Taulbee Survey," by George R. Andrews, Chair, CRA Surveys Committee. The report states,

> We based our ranking on information from a 1980 assessment of research-doctorate programs in the United States done under the auspices of the National Research Council. We modified our ranking to include Canadian universities. The top 12 schools are: Stanford, Massachusetts Institute of Technology, Carnegie Mellon Institute, University of California at Berkeley, Cornell University, University of Illinois, University of California at Los Angeles, University of Toronto, University of Washington at Seattle, University of Texas, University of Wisconsin at Madison, and the University of Southern California. The departments ranked 13 to 24 are: University of Maryland, Princeton University, Brown University, University of Utah, New York University, University of Massachusetts, State University of New York at Stonybrook, University of North Carolina at Chapel Hill, University of Pennsylvania, Yale University,

3.2.3 Department Education

At the start of the Department in 1973, it had two major educational problems. The graduate program which had started in 1968 was turning out a good number of well-trained students at the M.S. level, but the Ph.D. program had not yet started to graduate as many students as they should have been doing. At the undergraduate level, although the newly formed B.S. degree was approved in 1973, it did not start in full-force until the fall of 1974. These aspects are discussed below.

At the start of the fall 1973 semester, there were 19.8 full time equivalent professorial faculty and 19 Teaching Assistants in the Department[149]. This was sufficient to handle the graduate program; however, the Department was not in position to handle a large influx of undergraduate majors. The administration of the educational program was intact, since Dr. Richard Austing, who had been handling the educational aspects of the Center education programs agreed to continue as Education Director. However, the faculty were not prepared to have increased loads for teaching and advising undergraduate students, while maintaining their research.

Although the B.S. degree was approved in 1973, it was not possible to inform students that they could enroll in the program. It was not until the fall semester 1974 when the program started. The list of undergraduate courses offered in 1974 is given in Appendix 1. At the beginning of the fall semester 1974 there were 150 undergraduate computer science majors enrolled in the program. The large number of undergraduate majors clearly demonstrated the need that existed at Maryland for an undergraduate curriculum in computer science. This figure increased significantly each year so that by the end of the spring semester 1979, there were a total of 625 undergraduate majors. This represented a 417% increase in student undergraduate majors. In the following table, a summary of the enrollments is included. Student enrollments include students who took multiple courses and include those who were not necessarily majoring in computer science. At the end of the spring 1979 semester there were 20.9 full time equivalent faculty.

The total teaching faculty during the period 1973 through 1979 increased by 1 faculty line and decreased by 2 Teaching Assistant lines. This was due to reversions of faculty. The University budget had not been increased substantially and the campus administrators decided that although departments in the the MPSE Division were rated highly, other parts of the campus were not rated highly, and faculty lines were reverted from the MPSE Division. The MPSE Provost, Dr. Marchello, minimized the reversions for the CSD as best he could. The CSD did not want to lobby for more positions from Mathematics, Physics, or Engineering since these were quality programs ranked highly nationally. The CSD did not want to harm their colleagues and appreciated Dr. Marchello's assistance.

Enrollment Growth

	1974-75	1975-76	1976-77	1977-78	1978-79
Student Enrollments	3192	3482	3661	4427	4894
Undergraduate Majors	150	287	464	549	625
Graduate Majors	250	220	220	198	180
Baccalaureate (B.S.)	16	31	56	66	92
Master (M.S.)	29	32	27	27	33
Doctoral (Ph.D.)	0	7	6	6	9

Pennsylvania State University, and Georgia Institute of Technology.

[149]The statistical information contained in this section were taken from the "Report of the Computer Science Review Committee," December 8, 1978. The report, and a memorandum from Provost Frank J. Kerr, dated June 20, 1979, are contained in the Minker collection, in the University of Maryland Archives, Hornbake Library.

The undergraduate education program was enhanced by a departmental Honors Program which was introduced at the beginning of 1975. To enroll in the Honors Program a student had to be majoring in computer science and had to have over 3.5 GPA in computer science, a GPA of 3.0 overall, and more than 45 credits and to maintain the GPAs to graduate with Honors in Computer Science. In addition, they must also have achieved A's in at least three 400-level upper level CMSC courses that were not reading-research courses, must have completed one semester of CMSC 390, an Honors Paper, with a grade of A, and completed a project with a faculty member. In its first offering, four students entered the honors program. The Department also made available a general honors course for the University Honors Program. The quality of our undergraduates improved each year. The quality of the students in mathematics and the sciences was very high. In 1979, 10% of the students in Computer Science were on the honor roll in our division. Students who graduated from our program were sought after highly by industry. Those who went on to graduate school at other universities received fellowships at such universities as Carnegie Mellon, Harvard and the Massachusetts Institute of Technology. Students received NSF graduate fellowship awards. One such student was Mr. Philip Agre, who was accepted for graduate school at the Massachusetts Institute of Technology.

Throughout the period 1974–1979, new courses were introduced both at the undergraduate and graduate levels. The first course on *Structured Programming* was introduced in the fall 1974 by Dr. Harlan Mills of IBM. Dr. Minker had invited Dr. Mills to teach at Maryland and to join our faculty either as an Adjunct Professor or as a full time faculty member. Dr. Mills elected initially to be an Part-time Visiting Adjunct Professor in 1974 and joined the faculty at a later date. Figure **??**, taken in 1974 by Ben Shneiderman, shows Mills in front of a blackboard discussing the 1966 article by Bohm and Jacopini in the Communications of the ACM. That article gave a formal proof that all programs could be written with just sequence, repetition, and conditionals (no GOTOs needed). This was an important basis for the structured programming movement for which Harlan Mills was a strong advocate. Several new courses were introduced such as: Exploratory Data Analysis, taught jointly by Dr. Kanal and Dr. Eric Slud in Statistics; Computers and Society introduced by Dr. Atchison; Database system design introduced by Dr. Minker; and Design and Construction of Personal Computers, introduced by Dr. Chu and Dr. Rieger.

Although the Ph.D. program was approved in 1969 and the first Ph.D.s in computer science were granted in December 1973, only three (3) students had been granted Ph.D.s before 1975. Minker initiated a policy to write letters to Ph.D. students who were not making adequate progress. Ph.D. students became concerned that they would be terminated from the Ph.D. program and faculty started to provide closer supervision to their Ph.D. students. The Department Ph.D. program matured during the 1975–1976 period when seven (7) Ph.D. students received degrees that year. As seen from the chart on Enrollment Growth, 6 Ph.D. students were graduated in the 1976–1977 and 1977–1978 years and 9 were graduated in the period 1978-1979. The list of students, their advisors and titles of their theses are contained in Appendix 7.

3.2.4 Developing a Department Laboratory

In order to enhance research and education, it was important to obtain computer equipment within the Department. In this way the faculty and students would have direct access to the machines for hands-on education and research. In addition, the students in the Department were having difficulties in accessing the computers within the Center. As noted in the 1979 Research Review of the Department of Computer Science[150],

[150] A copy of the 1979 Research Review of the CSD is available in the Minker collection in the University of Maryland Archives, Hornbake Library.

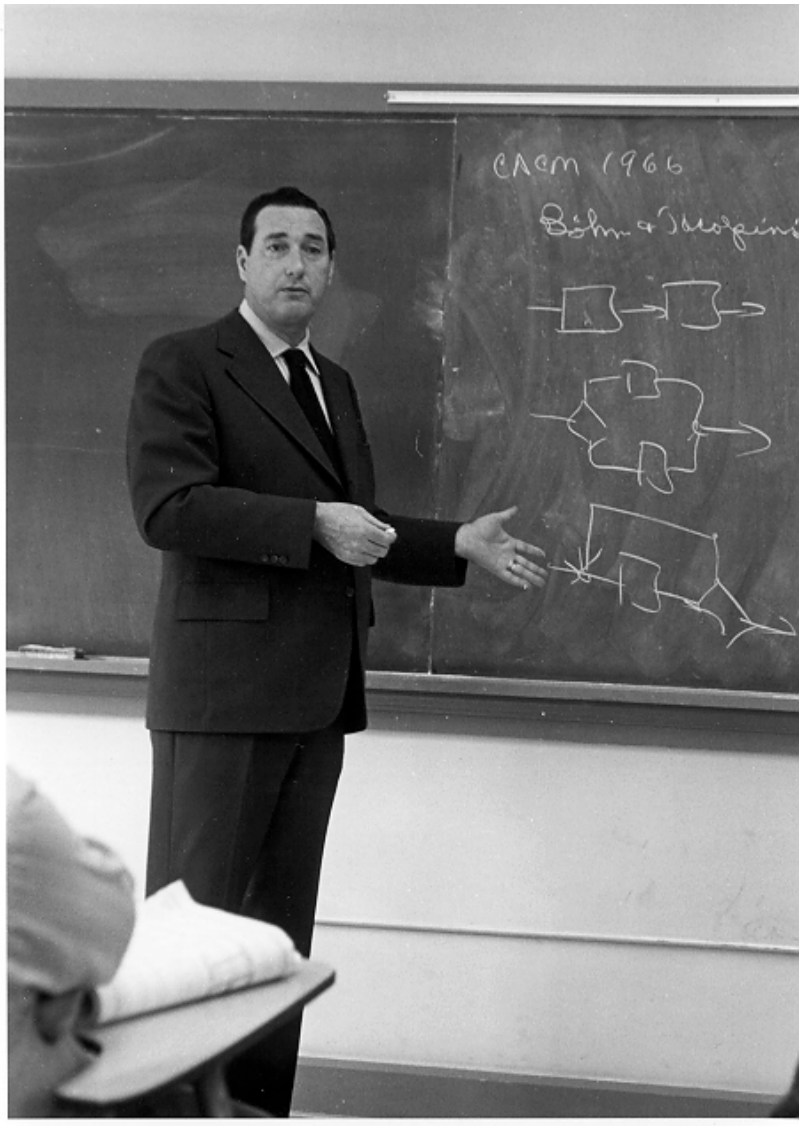

Figure 11: Harlan Mills, Lecturing on Structured Programs, 1974, Photograph by Ben Shneiderman.

> ... On the Center facilities, response time is slow and hardly usable during peak periods, that is, connecting up a terminal is almost impossible and turn-around time is 4 to 6 hours on submitted jobs.

The Department computer laboratory started under the Center approximately[151] in 1971. Perhaps the first computers obtained for the Laboratory were a PDP-11/45 obtained by Kanal under an NSF research grant for research in pattern recognition, and two Minutemen II given under an Air Force grant to Professor Laveen Kanal also for use in his work on pattern recognition[152]. Kanal also obtained the first license from Bell Laboratories to use the UNIX operating system for the entire university. This came about when Dr. David Mills told Kanal that the UNIX operating system should be used on the PDP-11/45. These computers were followed by the PDP-11/40 which was obtained for use in operating system courses for hands on programming. The PDP-11 computers were preceded by a PDP 8, which had been on loan to the Center. In a memorandum from Provost Marchello to the Campus Budget Committee requesting funds for additional equipment to the laboratory, an attachment to the memorandum stated[153],

> Students, both individually and in groups, have first call on all the PDP-11 equipment, and during the semester the system is in almost constant use, literally whenever the building is open if a project is assigned. The Laboratory is open to students, who sign out for a key, and are then responsible for the system. An assistant has been available for consultation and routine tasks, but he does not run the machine. In a typical project students are supplied with system documentation, literature references, and a problem; they are then expected to find their own ways. Such assignments require careful planning to succeed in a limited time period, but no matter how much help is provided, students control what they do, from power-on to project completion. The magic of the unseen computer is replaced by knowledge of things really work.

In addition to the use of the Laboratory equipment for student use in operating systems courses, Professor Agrawala recalls that a member of the Department was using equipment for networking during its early days. He states that there was a [154],

> ... full ARPANet node in the basement of Dr. David Mills. This may show the early involvement we had in networking. (Dave had his personal PDP 11 which he used for experimentations at home and that was given the special status of a full node on the ARPANet, as I recall it).

From the time of the Department's inception, a major goal was to enhance the computer laboratory. As noted in Section **??**, the University did not have autonomy to purchase computers, and all such purchases had to be approved by State administrators. This caused many problems that frustrated our efforts. Four incidents are discussed, below.

The first situation arose when the Department submitted an order to purchase a PDP-11/40 computer for a course on operating systems that was being offered in the following semester. Over

[151] See Department of Computer Science Digital Systems Laboratory attached to a memorandum by Joseph Marchello dated July 17, 1973 to the Campus Budget Committee requesting assistance in establishing the department's teaching program, contained in the Minker collection, the University of Maryland Archives, Hornbake Library.

[152] See the e-mail message from Ashok Agrawala to Jack Minker, dated, June 27, 2003, contained in the list of e-mail messages on this history in the Minker collection, University of Maryland Archives, Hornbake Library.

[153] The memorandum from Provost Marchello to the Campus Budget Committee, dated July 17, 1973 is contained in the Minker collection, the University of Maryland Archives, Hornbake Library.

[154] The information related by Dr. Agrawala appears in an e-mail message to Jack Minker dated 13 August 2003 and is contained in the e-mail messages regarding this history in the minker collection, the University of Maryland Archives, Hornbake Library.

60 students were registered for the course. The State learned about the purchase since, as discussed in Section **??**, it was necessary to submit a BB4 form for the purchase. Upon receiving the request, without discussion with the Department, the state administrators wrote to Minker stating that they saw no need for the computer since the Center equipment was available. The state administrators rationale was that state funds for the Center computers would be offset by the federally-funded use of the Center machines. Minker responded that this would cause a major problem within the University for several reasons. The computer was required for hands-on operating system work and it was not appropriate to turn over a major academic computer to be run by students who were learning the machine details. Furthermore, we would have to cancel the course if we could not purchase the computer. Students would then complain that the University was not providing them with appropriate experience to permit them to function in the work place when they graduated. The state administrators backed down and permitted the Department to purchase the PDP-11/40.

A second incident involved Dr. Laveen Kanal who wrote a proposal to the National Science Foundation to obtain a computer for work in research in pattern recognition. The proposal was granted to Dr. Kanal by the NSF. When a BB4 form was submitted for the purchase, the state administrators wrote to Minker, with copies to the University Administration, castigating the Department for not obtaining funding for use with the main computers rather than obtaining a stand-alone computer. Minker responded to the state administrators that the computer was to be used for a special purpose and, if funds for the computer were redirected to the CSC, the special purpose use for students involved in the research would not be able to be continued once the funds were depleted. In addition, the NSF funding was to support the purchase of a computer, and not for funding to support the purchase of time on a computer. The State reluctantly agreed not to make an issue of this and approved the equipment.

Professor Ashok Agrawala recalls a third BB4 incident[155],

> Another BB4 incident that I recall is when the Department requested the purchase of 4 portable terminals which faculty could borrow to take home. The BB4 request was denied with the comment that as MISD had approved a purchase of 12 terminals for BSOS for office use, they saw no need for the purchase of portable terminals by Computer Science Department. As I recall it, they went further to comment that they had observed that the University was making very uneven use of terminals on campus. The use of terminals is very low in August and September and very high in December. Then the use is very low in January, low in February and high again in May. They were suggesting that the University should take actions to balance the utilization of the terminals. (!!!!)

The fourth incident occurred in 1978. The NSF was supporting the purchase of computers by newly formed departments of computer science to assist them in conducting research. As Chairman of the Department, Minker decided to submit a proposal to the NSF with his faculty. As noted in the abstract to the proposal, the following was requested[156].

> Funds for a medium-scale research computer for academic use by the Department of Computer Science are requested. The requested machine will support research in the areas of distributed/intelligent databases, artificial intelligence, computer vision, and operating system design and measurement.

[155] The incident related by Dr. Agrawala appears in an e-mail message to Jack Minker dated 13 August 2003 and is contained in the e-mail messages regarding this history in the Minker collection, the University of Maryland Archives, Hornbake Library.

[156] A copy of the proposal and a memorandum from Jack Minker to Victor Medina, dated November 13, 1978, may be found in the Minker collection in the University of Maryland Archives, Hornbake Library.

Because of the events discussed above, Minker decided to obtain permission in advance to submit the proposal. He discussed this with the new Provost of the MPSE Division, Dr. Frank Kerr, who had replaced Dr. Marchello who had left to become President of Missouri State University. Dr. Kerr supported Minker's decision. Since the matter affected the University's autonomy, Dr. Kerr discussed the matter with the then Vice-Chancellor for Academic Affairs, Dr. Nancie Gonzalez, who insisted that Minker make a presentation to her to support this need. This was a surprise, since it was clear why the computer was needed and the University had wanted autonomy in purchasing computers. The result of the presentation was that instead of supporting the decision to send out the proposal and inform the State of the decision, the Vice-Chancellor left it up to Dr. Kerr to make the decision to go ahead with the proposal. This lack of support was a far cry from wanting autonomy for the University to make their own decisions concerning computing needs for research and education. Dr. Kerr completely supported Minker's decision, but Minker still had to make a presentation to the State administrators before the proposal could be submitted.

Since John Menard had experience in dealing with the State concerning computer purchases and in filling out the BB4 forms, Minker asked Menard to join him in his presentation and discussions with the state administrators in Annapolis, Maryland. The two of them went to Annapolis, Maryland, to convince the State computer administrators that they should allow the Department of Computer Science to submit a proposal to obtain a, medium-sized computer from the NSF in support of research. The State administrators questioned the advisability of the Department getting their own computer. They believed that it would proliferate computers on campus and all departments would then want their own computer laboratories. Instead, they wanted us to revise our proposal to obtain a grant to support use of the Center computers for our research. In that way the State would not have to provide as much support to the Center as they were paying. They relented when we convinced them that our students could not have hands-on access to computers as was proposed with the research on operating systems, and the proposal would not be responsive to the request by the NSF. The Computer Division within the NSF was trying to improve computer laboratories in computer science departments since computer science was an experimental science. They would not support funds for computer time under the grant. Reluctantly, the state administrators granted permission for the Department to submit the proposal. The NSF awarded the Department the grant for the purchase of a medium-sized computer, the VAX 11/780.

This was the genesis of the start of the Department of Computer Science Laboratory to support our special needs for research and education. Menard's assistance as Director of the CSC, was extremely important to obtaining the approval, as was support from Provost Kerr. The list of computer equipment obtained by the Department from 1974 to July 1979 is given in Appendix 6. The modest list pales in comparison to what was needed at the time to enhance our Department.

The lack of appreciation of educational and research needs of a University by the State administrators demonstrated the need for autonomy. It was one thing to try to administer data processing needs throughout the State. It was another matter to administer needs for scientific purposes and special education needs. It was not until 1985, when President John Toll convinced the State to change this practice and returned autonomy to the University.

3.2.5 External Relations and Service

Most of the senior faculty in the CSD were involved with service to external scientific organizations during the period 1973-1979. They served in high-level positions of the organizations to which they belonged. A brief description of some of the contributions is given in this section.

Bill Atchison continued his work on computer science education and served as Conference Chairman of the ACM Computer Science Conference in 1975. Atchison continued his work as an international leader in computer science education and service as U.S. representative to Technical

Committee for Education (TC 3) of the IFIP, Chairman of Working Group on Secondary School Education in Computers (WE 3.1) for IFIP, and as Program Chairman of the International Conference on Information and Mathematics in Secondary Schools, held in Bulgaria in 1977. For his work with Curriculum 68 and his subsequent contributions to computer science education, he received a number of awards during this period:

- ACM Distinguished Service Award, 1973
- IFIP 1974 Special Award in Appreciation for Services as Chairman of WG 3.1 1968-1974
- Chester Morrill Memorial Award from the Chesapeake Division of the Association for Systems Management, 1975

A complete set of his awards is given in Appendix 3.

Richard Austing served as Vice Chairman for the ACM Computer Science Conference in 1975. He was also Chairman of the committee that developed the first Advanced Graduate Record Examination in computer science. He was also General Chairman of ACM '78. He chaired the C^3S subgroup which produced "Curriculum '78: Recommendations for an Undergraduate Program in Computer Science."

Yaohan Chu founded the Chinese Language Computer Society (CLCS)in 1976 during the Eastern Computer Conference in New York city. There were 25 members who signed up for the Society. Dr. Chu was elected the first President of the CLCS and remained President until 1986. When he stepped down as President he was elected Honorary President and holds this title to date. Indeed, Dr. Chu is the only Honorary President of the CLCS. Dr. Chu started the CLCS as he was concerned that there were no publications in Chinese for computing. The CLCS was intended to advance and to promote computer processing of character-oriented languages such as Chinese, Japanese, and Korean. In addition it was intended as a place to present high-quality papers by Asians (specially shortened versions of Ph.D. theses), as well for the members to meet and to talk. The CLCS fostered many chapters in the USA, Taiwan, Hong Kong, Singapore, Canada, Japan, and Korea. International conferences were held in Washington, D.C., San Francisco, Honolulu, Taipei, Tokyo, Hong Kong, Singapore, and other cities almost every year. Proceedings were published in English for each conference. A high quality journal, "International Journal of Computer Processing of Oriental Languages" is published by the CLCS, and publishes work on such topics as text and character recognition, multi-lingual processing, information retrieval, multimedia computing, Korea language processing, and related subjects. The CLCS is still in existence and has made a significant and unique contribution to processing oriental languages over the past 27 years. Chu was also a member of the Editorial Board of the IEEE Transactions of Software Engineering. A photograph of Chu, taken by Ben Shneiderman in 1981 is shown in Figure **??**.

Laveen Kanal was a member of the Board of Governors of the IEEE Information Theory Society for 1976-1978. He also served as a member of the NSF sponsored Automation Research Council of the American Automatic Control Council. He was a founding member of the Pattern Recognition Committee in 1965 and Associate Editor for Pattern Recognition of the IEEE Information Theory Transactions from 1967–1970.

Harlan Mills, Jack Minker, and Werner Rheinboldt were appointed to the Advisory Editorial Board of the NBS/NSF Software Engineering Handbook.

Jack Minker helped to organize the first workshop on Logic and Data Bases. The workshop was held in Toulouse, France. He co-edited a book, based on papers at the workshop, with Hervé Gallaire. Minker was also involved in human rights for scientists and computer scientists. He was Vice-Chairman of the Committee on Scientific Freedom and Human Rights (CSFHR) of the Association for Computing Machinery. In this capacity he published comprehensive lists of computer

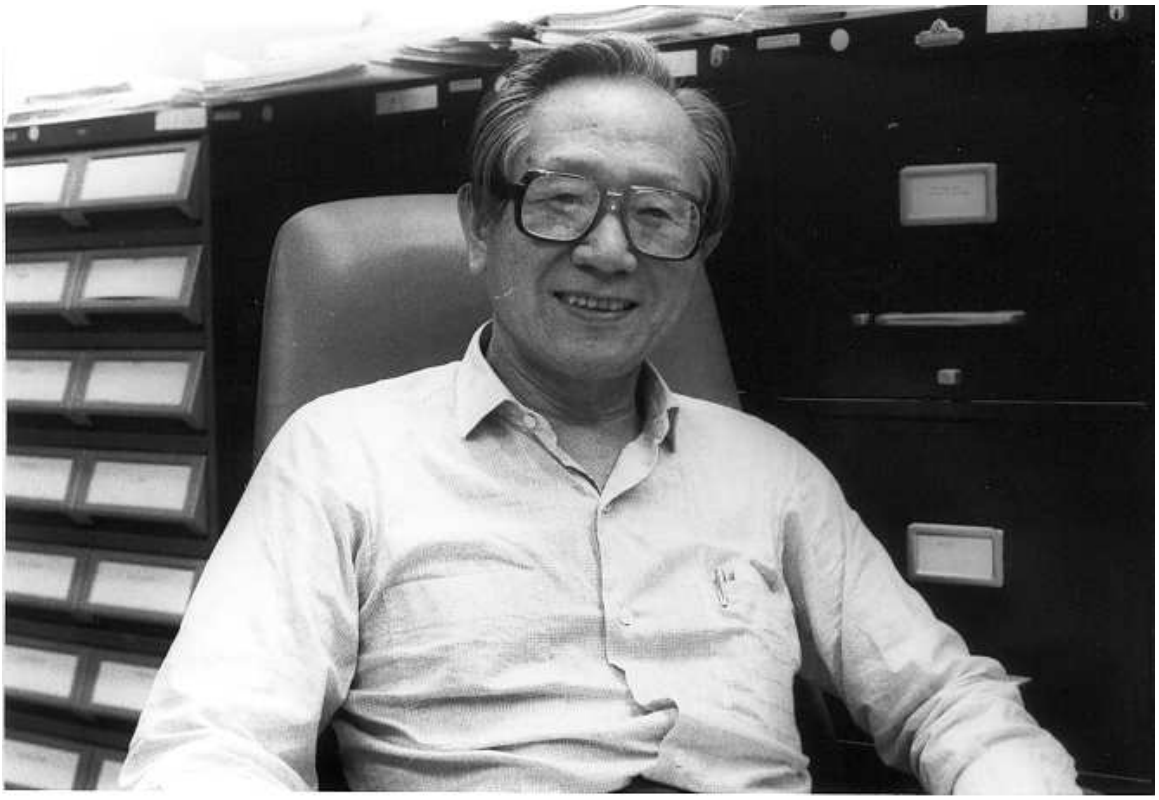

Figure 12: Professor Yaohan Chu, Taught First Course on Digital Computer Organization in 1958 at the University of Maryland. Photograph taken by Ben Shneiderman in 1981.

scientists throughout the world whose human rights had been violated. For his work in this area he received the ACM's 1985 Outstanding Contribution Award. He was also Vice-Chairman, Computer Science, Committee of Concerned Scientists (CCS). In this capacity he wrote letters in support of scientists and computer scientists whose human rights had been violated. He was active on behalf of such well-known scientists as Andrei Sakharov and visited the Soviet Scientific Attache in the Soviet Union Embassy in Washington, D.C. in an effort to obtain Sakharov's release from exile in his dacha (country home) in Gorky, to permit him to return to Moscow. He also assisted such well-known individuals as Dr. Aleksandr Lerner and Anatoly Shcharansky, as well as numerous other individuals. In 1979, when Shcharansky was imprisoned in the Soviet Union, his wife Avital Shcharansky came from Israel to generate support for her husband. She contacted Minker who organized a rally on campus to hear Mrs. Shcharansky. The rally was held in the Physics Lecture Hall, which has a capacity of 500 people. The Lecture Hall was full and people were standing in the aisles and the back of the Lecture Hall. President Toll and Chancellor Gluckstern could not attend, but lent their support with letters read at the rally. Professor J. Robert Dorfman translated for Mrs. Shcharansky, who spoke in Hebrew. Many of the chairs of departments also gave their support and attended. Among the chairs and directors who attended were Minker, who served as Master of Ceremonies, Alex Dragt of Physics, Brit Kirwan of Mathematics, and Joe Silverman of IPST. Minker was also Chairman of the Samuel Alexander Award Committee. The award was given to the most promising graduate student in the Washington, D.C. area. He was a member of the ACM Committee on Relations with other organizations, with responsibility for coordinating activities with the National Bureau of Standards. He also served as Awards Chairman of the Washington D.C. chapter of the ACM. Minker was appointed to the Computer Science Board, an organization of department chairpersons which coordinates university and college computer activities.

Chuck Rieger and Jack Minker served as advisors to NASA on Artificial Intelligence and Space Exploration. The NASA panels on interplanetary robotic exploration, chaired by Professor Carl Sagan of Cornell University, during the 1977-1981 time frame, were to assess the feasibility and prospects of unmanned interplanetary space exploration. The format of each meeting was typically a two-day visit to a NASA-related facility, including such places as Langley Research Center in Hampton, VA, Goddard Space Flight Center in Greenbelt, MD, and the Jet Propulsion Lab in Pasadena. One day of each meeting would typically be devoted to a series of presentations by panel members from the academic and NASA communities, describing current research in such areas as artificial intelligence, problem solving, operations research, and deep space communications. Profs. Minker and Rieger represented the University of Maryland, and gave presentations on their research in artificial intelligence and problem solving systems. The second day of each meeting typically included informal discussions among the group, a tour of the NASA facility, and opportunities to meet and talk with NASA researchers. The results of the series of meetings were eventually compiled into a final report[157], which was circulated among the participants, within NASA, and within selected governmental agencies and influenced the direction of unmanned interplanetary space explorations at NASA.

Werner Rheinboldt was active with the Society for Industrial and Applied Mathematics (SIAM). In 1976 he became Vice President for Publications for SIAM and, in 1976 became its President-Elect, and subsequently became President in 1977. He was also appointed Acting Vice President for Publications, and Chairman of the Publications Committee for SIAM. He was appointed Director of the Applied Mathematics Program at Maryland on July 18, 1974. The inter-disciplinary program

[157] A copy of the report, "Machine Intelligence and Robotics: Report of the NASA Study Group – FINAL REPORT", March 1980, 715-32, National Aeronautics and Space Administration, Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California, is included in the Minker collection, University of Maryland Archives, Hornbake Library.

within the MPSE and Engineering was established during the 1973-74 academic year.

Azriel Rosenfeld and Laveen Kanal were founding members of the IEEE Computer Society Technical Committee on Machine Intelligence and Pattern Analysis (founded in 1965 as the Pattern Recognition (Sub)committee).

Marvin Zelkowitz was active with the IEEE. He was Editor of the IEEE Computer Society Technical Committee on Software Engineering, as Symposium Chairman for an IEEE Computer Science/National Bureau of Standards (NBS) conference on Micro- and Mini-Computers, and as Proceedings Editor of the Fifteenth Annual Technical Symposium, ACM Washington Chapter and NBS. He was appointed Newsletter Editor of the IEEE Computer Science Technical Committee on Software Engineering. He was elected Secretary/Treasurer of the Washington, D.C. chapter of the IEEE Computing Society for 1976-1977.

3.2.6 Departmental Activities: 1973–1979

Activities During First Year of Minker's Chairmanship (1974). The first year of the Department was particularly busy. We were inundated by a large number of students who wanted to major in computer science. The halls of the Department were filled with students taking courses. Classrooms were outside faculty offices on the second floor of the CSC, and those faculty with offices opposite classrooms had to cope with the student traffic and the noise from the classrooms when lectures were being conducted. Faculty had to cope with large classes consisting both of majors in CS and students from other departments who took our courses. Faculty also had to spend time advising students and answering questions after class for the undergraduate students.

In order to develop a community spirit within the Department, Minker initiated a Department of Computer Science Newsletter called PRINTOUT. He asked Dick Hamlet to be the Editor-in-Chief of this a-periodic publication. Hamlet was the ideal person to be E-i-C. He was witty, irreverent, and an excellent writer. PRINTOUT contained an eclectic collection of articles on topics of interest, anecdotes, information about the Department, amusing stories, jokes, births, information about departmental equipment, colloquium, students, staff, and faculty. The first issue of the publication was on 9 September 1974 and several issues were published each year until 1980 when it was terminated after Minker had stepped down as Chair[158]. In addition to the PRINTOUT, the Department held annual picnics in park areas near the University. Hamlet brought his guitar, and strummed along, soccer games were formed, children went on the swings, food galore was available, and a warm atmosphere was achieved.

Minker also believed that it was important to publicize the Department both in the University and to the community outside. To achieve this he instituted a Computer Science Department Annual Report. The first report was issued in September 1975 and has been continued since then. Minker believes that it may be among the first annual reports published by departments on the University of Maryland College Park campus. Unlike the PRINTOUT, which was informal, the Annual Report contained formal material about the Department for each fiscal year. It listed the Ph.D. and M.S. students who graduated, grants received by faculty members, publications and technical reports written by faculty and/or students, the courses offered that year, the number of students who completed their B.S., M.S., and Ph.D.degrees, a message from the Chair, faculty awards, and computing facilities in the Department[159].

The first year of Minker's tenure was especially busy for him since he was conducting research, had several students doing Ph.D. and M.S. degrees under his direction, and was personally taking

[158] A number of issues of the PRINTOUT are in the Minker collection in the University of Maryland Archives, Hornbake Library. Dick Hamlet had saved the issues and kindly sent them to Minker.

[159] Copies of the Annual Report for the period 1974–1979 are contained in the Minker collection in the University of Maryland Archives, Hornbake Library.

over a good deal of the service from which the junior faculty had been relieved. In addition, the Department was trying to hire new faculty, which took up a great deal of time.

Succeeding Years of Minker's Chairmanship (1975-1979). Once all of the committees were in place, and the procedures and policies worked out during the 1973–1974 period, the department functioned smoothly and junior faculty were not burdened with excessive amounts of service. The following years were less hectic, both for Minker and the Department. The Department was well under way, the junior faculty were spending a greater amount of time doing research and being productive. Minker, who had known Dr. Harlan Mills since the late 1950s, and who was now working at IBM in the Washington, D.C. area, asked Harlan if he would join the faculty as either a permanent faculty member, or as a part time or visiting member of the faculty. Mills was doing important work in the new field of software engineering. Mills decided to be associated with the Department in 1975 as a Visiting Part Time Faculty member. He did not want to leave his position at IBM where he was doing interesting work. He continued to be associated with the Department throughout the time that he worked in the Washington, D.C. area, and collaborated with some of our faculty in software engineering.

Department Staff. The Department had a small, but very capable staff. The members of the staff in 1974 were:

- Barbara Ellis, Secretary to the Chairman
- Betty Donovan, Secretary to the Director of Education
- Eleanor Waters, Typist
- Jo Ann Thompson, Director of Administration
- Brenda Bigwood, Account Clerk

Mrs. Ellis was responsible for typing all of the work coming out of the chairman's office, confidential material from APT meetings, handling appointments, contacting potential new faculty and making arrangements for them to visit the campus. Betty Donovan, Barbara Ellis's daughter handled all of the material that dealt with educational aspects of the Department. Eleanor Waters was a typist who handled support for typing proposals, technical reports and articles for the faculty. Jo Ann Thompson was in charge of the administration. She handled payrolls, provided information to faculty on the status of funds in their grants, provided budgets for proposals, kept tabs on the operating budget and our expenditures, and numerous other tasks. It was necessary to hire an account clerk, Brenda Bigwood, to support her efforts. The staff worked cooperatively and functioned very well.

Relationship with Venezuelan Institute, IVIC. Through the good graces of Provost Marchello, the Department set up a relationship with the Venezolano de Investigones Cientificais (IVIC). IVIC was a scientific research institute located in Caracas, Venezuela. Provost Marchello was a friend of Dr. Pedro Bolsaitis, who was head of the "Centro de Ingenieria" at IVIC, which hosted a small Department of Computer Science. The Department entered into a joint relationship with IVIC in July 1977. Several faculty, Jack Minker, Chuck Rieger, Azriel Rosenfeld, augmented by Raj Reddy of Carnegie Mellon offered a course in artificial intelligence to the faculty at IVIC. In addition, Marvin Zelkowitz spent 6 weeks at IVIC, from late February through March 1978, working with their faculty in programming languages. The relationship with IVIC was mutually productive.

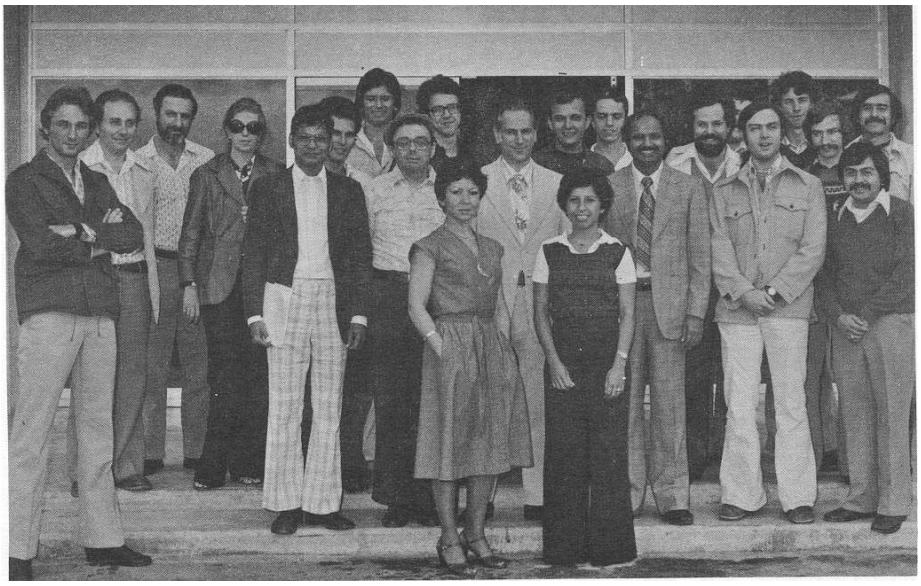

Figure 13: Students and Lecturers at IVIC, Caracas, Venezuela, 1977.

Unfortunately their Department did not last too long. Several members of the Department left for other institutions or commercial firms. The Director of IVIC at the time was Dr. Luis Carbonel, a physician and microbiologist. Dr. Carbonel supported the joint relationship.

Problems with Information System Management Department. The only major problems that existed in the Department were the problems with the State who had a stranglehold on purchases of equipment, and with the Information Systems Management Department (IFSM) in the Behavioral and Social Studies Division. Problems with the State were addressed in Section **??**. The problems with the IFSM are discussed below.

The Information Systems Management Department (IFSM) was in the Division of Behavioral and Social Sciences and was independent of the Business School. The Department of Computer Science generally looked favorably upon IFSM. The IFSM taught Cobol to their students and the CSD had no interest in teaching such a course. They also taught students how to analyze computer needs within an organization, and to set up management of such organizations. Again, the CSD was not particularly interested in such courses, but realized their importance and relevance. In addition, the IFSM started to hire computer science faculty in databases. Again, the Department had no objections. There was a need to teach business-oriented students in the use of databases in their work. However, problems arose when the IFSM started to build an organization that would compete with the CSD. Part of the problem was that the IFSM did not report directly to the Dean of the Business School, but to the Division of Behavioral and Social Sciences.

Problems became exacerbated when the Chair of IFSM informed the Chair of CSD that it would be best if the CSD would teach the theoretical aspects of computing, while the remainder of computing was in their domain. Thus, they would be responsible for operating systems, programming language development, software engineering, database systems, and related work. This, of course, was not acceptable to the CSD faculty. It was clear that there was no need for two competing computer science activities on the same campus.

The issues became focused in June 1975 when a proposal was made by the IFSM to the President's Advisory Committee on computing to purchase a PDP 11/40 minicomputer[160]. The proposal

[160]The proposal for IFSM to purchase a computer appears in a memorandum from B.F. Courtright to Dr. Thomas

requested the minicomputer for:

> ... two principal kinds of need: "hands-on" machine experience for students; and the understanding of an increasingly important genre of equipment.

The Department had been discussing the increasing efforts of IFSM to move into computer science over several months. Minker had discussed the potential problems with Provost Marchello during this time. After discussion with the Department Council, Minker wrote a memorandum[161] to Provost Marchello expressing his concerns with both the purchase of the PDP 11/40 and the desire of the IFSM to start an M.S. degree in IFSM. In his memorandum to Provost Marchello he stated,

> There are three occurrences that lead me to the conclusion that courses that exist, within the Department of Computer Science are either being given or are planned to be given with the Information System Management Department (IFSM). These are:
>
> 1. A planned Master of Science Degree in IFSM.
> 2. A Computer Science Faculty being built up in IFSM.
> 3. A request by IFSM for a PDP 11/40 Computer facility.

With respect to the proposed M.S, degree in IFSM, Minker stated that a "very rough draft" of the proposed M.S. degree listed a large number of courses which were, in nature, computer science courses. He stated,

> I believe the major part of the curriculum fits within computer science, and that the remaining courses are not sufficient to sustain an M.S. degree in IFSM. The proposed program is computer science with the adjective Data Base Management appended to it.

With respect to the express purpose to provide "hands-on" computing experience, Minker stated,

> The Department of Computer Science already has two PDP-11 computers devoted exclusively for educational purposes at the graduate and undergraduate level. The express purpose of these computers is to provide students with "hands-on" computing experience. If our "hands-on" courses are not precisely right for IFSM students, it would take little effort to offer a special course for them.

The President's Advisory Committee on Computing approved the IFSM PDP 11/40 purchase. The issue with the IFSM was not resolved until 1979. As noted in Section **??**, the University Administration decided to move the IFSM to the University of Maryland Baltimore campus in the Fall 1979 and transferred several faculty members from IFSM to the CSD.

Rheinboldt Obtains Chair at the University of Pittsburgh. In 1978 Werner Rheinboldt informed Minker that he had received an offer to be the Andrew Mellon Professor of Mathematics at the University of Pittsburgh. Minker was pleased that Rheinboldt was being recognized as one of the world leading experts in numerical analysis and scientific computing. However, he was personally upset since he had relied upon Rheinboldt as a major resource with whom he could

B. Day, Vice-Chancellor for Academic Planning and Policy, dated June 2, 1975, contained in the Minker collection in the University of Maryland Archives, Hornbake Library.

[161] Memorandum from J. Minker to J. Marchello, dated June 2, 1975, is contained in the Minker collection in the University of Maryland Archives, Hornbake Library.

discuss departmental problems and obtain valuable advice. Minker felt so strongly about the value of Rheinboldt both to the Department of Computer Science and the University that he discussed the matter with Provost Marchello. He asked Marchello to speak to the Chancellor and to see if anything could be done to retain him. Marchello did speak to the Chancellor, who invited Rheinboldt to meet with him. Unfortunately, there was nothing that the Chancellor was able to offer Rheinboldt to be able to retain him. The University lost a valuable scientist who had contributed immeasurably to making computing and computer science at Maryland a success. Rheinboldt was an outstanding scholar, administrator, and individual.

Minker Resigns as Chair of the Department of Computer Science. In mid-1978, Minker met with Provost Kerr and informed him that because of personal reasons, he would not seek a continuation as Chair when his five year term was completed and his resignation would be effective September 1979. Minker wanted to spend more of his time with his research, and less time on administration. Starting a new department, had been a major effort. As the department was functioning well after his first four years as Chair, he believed it was time to return to his research and teaching and to be able to spend more time with his family.

3.3 1978 Review of the Department of Computer Science

In March 1978 then Provost J.M. Marchello established a committee to conduct a review of the Computer Science Department following the guidelines of the "MPSE Documents Procedures for Review of Units and Administrators." Two committees were formed: an internal Computer Science Review Committee[162]; and an External Review Committee[163]. The departmental review did not review Minker's chairmanship since Minker had informed Provost Frank Kerr that he would not continue to serve as chairman for another term.

Two reports were written. The internal review was completed in the fall 1978, and the external review was completed in December 1978[164]

The Internal Review Committee submitted to the new Provost, Dr. Frank Kerr, an executive summary that summarized the conclusions of both the Internal and the External Committees. This was followed by the reports of the two separate committees. Among the conclusions were the following:

[162]The members of the internal Computer Science Review Committee were:
A. Agrawala, Computer Science
V. Basili, Computer Science
M. Beard, Computer Science
D. Bobrow, Government and Politics
K. Freburger, Computer Science
B. Guarniere, Computer Science
R. Harger, Electrical Engineering
M. Hecht, Computer Science
W. Kirwan (Chairman) Mathematics
C. Rieger, Computer Science
G. Stewart, Computer Science

[163]The members of the External Review Committee were:
J.C. Browne, University of Texas
J. Hartmanis, Cornell University
R. Reddy, Carnegie-Mellon Institute of Technology
J. Sammet, IBM Corporation
S. Yau, University of Florida.

[164]A copy of the December 1978 internal and external reviews of the Department of Computer Science, without the appendices, may be found in the Minker collection in the University of Maryland Archives, the Hornbake Library.

> The Computer Science Department has established a reputation for a solid educational and research program. Both in the view of the External Committee and an independent survey conducted by Cornell University, the Department ranks approximately fifteenth among roughly 70 graduate departments in the U.S. and Canada.
>
> Given the favorable location near Washington, D.C., there would be hope that the Department could rise to a higher level. But given the current and anticipated level of state financial support, such a goal seems unattainable. The Committee has come to the inescapable conclusion that if the University wants to develop a distinguished Computer Science Department, it must dramatically increase its support of the Department or limit the number of computer science majors. During the three year period from 1974-75 to 1977-78 student enrollments increased by over 1,200 (37%) and undergraduate majors by 400 (270%). In this same period the faculty F.T.E. count decreased by two positions. It is not realistic to expect that a department can absorb an instructional load increase of this magnitude and simultaneously significantly elevate its research reputation. Indeed, it is remarkable that the Department has been able to attain its present position in the face of such phenomenal growth. The fact that it was able to do so is a tribute to the Chairman and the Department.

The Internal Review Committee made several specific recommendations:

(1) increase the number of faculty by 5-7 positions,
(2) improve Departmental salary scale,
(3) increase number of teaching assistants by 10-15,
(4) upgrade computing facilities,
(5) increase classified positions by 2,
(6) increase admission standards and develop aggressive recruiting at the graduate level,
(7) provide more breadth in graduate and undergraduate training.

One of the issues brought before the External Review Board was that of problems with the Information Systems Management Department (IFSM). Problems that the CSD were having with IFSM were discussed in Section **??**. The Chair of IFSM met with the External Review Committee and in their report they wrote,

> The External Review Committee met with Ed Sibley who stated that he thought the theoretical and practical aspects of computer science should be separated. The External Review Committee does not agree with this.

As a consequence, the University Administration decided to move the IFSM to the University of Maryland Baltimore campus in the Fall 1979 and transferred several faculty members from IFSM to the CSD.

Although the External Committee did not review the Chairman, they commented upon the Departmental Leadership and stated,

> Jack Minker has done an outstanding job of developing the department with the constraints of available resources, and the historical context of the Computer Science program at the University of Maryland, It is extremely difficult to develop a comprehensive program across the wide spectrum of expertise involved in a computer science program without having a strong base of senior leadership in the computing area. There are several distinguished senior computer scientists at the University of Maryland. It appears that only the now departed W. Rheinboldt has maintained a strong commitment to departmental affairs and the broadscale development of the Department.

The External Review Committee further stated,

> The Committee recognizes that several of the Associate Professors, e.g. Agrawala, Basili, and Zelkowitz are active in research and are strong participants in departmental affairs and development.

In his report to Chancellor Robert L. Gluckstern[165], Dr. Frank Kerr supported the conclusions and recommendations of the external and internal committees. He also requested that the then Chairman, Dr. Jack Minker, submit a letter commenting on the reports[166]. Minker agreed with all of the conclusions and recommendations and stated,

> During the five years that I have served as chairman, I was able to take a young group of researchers and mold them to become an internationally recognized department. This was accomplished while experiencing a tremendous growth in undergraduate computer science majors and students. It is probably the largest percentage growth of any major department in the university. We were able to handle to large influx of students because of the foresight of Dr. Lee Hornbake who in the late '60s and early '70s gave the department enough faculty positions to provide modest growth. Thus for the first two years as chairman I was able to hire both new faculty and part-time Ph.D.'s in computer science while creating an atmosphere that encouraged and rewarded research. Our resources have, however, been eroded with the loss of both faculty lines and teaching assistants through reallocations and reversions, and the continuing swell of students. However, the momentum and spirit developed in those early years has maintained excellence during the past three years of my chairmanship.

Minker further noted that,

> In a time of budget constraint one can uniformly dole out the negative increases to all departments. One can also select some whose quality, potential, and interest are such that they should be enhanced, while others are cut more severely.

It was his hope that the University would select the latter option with respect to the Department of Computer Science. Unfortunately, this did not occur for several years.

3.4 Summary of Activities in the Department of Computer Science Center: 1973-1979

The first six years of the newly formed Department of Computer Science were dynamic. It was necessary for the Department to become integrated into the Mathematics, Physical Sciences and Engineering (MPSE) Division, stabilize its Ph.D. graduate program, start an undergraduate program, develop a research direction, build a laboratory, and cope with a competing organization within the University.

Becoming a part of the MPSE Division was an easy task. The chairs in the MPSE and the Dean of Engineering, George Dieter, were easy to work with. Although there was competition for funds and lines, all members of Dr. Marcello's Council were fair, honest, and supportive of the newly formed department.

The Ph.D. program stabilized when the Chair wrote letters to the Ph.D. students informing them that progress toward their degree was essential and that there was a time limit on the Ph.D.

[165] Letter from Provost Kerr to Chancellor Gluckstern, dated July 30, 1979 is contained in the Minker collection in the University of Maryland Archives, Hornbake Library.

[166] Letter from Chairman Minker to Provost Kerr, dated July 30, 1979 may be found in the Minker collection in the University of Maryland Archives, Hornbake Library.

degree. The undergraduate program caused problems because of the tremendous growth of undergraduate students and the reversion of lines from the Department. It was a disappointment when the administration did not support this growing and important department. The support from Provost Marchello was welcome, but his resources were limited. In spite of the increased teaching load, the faculty teaching ratings were high.

The emphasis placed on research and teaching by the Chair, and relief from committee loads of the junior faculty, paid dividends. The junior faculty developed vibrant research activities which resulted in the Department attaining a national ranking of twelfth in the nation, and thirteenth including Canadian universities.

The development of a laboratory was modest, because of the limited funds available and the requirement that the University have all computer equipment purchases be pre-approved by the State. The problems this caused for both the University and the Department are a lesson that should be learned by all state universities. Education and research computing needs are different from data processing needs, and it is necessary for state universities to have purchasing autonomy for computing equipment.

The problems with the IFSM activity were unfortunate. There was a need for both a Department of Computer Science and an Information System Management Department. However, there was no need for two competing organizations. The desire by IFSM to split computer science into a theoretical and an applied activity was ill conceived and led to the University eliminating the IFSM department when the External Review Board disagreed with such a split.

The vision of the Chair to focus the Department in the areas of research and education was important to the success of the Department. However, this could not have been done without outstanding researchers. As noted by the External Review Committee,

> It is not realistic to expect that a department can absorb an instructional load increase of this magnitude and simultaneously significantly elevate its research reputation. Indeed, it is remarkable that the Department has been able to attain its present position in the face of such phenomenal growth. The fact that it was able to do so is a tribute to the Chairman and the Department.

4 Conclusion

It is useful to reflect on the history of the start of computing at the University of Maryland, College Park, during the period from the 1940s through September 1979. Although computing at universities started about 1945, Maryland introduced its first course that covered computing in 1948. This was a major accomplishment since Maryland was not among the first five universities which started computing activities in the 1940s. It is a tribute to Dr. Harry Polachek, one of the pioneers in computing and who, as an Adjunct Associate Professor in the Mathematics Department, introduced computing in his classes. However, it was not until ten years later, February 1958, that a committee was formed under the direction of Professor John Toll, Chair of the Physics Department that recognized the need for a central computer facility for education and research. The Toll Committee's recommendation languished until the late 1960s when a search was made for a Director of a Computer Center.

Although the University was slow to recognize the need for computing, it moved rapidly to support this area. The University developed a strong centralized computer activity, strong research and education programs, and initiated a Department of Computer Science which, within six years attained a ranking of twelfth in the United States as evaluated by the National Academy of Sciences in 1980. I believe that there are three major reasons that led to these achievements:

1. A vision as to what was needed.

2. Strong leadership that assured that their visions would be carried out.

3. University administrators who understood the visions and supported those who carried them out.

There is no doubt that the initial success of computing at Maryland was due primarily to one person – Werner C. Rheinboldt. He started the Computer Science Center, and in the first six months of its existence made significant progress with minimal support. His vision was to build not only a computation center, but a research and education program in computer science. In a short period of time he was involved in the development of a building for the Center, wrote proposals to IBM, NASA, NIH, and the NSF for computer equipment and research support, hired several key faculty, started a research program, and initiated courses in computer science. He made major contributions to the Plan of Organization of the Center and the Department of Computer Science, and to all of the degree programs in computer science. Through all of this he showed leadership by implementing what he had envisioned. Vice-Presidents Hornbake, and Kuhn supported Rheinboldt by finding funds for a new building, and providing a budget and lines for faculty and staff to operate the computation center. In the view of this writer, Rheinboldt, because of all his major contributions, is "The Father of Computer Science at the University of Maryland."

John Menard played a central role as Assistant Director of the Computer Science Center. Rheinboldt delegated much of the operation and management of the computing facilities to Menard who successfully built the infrastructure and administrative processes. After Rheinboldt stepped down as Director, Menard worked with the new Director, Bill Atchison, and subsequently became Director of the Computer Science Center. Menard did a superb job in making the University of Maryland one of the outstanding centers for academic computing. Without his work in building up the Computer Science Center over a 20 year period, the University of Maryland might not be in the enviable state we are now with in computing. This writer considers Menard to be "Mr. Computing" at Maryland.

William F. Atchison played a major role in running the Center from 1966-1972. He had the vision to develop a curriculum for computer science that had never before existed. He worked

hard, with support from the Administration, to try to eliminate the State requirement to approve all computer equipment. Although he was not successful, he was shown to be right when the State finally gave up this impediment and returned autonomy to purchase computer equipment to the University. During this time he helped maintain the Center as a leading organization, was heavily involved in the development of all of the degree programs, and was the Chairman of the Committee that wrote the famous Curriculum '68 Report that set the direction for computer education throughout the world. This writer considers Atchison to be the "Father of Computer Science Education."

Jack Minker set the direction for the Department of Computer Science. He had the vision to make the Department of Computer Science one of the leading research and education departments in this field. He provided an atmosphere within the Department that encouraged and rewarded research and excellence in teaching. Together with the outstanding researchers in the Department, he led the Department in achieving a ranking by the National Academy of Science, in 1980, to be among the top twelve universities in computer science in the United States. The Department was also ranked among the top thirteen universities in the United States and Canada. He was ably supported by Provosts Marchello and Kerr, who were in charge of the MPSE Division. The support from top administrators in the university for the needs of the growing and important Department was not as strong as one might have desired.

Richard Austing led the education aspects of the Department ably and, with Minker, permitted the educational program to flourish in spite of the large enrollments and the loss of faculty.

A number of faculty who were part of the Computer Center contributed significantly to the Department's strong research program. Rheinboldt and Ortega led Maryland to be considered among the top programs in scientific computing and numerical analysis. Azriel Rosenfeld developed a group in image analysis and computer vision that became one of the top three programs in the world. Laveen Kanal developed a world-leading group in pattern recognition. Jack Minker developed a group in the areas of deductive databases and logic programming that was considered among the leading world groups in these areas. Yaohan Chu was one of the leading people in computer organization.

The young faculty in the Department during the period 1973-1979 matured and subsequently became world leading researchers. Vic Basili and Marv Zelkowitz developed one of the finest groups in the world in software engineering. Basili, recipient of the IEEE 2003 Harlan L. Mills Award for his work in software engineering, also served as Chairman of the Department of Computer Science from 1982-1988. Ashok Agrawala made major contributions to computer systems developments. In addition, several of the new hires during the period 1973-1979 made major contributions to the research program. Hanan Samet became the world's leading expert in geometric data structures; Dana Nau became a leading expert in computer planning and game playing by computers; Chuck Rieger won the IJCAI Computers and Thought Award; Pete Stewart became one of the world leading experts in numerical analysis and was awarded the distinguished F.L. Bauer Prize; Dianne O'Leary also became one of the world leading researchers in numerical analysis; John Gannon became well-known for his work in software engineering; and Satish Tripathi became a leading researcher in computer systems. Tripathi served as Chairman of the Department from 1988-1995 and Gannon served as Chairman of the Department of Computer Science from 1995-1999.

The Department of Computer Science's first six years led to solidifying the undergraduate and graduate programs that were started as part of the CSC. A tradition of research excellence was instilled into the junior faculty that led to the Department being ranked highly in 1980. The Department has maintained its excellence in education, research, and service both within the University and externally up to the date of this paper, and continues to be among the top

twelve departments of computer science in the United State[167].

[167]The latest ranking was in the article, "American's Best Graduate Schools," U.S. News & World Report, L.P., 2002, where Maryland ranked 12th, tied with another university.

5 Acknowledgments

This paper would not be possible without the foresight of John Menard who retained documents concerning the start of the Computer Science Center. He also gave liberally of his time to read and to provide recollections of his involvement with Werner Rheinboldt in the start of the Center. John also made available to me his personal collection. I have taken the liberty to copy many documents from his collection and to include them in my personal collection to be donated to the University of Maryland Archives, Hornbake Library. Werner Rheinboldt was kind enough to read several versions of the paper and to provide his comments on them. He also provided material that was not generally available that I incorporated into the paper.

Harry Polachek's daughter, Linda Borkow sent me material concerning the courses that her father taught at Maryland. David Young Jr., with the assistance of David R. Kincaid, supplied me with material on the first programming course taught at Maryland. Yaohan Chu sent me his reminiscences on the first courses that discussed the organization of analog computers and digital computers at Maryland. Earl J. Schweppe provided material for the educational aspects of the Center and his involvement with Curriculum 68. George Lindamood provided material on the start of the Computer Science courses, as did Edward Miller. Thomas B. Day provided me with material on the start of computing at Maryland and his involvement. Richard Hamlet sent me copies of the aperiodic publication PRINTOUT, which were valuable for reconstructing events in the Department from 1974–1979. Laveen Kanal, Jim Ortega, Jim Reggia, Azriel Rosenfeld, and Marvin Zelkowitz read and provided valuable comments on several versions of the paper. Chuck Rieger, after reading one of the later versions of the paper, without being asked, sent me his reminiscences as a faculty member during my tenure as Chair. His reminiscences appear in the Foreword to the paper.

I especially want to thank my wife, Johanna Weinstein, who read the entire report and provided useful and constructive comments on the paper.

Ben Shneiderman kindly made his extensive collections of photographs available to me. Many of the photographs that appear were drawn from his collection. Especial thanks are due to Yaser Yacoob and Jeffrey Foster who helped scan and enhance several of the photographs.

I would also like to thank all of the individuals who I contacted, who are no longer at the University, who supplied information concerning their stay at the University and sent anecdotes concerning their experiences at Maryland. The time-line of faculty could not have been as complete as it is without their inputs. Other current faculty at Maryland who were either in the Center and/or Department during the period covered in this paper also provided useful comments on some sections were: Ashok Agrawala, Vic Basili, and Dianne O'Leary.

Special thanks are due to Jordan Landes, the Department of Computer Science Librarian, who assisted me in many ways. The librarians at the Hornbake Library spent a great deal of time to help me track down information. I am especially indebted to Anne S.K. Turkos, Jennie A. Levine, and Anne's Graduate Student Assistant, Alida Friedrich. It was a pleasure to spend time in the Hornbake Library with such wonderful support.

Appendix 1

Number and Title of Undergraduate Courses Offered in 1973

COURSE NUMBER	COURSE TITLE	CREDITS
CMSC 110	Elementary Algorithmic Analysis	(3)
CMSC 120	Intermediary Algorithmic Analysis	(3)
CMSC 210	Assembly Language Programming	(3)
CMSC 220	Introduction to File Processing	(3)
CMSC 250	Introduction to Discrete Structures	(3)
CMSC 270	Introduction to Numerical Computation	(3)
CMSC 280	Discrete Probability and Computing	(3)
CMSC 325	Information Processing Systems	(3)
CMSC 388	Special Computation Laboratory	(1 or 2)
CMSC 410	Computer Organization	(3)
CMSC 415	Systems Programming	(3)
CMSC 420	Data and Storage Structures	(3)
CMSC 423	Generalized Data Management Systems	(3)
CMSC 425	Computer Center Management	(3)
CMSC 440	Structure of Programming Languages	(3)
CMSC 445	Compiler Writing	(3)
CMSC 450	Elementary Logic and Algorithms	(3)
CMSC 452	Elementary Theory of Computation	(3)
CMSC 455	Elementary Formal Language Theory	(3)
CMSC 460	Computational Methods	(3)
CMSC 470	Introduction to Numerical Analysis	(3)
CMSC 475	Combinatorics and Graph Theory	(3)
CMSC 477	Optimization	(3)
CMSC 480	Simulation and Modeling	(3)
CMSC 498	Special Problems in Computer Science	(1-3)

Appendix 2

CHRONOLOGY OF THE COMPUTER SCIENCE CENTER

AND

DEPARTMENT OF COMPUTER SCIENCE

1940s–1969

DATE	EVENT
Late 1940s/ Early 1950s	Faculty in Physics, Astronomy, Engineering, Institute for Fluid Dynamics and Applied Mathematics, Social Sciences, and Medical School start to use computers in their research.
September 1948	Dr. Harry Polachek, part-time Assoc. Prof. of the Mathematics Dept. teaches first course that discusses the use of computers for calculations and the first course on numerical calculus at Maryland, "Numerical Analysis, Math 135".
January 1955	Asst. Prof. David M. Young, Jr. of the Mathematics Dept. teaches first digital programming course on campus, Math 156, "Programming for High Speed Computers."
September 1957	Adjunct Prof. Yaohan Chu of the Electrical Engineering Dept. teaches first analog computer course on campus, EE 130, "Electronic Analog Computers."
October 1957	President Wilson E. Elkins appoints Prof. John Toll, Chair, Physics Dept. to Chair a committee on the need for a Data Processing or a Computer Center.
January 1958	Adjunct Prof. Yaohan Chu of the Electrical Engineering Dept. teaches first digital computer organization course on campus, EE 131, Electronic Digital Computers.
February 1958	Toll Committee urges the purchase or rental of an IBM 650 and that a "New Program" be requested in the asking budget.
September 30, 1959	President Elkins requests that the Board of Regents provide funds in the 1960/1961 budget to establish a Data Processing Center.
Late 1960	Vice-President R. Lee Hornbake forms Committee to find a Director for a Computer Center. Dr. Monroe Martin appointed committee Chairman.
August 24, 1961	Vice-President Hornbake announces that Dr. Werner C. Rheinboldt has accepted the position of Director of the Computer Center.
November 30, 1961	President Elkins approves name of Computer Science Center (CSC) for the new Center. John Menard originally suggested the name, and Werner Rheinboldt liked the suggestion.
February 1962	Computer Center established as an all university facility for use in all computer-related activities. It had a triple function: 1) to provide necessary centralized high-speed computing service and programming assistance to all research activities of the University; 2) to build and administer an interdisciplinary educational program in the computer sciences; 3) to build and conduct a research program in the computer sciences.
February 1, 1962	Prof. Werner Rheinboldt hired to be Research Professor and First Director of the Computer Science Center. He moves into Room 100 of the Shoemaker Building.
July 1, 1962	Mr. John Menard hired as Associate Director of the Computer Science Center.
September 1962	Construction of the Computer Center building commences.
September 1962	Prof. Werner Rheinboldt starts Numerical Analysis Research Group.
January 3, 1963	Revised proposal submitted to NASA for "Computer-Oriented Research in the Space Related Sciences."
February 1, 1963	Rheinboldt negotiates a special grant with IBM Corporation for $300,000 to permit purchase of an IBM-7090. The Board of Trustees had not provided sufficient funds and without the special grant a considerable scale back would have been necessary.
February 1963	Initial Computer Science Center building completed.

DATE	EVENT
March, 15, 1963	Computer Science Center moves into its new and permanent building.
March 15, 1963	IBM-7090/1401 system installed and operation commences; batch service only – 32K memory – magnetic tapes and card-oriented.
March 1963	Rheinboldt proposal, "Computer-Oriented Research in the Space Related Sciences," awarded by NASA for $2,620,000.00 to the CSC. The grant runs for 10 years and allows Center flexibility to hire personnel.
April 1964	Center computers operated with 2 1/2 shifts, five days a week.
June 1964	Rheinboldt and George Entwisle, M.D. of the Medical School proposal, to the NSF, "Health Science Computer Facility," for $296,883 awarded.
September 3, 1964	Rheinboldt proposal to NSF, "Expansion of Computing Facilities," approved for $200,000. Equipment grant permits CSC to expand IBM-7090 to an IBM 7094 and to pay for the rental of an additional input/output computer, an IBM 1460.
September, 1964	Upgrade of IBM 7090 to IBM 7094.
October, 1964	NSF grant of June 1964 permits initiation of the Health Sciences Computer Center (HSCC), Baltimore campus, a branch of the CSC at College Park.
October, 1964	Research Associate Prof. Azriel Rosenfeld hired - forms Picture Processing Research Group.
March, 1965	Computer Science Center Building completed, doubling the floor space.
March 25, 1965	Vice-President Hornbake appoints Dr. Monroe Martin as Chairman of the Search Committee for the Director of the CSC to replace Dr. Rheinboldt who resigns to return to research and teaching.
September 1965	Computer Science Center begins to offer six basic credit courses in computer science, Introductory Algorithmic Methods; Elementary Algorithmic Methods; Numerical Calculus Laboratory I; Numerical Calculus Laboratory II; Language and Structure of Computers; and Special Computational Laboratory.
September 1965	Prof. Rheinboldt resigns as CSC Director effective Sept. 1966 to return to research and teaching. John Menard appointed Acting Director of CSC.
October 1965	Computer Science Advisory Committee (CSAC), with M.H. Martin, Director of the Institute for Fluid Dynamics and Applied Mathematics, as Chair, formed to consider starting formal degrees in computer science and computer systems engineering.
December 1965	IBM 360/30 system added.
July 1966	Operating schedule expanded to 24 hours/day, 7 days/week.
September 1966	Prof. William F. Atchison hired as Director of Computer Science Center to replace Prof. Werner Rheinboldt who returned full time to teaching and research.
October 1966	Task Force for Design of an Interdisciplinary Graduate Program in Computer Science, formed by the CSAC recommends a Master of Science computer science program to commence September 1967 offered through the CSC.
Spring 1967	Computer Science Center building consisting of 4 floors is completed.
September 1967	Master of Science Program in computer sciences commences as part of the CSC.
September 1967	Dr. Jack Minker hired as Visiting Member joins permanent faculty, as Assoc. Prof., Sept. 1968 and starts research group in Question-Answering Systems, Databases, and Information Retrieval.
October 1967	UNIVAC 1108 installed to replace IBM 360/30; an additional IBM 1401 is added.
October 18, 1967	Faculty Plan of Organization for CSC is adopted and approved by the University Senate in approximately April 1968.

DATE	EVENT
Early 1968	UNIVAC 1108 Exec 8 operating system, implemented by CSC staff provides remote job entry (RJE) and conversational timesharing (ability to connect teletypes and to obtain an on-line capability with the machine).
January 28, 1968	Maryland House of Delegates introduces Joint Resolution 3 to study possibility of establishing a central Data Processing Center for all departments and agencies of the State of Maryland and the University of Maryland.
March 1968	ACM Curriculum '68 Report published by the ACM specifies first formal curriculum for computer science. Maryland faculty make major contributions to report: Prof. W.F. Atchison, Committee Chair, Assoc. Prof. Earl Schweppe, Committee Secretary, and Prof. W.C. Rheinboldt, Committee Member, participated in writing the report.
Late 1968 Early 1969	Computer Science Corporation awarded a contract to study Automatic Data Processing in the State of Maryland and the University of Maryland.
February 26, 1969	CSC submits "Proposal for a Ph.D. Program in Computer Science," to Faculty Senate to request approval to commence September 1969.
June 7, 1969	Mr. J. Gary Augustson first student to complete all requirements for the M.S. degree in computer science. His M.S. thesis, "Experiments with Graph Theoretical Clustering Techniques," was directed by Prof. Jack Minker.
August 1969	Computer Science Corporation Report, "State of Maryland Automatic Data Processing Survey Report," recommends centralized organization to purchase equipment at the State level.
September 1969	CSC initiates a Ph.D. program in Computer Science.
1969	UNIVAC 1108 converted to dual processing system with 262K memory.
Late 1969 Early 1970	State of Maryland sets up Automatic Data Processing organization and appoints an administrator. University of Maryland loses autonomy to purchase computer equipment. Autonomy regained in 1985.
Fall 1970	Health Sciences Computer Center administratively transferred to UMD at Baltimore (UMAB).
1971	Chancellor Charles J. Bishop appoints Vice-Chancellor Thomas B. Day to be Chair of a committee to reorganize the College Park Campus.
1971-1972	EXEC-8 command language designed and developed by the UOM CSC was accepted by UNIVAC.
January 4, 1972	Day committee submits "Report to the College Park Campus Senate from Organization Committee." Report recommends separation of academic functions from the Computer Science Center to form a Department of Computer Science as part of a new Division of Mathematics Physical Science and Engineering.
August 1972	PDP-11/45 installed.
March 12, 1973	Vice-Chancellor for Academic Affairs, George Callcott appoints "the Ad Hoc Committee for the study of the Establishment of a Separate Department of Computer Science," consisting of Dr. R. Austing, Mr. J. Menard, Dr. J. Minker, Dr. W. Rheinboldt, and Dr. W. Atchison, Chairman.
April 1973	University announces new organization of faculties. Department of Computer Science is formed and is part of the Mathematical and Physical Science and Engineering (MPSE) Division. Prof. Joseph Marchello is appointed Acting Provost of the MPSE Division and shortly thereafter as Provost.
April 1973	Installation of UNIVAC 1106 to replace the IBM 7094.

DATE	EVENT
April 16, 1973	Vice-Chancellor for Academic Affairs, George Callcott approves "Report of the Ad Hoc Committee for the study of "the Establishment of a Separate Department of Computer Science," submitted April 12, 1973.
May 3, 1973	Faculty Senate approves B.S. degree in Computer Science to commence September 1973.
May 1973	Plan of Organization and Bylaws of the CSD drafted in April 1973 by Professors Minker and Rheinboldt is reviewed, modified slightly, and approved by faculty.
June 23, 1973	Board of Regents Approves establishment of a Department of Computer Science.
1973	William F. Atchison receives ACM Distinguished Service Award in appreciation for his work in curriculum development in computer science.
July 1, 1973	Computer Science Department commences at Maryland. Education program of the CSC is transferred to the newly established CSD within the MPSE Division.
August 1, 1973	John Menard appointed Director of the Computer Science Center.
August 1973	Daniel H. Fishman becomes first student to complete all requirements for the Ph.D. degree.
September 1, 1973	Prof. William F. Atchison appointed Acting Chairman, Computer Science Department.
December 22, 1973	Daniel H. Fishman and David Milgram granted first Ph.D. degrees in computer science. Dr. Fishman's thesis, "Experiments with a Resolution-Based Deductive Question-Answering System and a Proposed Clause Representation for Parallel Search," was directed by Prof. Jack Minker. Dr. Milgram's thesis, "Web Automata," was directed by Prof. Azriel Rosenfeld,
July 1, 1974	Prof. Jack Minker appointed first permanent Chairman, Computer Science Department.
September 1, 1974	Bachelor of Science Degree program, authorized in 1973, commences.
September, 1974	Minker initiates informal newsletter, PRINTOUT. to be published aperiodically, and assigns Dr. Richard Hamlet to be Editor-in-Chief.
January 1975	Department forms undergraduate honors program in computer science. Honors students need to maintain a 3.0 overall GPA, and a 3.5 GPA in computer science.
Spring 1975	William F. Atchison receives International Federation of Information Sciences (IFIPS) in appreciation for service as Chair WG 3.1 section, 1968-1974 and the Chester Morrill Memorial Award from the Chesapeake Division of the Association for System Management for 1975.
September, 1975	Minker initiates Annual Report publication to review accomplishments in the Department each year.
Spring 1976	Professor Yaohan Chu founds the Chinese Language Computer Society (CLCS) and becomes the first President of the CLCS.
July 1978	Professor Werner H. Rheinboldt leaves the University of Maryland to accept Andrew Mellon Professor of Mathematics at the University of Pittsburgh.
December 1978	Department of Computer Science Internal and External Review Committees submit reports which commend the faculty and the chairman of the Department in their efforts to develop a strong research-oriented department and note the need for more support from the University.
Spring 1979	NSF awards CSD grant to purchase a medium-sized computer, the VAX 11/780 for research activities.
July 1979	Professor Jack Minker resigns as Chairman to return to research and teaching.

Appendix 3

COMPUTER SCIENCE CENTER

FACULTY TIME-LINE 1962–1973

Year 1962, Computer Science Center

- Werner C. Rheinboldt, Scientific Computing,
  - Ph.D.: University of Freiburg, 1955
  - Research Assoc. Professor and Director Computer Science Center, February 1962-1963,
  - Research Professor and Director Computer Science Center, and Research Professor Inst. Fluid Dynamics, 1963-1965,
  - Research Professor Inst. Fluid Dynamics, 1963-1978,
  - Research Professor of CS and Applied Mathematics, 1968-1978
  - Andrew W. Mellon Professor of Mathematics, University of Pittsburgh, 1978-2000
  - Andrew W. Mellon Professor Emeritus, University of Pittsburgh, 2000-
  - Vice President for Publications, Society for Industrial and Applied Mathematics, 1976
  - President-Elect, Society for Industrial and Applied Mathematics, 1976
  - President, Society for Industrial and Applied Mathematics, 1977-1978
  - Fellow, American Association for the Advancement of Science, 1984
  - Chairman Board of Trustees, Society for Industrial and Applied Mathematics, 1985-1990
  - Special Creativity Award in Computer Science, National Science Foundation, 1986
  - Alexander von Humboldt Senior Distinguished Scientist Award, 1988 A. von Humboldt Foundation, Germany,
  - Award for Outstanding Contributions to Computer Science, Association for Computing Machinery, 1990
  - University of Pittsburgh, The President's Distinguished Senior Research Award, 1991
- John P. Menard, Scientific Computation,
  - BA: St. Michael's College, 1954
  - Assistant Director Computer Science Center, July 1962–1964
  - Associate Director Computer Science Center, July 1964–1973
  - Acting Director Computer Science Center, July 1965–1966
  - Instructor, Computer Science 1965–1977
  - Director, Computer Science Center 1973–1982
  - Administrative Director to the Provost/Dean, MPSE/CMPS, 1982–1994
  - Assistant to the President, 1985–1994
  - Retired 1994
- Charles J. Mesztenyi, Scientific Computation
  - M.S., Mathematics, Syracuse University, 1962
  - Senior Research Programmer, 1962-199?

- Abraham Sinkov$^{(*)}$,[168] Cryptology
  - Ph.D.: George Washington University, 1933
  - Mathematical Consultant (Part Time), and Assoc Prof Mathematics, 1962-1964
  - Inducted into the National Security Administration "Hall of Honor", 1999 (see URL: www.nsa.cov/honor/sinkov.html)
- Earl J. Schweppe, Data Structures
  - Ph.D.: University of Illinois, 1955
  - Lecturer, 1962-1963
  - Research Assistant Professor, 1963-1965
  - Associate Professor, 1965-1968 (Accepted Position as Chair of Department of Computer Science, University of Kansas)
- James D. Chappell,
  - M.S.: Columbia University, 1954
  - Instructor, 1962-19??

Year 1963, Computer Science Center

- Richard H. Austing, Numerical Analysis, Computer Science Education
  - Ph.D.: Catholic University of America, 1963
  - Research Assistant Professor 1963-1965
  - Assistant Professor 1965-1973
  - Associate Professor, 1973-1994
  - Acting Chairman, Department of Computer Science, 1976(July)-1977(Jan) 1980(July)-1981(Jan); 1981-1982
  - Assistant Dean, University of Maryland University College (UMUC), 1994-1998
  - Retired October, 1998
  - ACM Outstanding Contribution Award 1983
  - Founding Fellow, ACM, 1994
  - ACM Special Interest Group on Computer Science Education (SIGCSE) Award for Lifetime Contributions, 1997
  - Co-editor, Curriculum '78: Recommendations for the Undergraduate Program in Computer Science, A Report of the ACM Curriculum Committee on Computer Science
  - Co-editor, Recommendations for Master's Level Programs in Computer Science. A Report of the ACM Curriculum Committee on Computer Science
  - Co-editor, A Model Curriculum for Doctoral-Level Programs in Health Computing, A Report of the ACM Committee in Curriculum for Health Computing Education
  - Co-editor, Recommendations and Guidelines for an Associate Level Degree Program in Computer Programming, A Report of the ACM Committee on Curriculum for Community and Junior Colleges
  - Co-editor, Computing Curricula Guidelines for Associate-Degree Programs: Computing for Other Disciplines. A report of the Two-Year College Computing Curricula Task Force. The Association for Computing Machinery (ACM)

[168] Dr. Sinkov retired in 1962 as Director of Research at the National Security Agency. He had also lectured in the Mathematics Department, and taught the course, Math 156, Programming for High Speed Computers from 1959-1964

  - Co-editor, Computing Curricula 2001 Computer Science. Final Report. The Joint Task Force on Computing Curricula IEEE Society and ACM.
  - Assistant Dean, University of Maryland University College (UMUC), 1994-1998
  - Retired October, 1998
- George E. Lindamood,
  - MA: University of Maryland, 1964
  - Research Programmer, 1963-1965
  - Instructor, 1965-1971
- Azriel Rosenfeld$^{(**)}$, Computer Vision
  - DHL: (Rabbinic Literature), Yeshiva University, 1955
  - Ph.D.: (Mathematics), Columbia University, 1957
  - Research Associate Professor (Part Time), 1963-1964
  - Research Associate Professor, 1964-1966
  - Research Professor, 1966-1983
  - Research Professor and Director, Center for Automation Research, 1983–2001
  - Director, Center for Automation Research, 1983-2001
  - Distinguished University Professor, 1995-2001; Emeritus, 2001-
  - Bernard Revel Memorial Award in Arts and Sciences, Yeshiva College Alumni Association, 1964
  - Fellow, Institute of Electrical and Electronics Engineers, 1972; Life Fellow, 1996
  - Dr. Tech. (hon.), Linköping University, Sweden, 1980
  - President, International Association for Pattern Recognition, 1980-2
  - Corresponding Member, National Academy of Engineering of Mexico, 1982
  - Fulbright grant (for research at Hebrew University and Bar-Ilan University, Israel during August-October 1982); awarded March 22, 1982, declined May 27, 1982
  - Emanuel Piore Award, Institute of Electrical and Electronics Engineers, 1985
  - IEEE Computer Society Meritorious Service Award, 1986
  - President's Award, SME Machine Vision Association, 1987
  - Fellow, Washington Academy of Sciences, 1988
  - Scientific Achievement Award, Washington Academy of Sciences, 1988
  - K.S. Fu Award, International Association for Pattern Recognition, 1988
  - Foreign Member, National Academy of Science of the German Democratic Republic, 1988–1992
  - Founding Fellow, American Association for Artificial Intelligence, 1990
  - IEEE Standards Medallion, 1990
  - Imager of the Year Award, Electronic Imaging International, 1991
  - Founding Fellow, Association for Computing Machinery, 1994
  - Founding Fellow, International Association for Pattern Recognition, 1994.
  - Dr. Tech. (hon.), Oulu University, Finland, 1994
  - Harry Goode Memorial Award, IEEE Computer Society, 1995
  - Norbert Wiener Award, IEEE Systems, Man, and Cybernetics Society, 1995
  - K. Bowyer and N. Ahuja, eds. *Advances in Image Understanding—A Festschrift for Azriel Rosenfeld*, IEEE Computer Society Press, Los Alamitos, CA, 1996

- Information Science Award, Association for Intelligent Machinery, 1998
- Third Millenium Medal, IEEE, 2000
- Dr. Humane Letters (hon.), Yeshiva University, New York, NY, 2000
- L.S. Davis, ed., *Foundations of Image Understanding* [*A Festschrift for Azriel Rosenfeld*], Kluwer, Boston, 2001.
- Computer Vision and Pattern Recognition Lifetime Achievement Award, IEEE Computer Society Distinguished Service Award, 2001.

Year 1964, Computer Science Center

- James M. Ortega, Numerical Analysis
  - Ph.D.: Stanford University, 1962
  - Research Assistant Professor, 1964-1966
  - Associate Professor (Jointly with Inst. Fluid Dynamics and Applied Mathematics) 1966-1969
  - Professor (Jointly with Inst. Fluid Dynamics and Applied Mathematics and the Department of Mathematics), 1969-1973
  - Director and Founder, Institute for Computer Applications in Science and Engineering (ICASE), 1973-1977
  - Professor and Head, Mathematics, North Carolina State, 1977-1979
  - Charles Henderson Professor, University of Virginia, 1979-1998
  - Chair, Applied Mathematics and Computer Science, 1979-1984
  - Associate Dean, Engineering, 1980-1982
  - Chair, Applied Mathematics, 1984-1989
  - Director, Institute for Parallel Computation, 1990-1993
  - Chair, Computer Science, 1993-1996
  - Professor Emeritus, University of Virginia, 1998-
- Chan-Mo Park, Applications
  - Ph.D.: University of Maryland, 1969
  - Research Programmer, 1964-1968
  - Post Doctoral Fellow, 1968-1969
  - Assistant Professor, 1969-1972
  - Visiting Lecturer (part-time), 1976-1989
  - Dean, Graduate School for Information Technology, 1991-1994, Pohang Univ. of Sci. & Tech. (POSTECH) May 2000-
  - Dean, Graduate School and Professor, Computer Science & Engineering, Pohang Univ. of Sci. & Tech. (POSTECH) May 2000-
  - Acting President, POSTECH, October 15, 2002-
- Robert G. Glasser$^{(*)}$, Scientific Computation
  - Ph.D.: University of Chicago, 1954
  - Lecturer, 1957-1961, Physics Department
  - Visiting Professor (part time), 1961-1965, Physics Department
  - Assoc. Professor (Joint with Physics Department), 1965-1973
  - Professor, 1973-1975, Joint with Physics Department

- Edmund M. Glaser, Physiology,
  - Ph.D.: Johns Hopkins University, 1960
  - Research Associate Professor (Joint with Phsyiology, University of Maryland, Baltimore), 1964-1973
- John L. Pfaltz, Discrete Mathematics
  - Ph.D.: University of Maryland, 1969
  - Senior Research Programmer, 1964-1968
  - Assistant Professor, U. Maryland, 1968-1970

Year 1965, Computer Science Center

- James F. Williams,
  - MA: University of Maryland, 1965
  - Instructor, 1964?-197?
- James C. Owings, Theory of Computing,
  - Ph.D.: Cornell, 1966
  - Assistant Professor, 1966-1973 (Joint with Mathematics)
- David Lorge Parnas, Computer Systems
  - Ph.D.: Carnegie Institute of Technology, 1965
  - Assistant Professor, 1965-1966
- Abraham Tal, Numerical Analysis,
  - Ph.D.: Carnegie Institute of Technology, 1965
  - Visiting Research Assistant Professor, 1965-1967
- James S. Vandergraft$^{(*)}$, Numerical Analysis,
  - Ph.D.: University of Maryland, 1966
  - Research Associate, 1965-1966
  - Assistant Professor, 1966-1973
  - Associate Professor, 1973-1975 or 1976

Year 1966, Computer Science Center

- William F. Atchison$^{(*)}$, Computer Science Education, Computers and Society
  - Ph.D.: University of Illinois at Urbana/Champaigne, 1943
  - Professor and Director Computer Science Center, 1966-1973
  - Professor, Computer Science, 1966-1988,
  - Acting Chair, Department of Computer Science, 1973-1974
  - Professor Emeritus, 1988-1998
  - Chairman, ACM Curriculum 68 Report
  - ACM Distinguished Service Award, 1973
  - IFIP 1974 Special Award in Appreciation for Services as Chairman of WG 3.1 1968-1974
  - Chester Morrill Memorial Award from the Chesapeake Division of the Association for Systems Management, 1975

  - ACM Special Interest Group on Computer Science Education (SIGCSE) Award for Outstanding Contributions to CS Education, 1981
  - Distinguished Alumni Award from Georgetown College for work in Computer Science and Mathematics, 1982
  - Founding Fellow, Association for Computing Machinery, 1994
- Yaohan Chu$^{(**)}$, Computer Systems,
  - ScD: Massachusetts Institute of Technology, 1953
  - Lecturer, Electrical Engineering, 1956-1966
  - Professor, (Joint with Electrical Engineering), 1966-1990
  - Professor Emeritus, 1990
  - President, Chinese Language Computer Society, 1976-1986
  - Meritorious Service Award, Chinese Language Computer Society, 1988
  - Guest Editor, Issue on "Hardware Description Language," IEEE Computer Society, December 1974
  - Guest Editor, Issue on "High-level Architecture," IEEE Computer Society, July 1981
  - Guest Editor, Issue on "Chinese/Kanji Text and Data Processing" IEEE Computer Society, Jan. 1985
  - Lecturer, IEEE Distinguished Visitors Program, 19??
  - Lecturer, ACM Lecturer Program, 19??
  - US Representative, IFIP Technical Committee 10 on Digital System Design
  - US Patent No. 2,996,137, "Automatic Radar Guided and Computer Controlled Vehicles
  - US Patent No. 2,187,227, "Packing Technique for Microelectronic Circuits"
  - US Patent No. 3,230,355, "Matrix Logic Computer"
  - US Patent No. 3,251,041, "Computer Memory System"

Year 1967, Computer Science Center

- Harold P. Edmundson$^{(**)}$, Theory of Computing,
  - Ph.D.: University of California at Los Angeles, 1953
  - Professor, Joint with Mathematics Department, 1967-1991
  - Professor, Joint with Mathematics Department, Emeritus, 1991-
- Laurence Heilprin$^{(*)}$, Library Science
  - Ph.D.: Harvard University, 1941
  - Professor 1967-1973, Joint with Library Science
- Jack Minker**, Database Systems and Artificial Intelligence,
  - Ph.D.: University of Pennsylvania, 1959
  - Visiting Member, 1967-1968,
  - Assoc Professor, 1968-1971
  - Professor 1971-1998
  - First Chair Department of Computer Science 1974-1979
  - Vice-Chairman, Computer Science, Committee of Concerned Scientists (CCS¿ 1974-
  - ACM Vice-Chairman, Committee on Scientific Freedom and Human Rights (CSFHR) 19??-1989

  - ACM Outstanding Contribution Award, 1985
  - Fellow, American Association for the Advancement of Science (AAAS), 1989
  - Founding Fellow, American Association for Artificial Intelligence (AAAI), 1990
  - Fellow, Institute for Electrical and Electronic Engineers (IEEE), 1991
  - Founding Fellow, Association for Computing Machinery (ACM), 1993
  - University of Maryland Presidential Medal, 1996
  - Distinguished Scholar-Teacher Award, University of Maryland, 1997-1998
  - Founding Editor-in-Chief, the Journal of the **Theory and Practice of Logic Programming (TPLP)**, 2000
  - Inducted as Fellow Academy for Excellence in Education and Teaching (AETL), 2002
- Victor B. Schneider, Programming Languages,
  - Ph.D.: Northwestern University, 1966
  - Assistant Professor, 1967-1970

Year 1969, Computer Science Center

- Edward S. Deutsch, Picture Processing
  - Ph.D.: University of London, 1969
  - Visiting Assistant Professor, 1969-1974 ???
- Eliott D. Feldman, Theory of Computing
  - Ph.D.: Stevens Institute of Technology, 1969
  - Assistant Professor, 1969-1974
- Patrick E. Hagerty, Computer Systems
  - Ph.D.: Syracuse University, 1969
  - Assistant Professor & Assistant Director for Systems, 1969-1974
- Michael Hanani. Programming Languages
  - Ph.D.: Northwestern University, 1969
  - Assistant Professor
- Robert G. Voigt, Numerical Analysis
  - Ph.D.: University of Maryland, 1969
  - Visiting Asst Prof, 1969-1971

Year 1970, Computer Science Center

- Victor R. Basili, Programming Languages, Software Engineering
  - Ph.D.: University of Texas at Austin, January 1970
  - Asst Professor 1970-1975,
  - Assoc Professor 1975-1982,
  - Professor 1982-,
  - CS Dept Chair: 1982-1988,
  - Executive Director, Fraunhofer Center 1998-
  - IEEE Computer Society Outstanding Paper Award (with R. Reiter, Jr.), IEEE Transactions on Software Engineering, May 1981

- IEEE Meritorious Service Certificate, IEEE Computer Society, October 9, 1985
- NASA Group Achievement Award - NASA/Gamma Ray Observatory (GRO) Dynamics Simulator Ada Experiment Team, May 1989
- Productivity Improvement and Quality Enhancement Award, NASA/GSFC, the "Cleanroom" Software Team, June 14, 1990
- Fellow, Institute for Electrical and Electronic Engineers (IEEE), 1990
- ASM Award, October 1991
- IEEE Meritorious Service Certificate, 1987-1992
- Second Distinguished Alumnus Award, Department of Computer Science, University of Texas at Austin, Austin, TX, 1993
- CRA - Computing Research Association Honor Award Plaque, August 10, 1993.
- IEEE Computer Society Award for Software Process Achievement, August 24, 1994
- NASA Group Achievement Award, May 30, 1996.
- IEEE Computer Society, Society of Golden Core, June, 1996
- Washington Academy of Sciences, for Outstanding Contributions to Mathematics and Computer Science, May 14, 1997
- Fellow, Association for Computing Machinery (ACM), 1997
- Outstanding Research Award, 2000, ACM SIGSOFT (Special Interest Group on Software Engineering)
- IEEE Computer Society 2003 Harlan D. Mills Award

• Laveen Kanal, Pattern Recognition
- Ph.D.: University of Pennsylvania, 1960
- Professor, 1970-1996
- Professor Emeritus, 1996-
- Fellow, American Association for the Advancement of Science (AAAS), 1972
- Fellow, Institute for Electrical and Electronic Engineers (IEEE), 1972
- Fellow, International Association of Pattern Recognition (IAPR), 1994
- Fellow, American Association for Artificial Intelligence (AAAI), 1992
- King-Sun Fu award, IAPR, 1992
- Contributions to Science Award, Sigma Xi UMD Chapter, 1996

• W. Michael Lay, Systems
- Ph.D.: Ohio State University, 1972
- Instructor 1970-1972
- Asst Prof, 1972-1976,

• Michael McClellan, Symbolic Computation
- Ph.D.: University of Wisconsin, 1971
- Instructor, 1970-1971
- Asst Prof, 1971-1977,

• Martin Milgram, Graph Theory
- B.S., Brooklyn College, 1953
- Lecturer, 1970-1972

Year 1971, Computer Science Center

- Ashok Agrawala, Computer Systems
  - Ph.D.: Harvard University, 1970
  - Asst Professor, 1971-1976,
  - Assoc Professor, 1976-1982,
  - Professor 1982-,
  - Fellow, Institute for Electrical and Electronic Engineers (IEEE), 1991
  - Outstanding Invention of Year 2000, University of Maryland, 2001
  - Director, Maryland Information and Network Dynamics Laboratory (MIND), 2001-
- Ronald M. Baecker, Computer Animation
  - Ph.D.: Massachusetts Institute of Technology, 1969
  - Visiting Assistant Professor, 1971-1972
- Richard G. Hamlet, Theory of Computing, Programming Languages, Software Engineering
  - Ph.D.: University of Washington, 1971
  - Asst Professor, 1971-1977
  - Assoc Professor, 1977-1984
- Robert Noonan, Programming Languages
  - Ph.D.: Purdue University, 1972
  - Asst Prof, 1971-1977,
- Marvin V. Zelkowitz, Software Engineering,
  - Ph.D.: Cornell University, 1971
  - Asst Professor, 1971-1975
  - Assoc Professor, 1975-1990
  - Professor, 1990-
  - Co-Director Fraunhofer Institute 1998-2002
  - Golden Core Member, Computer Society, 1996
  - Fellow, Institute for Electrical and Electronic Engineers (IEEE), 1997
  - Distinguished Service Award 2000, ACM SIGSOFT (Special Interest Group on Software Engineering), 2000
  - Chief Scientist, Fraunhofer Center, 2002-

Year 1972, Computer Science Center

- George J. Fix*, Numerical Analysis, Numerical Solution of Partial Differential Equations
  - Ph.D.: Applied Mathematics, Harvard, 1968
  - Associate Professor, joint with Institute for Fluid Dynamics and Applied Mathematics, 1972-1973
- David Milgram, Picture Processing
  - Ph.D.: University of Maryland, 1973
  - Instructor, 1970-1973
- David L. Mills, Computer Systems
  - Ph.D.: University of Michigan, 1971

  - Asst Prof, 1972-1977,
- Roger Nagel, Picture Processing
  - Ph.D.: University of Maryland, 1976
  - Instructor, 1970-1976
- Gordon VanderBrug, Instructor
  - Ph.D.: University of Maryland, 1977
  - Instructor, 1971-1976

Appendix 4

DEPARTMENT OF COMPUTER SCIENCE

FACULTY TIME-LINE 1973–2002

Year 1973, Department of Computer Science

- Matthew Hecht, Theory of Computing
  - Ph.D.: Princeton University, 1973
  - Asst Prof, 1973-1977

Year 1974, Department of Computer Science

- Charles J. Rieger, III, Artificial Intelligence
  - Ph.D.: Stanford University, 1974
  - Asst Professor 1974–1979
  - Assoc Professor 1979–1982
  - Adjunct Professor 2003–
  - Computers and Thought Award of the AAAI, 1975
  - Visiting Assoc Professor, MIT AI Laboratory, Spring semester 1976
  - Co-founder, Chairman, and CTO, SCION Corporation, 1977–1984
  - Co-founder and CTO, Vidar Systems Corporation, 1984–1987
  - Co-counder and CEO, Image Machines Corporation, 1987–1999
  - Co-founder and CTO, eQuorum Corporation, 1999–
- Gilbert W. (Pete) Stewart, Scientific Computing
  - Ph.D.: University of Tennessee, 1968
  - Assoc Professor 1974-1976
  - Professor 1976-
  - F.L. Bauer Prize, 1998

Year 1975, Department of Computer Science

- John D. Gannon$^{(*)}$, Software Engineering
  - Ph.D.: University of Toronto, 1975
  - Asst Professor 1975-1980,
  - Assoc Professor 1980-1988
  - Professor 1988-1999
  - Chair, Department of Computer Science 1995-1999
  - Distinguished Scholar-Teacher, University of Maryland, 1993-1994
- Virgil D. Gligor, Computer Systems
  - Ph.D.: University of California at Berkeley, 1975
  - Asst Prof, 1975-1980
- Chul Kim, Theory of Computing
  - Ph.D.: Pennsylvania State University, 1975
  - Asst Professor 1975-1980,

- Harlan D. Mills(∗), Software Engineering
  - Ph.D.: Iowa State University, 1952
  - Visiting Professor (Part Time) 1975-1987
  - Adjunct Professor, 1987-1995
  - Chairman, NSF Computer Science Research Panel on Software Methodology, 1974-77
  - the Chairman of the First National Conference on Software Engineering, 1975
  - Editor for IEEE Transactions on Software Engineering, 1975-81
  - U.S. Representative for Software at the IFIP Congress, 1977
  - Governor of the IEEE Computer Society, 1980-83
  - Chairman for IEEE Fall CompCon, 1981
  - Chairman, Computer Science Panel, U.S. Air Force Scientific Advisory Board, 1986
  - Deceased January 8, 1996
- Hanan Samet, Visual and Geometric Computing
  - Ph.D.: Stanford University, 1975
  - Asst Professor 1975-1980,
  - Assoc Professor 1980-1986,
  - Professor 1986-
  - Fellow, Institute for Electrical and Electronic Engineers (IEEE), 1990
  - Fellow, Association for Computing Machinery (ACM), 1995
  - Fellow, International Association of Pattern Recognition (IAPR), 1996

Year 1976, Department of Computer Science

- C. Dianne Martin
  - M.S.: Computer Science, University of Maryland, l971
  - EdD The George Washington University, l987
  - Acting Director, Education Office l976-77
  - Lecturer 1976-1983
- Pamela Zave, Programming Languages
  - Ph.D.: University of Wisconsin, 1976
  - Asst Prof, 1976-1981

Year 1977, Department of Computer Science

- John Privitera, Programming Languages
  - M.S.: Stevens Institute of Technology, 1972
  - Ph.D.: Cornell University, 1981
  - Instructor 1977-1980

Year 1978, Department of Computer Science

- Lawrence Dowdy, Computer Performance Evaluation
  - Ph.D.: Duke University, 1977
  - Asst Prof, 1978-1981

- Rachelle S. Heller, Computer Science Education and Advising
  - M.S.: University of Maryland, 1972
  - Ph.D.: University of Maryland, 1985
  - Lecturer, 1978-1985
  - Award of Excellence, Society of Technical Communication, 1986 1987
  - Recognition of Service Award. ACM. 1990.
  - Leo Schubert Award for Excellence in College Teaching, Washington Academy of Science, June 1994.
  - Professor of the Year for 1995-96, Engineer's Council, George Washington University, June, 1996
  - Adam Chair Visiting Professor, United States Military Academy, Spring 2001
- Barry Jacobs, Database Systems,
  - Ph.D.: Courant Institute, 1975
  - Asst Prof, 1978-1984
- Dianne O'Leary, Numerical Analysis and Scientific Computing
  - Ph.D.: Stanford University, 1976
  - Asst Professor 1978-1982, Joint with Institute for Physical Science and Technology 1978-1981
  - Assoc Professor 1982-1988, Joint with the Institute for Advanced Computer Studies 1985-1988
  - Professor, 1988-, Joint with the Institute for Advanced Computer Studies 1988-
  - Distinguished Alumna Award, Purdue University 1993
- Satish K. Tripathi, Computer Systems
  - Ph.D.: University of Toronto, 1979
  - Lecturer 1978-1979
  - Asst Professor 1979-1983
  - Assoc Professor 1983-1988
  - Professor 1988-1999
  - Chair, Department of Computer Science, 1988-1995
  - Fellow, IEEE 1997
  - Fellow, AAAS 1997
  - Dean of the College of Engineering at the University of California, 1999–

Year 1979, Department of Computer Science

- Michael Brodie, Database Systems,
  - Ph.D.: University of Toronto, 1978
  - Asst Professor, Information Systems Management 1979
  - Asst Professor 1979-1984
- John Grant, Database Systems,
  - Ph.D.: Courant Institute, 1970
  - Adjunct Assoc Professor 1979-1986
  - Adjunct Professor 1986-

- Dana Nau, Artificial Intelligence
  - Ph.D.: Duke University 1979
  - Asst Professor 1979-1984,
  - Assoc Professor 1984-1994,
  - Professor 1994-
  - National Science Foundation Presidential Young Investigator Award, 1984
  - Fellow, American Association for Artificial Intelligence (AAAI), 1996
- Ben A. Shneiderman, Human Computer Interaction
  - Ph.D.: State University of New York at Stonybrook, 1973
  - Assoc. Professor 1979-1989
  - Professor 1989-,
  - Honorary Doctorate of Science, University of Guelph, Canada, 1995
  - Director, Human-Computer Interaction Laboratory, UMIACS 1983-2000
  - Fellow, Association for Computing Machinery (ACM), 1997
  - Fellow, American Association for the Advancement of Science (AAAS), 2001
  - Making a Difference Award, 2001 ACM SIGCAS (Special Interest Group on Computers and Society)
  - Lifetime Achievement Award, 2001 ACM SIGCHI (Special Interest Group on Human Computer Interaction)
- Mark Weiser$^{(*)}$, Computer Systems
  - Ph.D.: University of Michigan, 1979
  - Asst Professor 1979-1984,
  - Assoc Professor 1984-1987
- Raymond T. Yeh, Theory of Computing
  - Ph.D.: University of Illinois, 1966
  - Professor and Chair, Department of Computer Science, 1979-1981

Year 1981, Department of Computer Science

- Larry S. Davis, Computer Vision and High Performance computing
  - Ph.D.: University of Maryland, 1976
  - Assoc Professor 1981-1986
  - Professor 1986-,
  - Assoc Chair CS 1982-1985
  - Head, Computer Vision Lab, CfAR 1985-1991
  - Acting Director, UMIACS 1985-1987
  - Director, UMIACS 1987-1994
  - Acting Chair, Computer Science, 1999-2000
  - Chair Department of Computer Science, 2000-
  - Fellow Institute for Electrical and Electronic Engineers (IEEE), 1995
  - Fellow, International Association of Pattern Recognition (IAPR), 2002
- Mohamed Y. Elsanadidi, Computer Systems
  - Ph.D.: University of California at Los Angeles, 1981

- Asst Professor 1981-1983

- Nicholas Roussopoulos, Database Systems
  - Ph.D.: University of Toronto, 1977
  - Asst Professor 1981-1985
  - Assoc Professor 1985-1991
  - Professor, 1991-,
  - Member of the Space Science Board Committee on Data Management and Computation, 1985-1988.
  - Member of the Advisory Board of the Air Force VSHIC program on "Engineering Information Systems," 1986-1989.
  - Guest Editor of the special issue of IEEE Computer Magazine, on "Future Directions on Database Systems-Architectures for Information Engineering," December 1986.
  - Elected Member of the Board Trustees of the VLDB Endowment 1990-1996.
  - Guest Co-editor of the special issue of Information Systems, on "Knowledge Engineering," 1990.
  - Recipient of the "Best Paper Award," IEE/CS 14th International Conference on Distributed Computing Systems, Poznan, Poland, June 1994.
  - Emeriti Member of the Board Trustees of the VLDB Endowment, 1996.
  - Recipient of the "10 Year Award for the most influential paper of VLDB 1987," International Conference on Very Large Databases, August 1997.
  - Recipient of the "Best Paper Award," ACM-SIGMOD International Conference on Management of Data, Philadelphia, May 31-June 3, 1999.
  - Keynote Speaker at the Second ACM International Workshop on Data Warehousing and OLAP, Kansas City, Missouri, November 6, 1999.
  - Fellow of the Association for Computing Machinery, 2001.
  - Keynote Speaker at the Second Greek Symposium on DataBase Management, Athens, September 4-5, 2003

Year 1982, Department of Computer Science

- Donald Perlis, Artificial Intelligence
  - Ph.D.: New York University, 1972 (Math)
  - Ph.D.: University of Rochester, 1981 (CS)
  - Asst Professor 1982-1988
  - Assoc Professor 1988-1997
  - Professor, 1997-,

- James A. Reggia, Artificial Intelligence
  - MD: University of Maryland at Baltimore, 1975
  - Ph.D.: University of Maryland, 1981
  - Asst Professor, Neurology, Univ of Maryland at Baltimore (UMAB), 1979–1984
  - Asst Professor 1982-1987
  - Assoc Professor, Neurology, UMAB, 1984–1989
  - Assoc Professor 1987-1993
  - Professor, 1993–

  - Research Professor of Neurology, UMAB, 1993–
  - Fellow, American Academy of Medical Informatics, 1984.
  - National Science Foundation Presidential Young Investigator Award, 1985
- Glenn Ricart, Computer Systems
  - Ph.D.: University of Maryland, 1980
  - Asst Professor 1982-1991
  - Assoc Professor 1991-1995
  - Director Computer Science Center, 1982-1995
  - Asst. Vice Chancellor Academic Info. Tech., 1992-1994
  - Distinguished Alumnus, Dept. of CS, 2002
- Carl Smith, Theory of Computing
  - Ph.D.: State University of New York at Buffalo, 1979
  - Habilitation, University of Latvia, 1993
  - Asst Professor 1982-1987
  - Assoc Professor 1987-1996
  - Professor, 1996–
  - Outstanding Performance Award, National Science Foundation 1988
  - Fulbright Scholar, 1997
  - Foreign Member, Latvian Academy of Science, 1999

Year 1983, Department of Computer Science

- Rodrigo J. Fontecilla, Numerical Analysis
  - Ph.D.: Rice University, 1983
  - Asst Professor 1983-1990
- I.V. Ramakrishnan, Theory of Computing
  - Ph.D.: University of Texas at Austin, 1983
  - Asst Professor 1983-1985
- A. Udaya Shankar, Computer Systems,
  - Ph.D.: University of Texas, 1982
  - Asst Professor 1983-1989
  - Assoc Professor 1989-1999
  - Professor, 1999–

Year 1984, Department of Computer Science

- David M. Mount, Theory of Computing,
  - Ph.D.: Purdue University, 1983
  - Asst Professor 1984-1990
  - Assoc Professor 1990-1999
  - Professor, 1999–

Year 1985, Department of Computer Science

- Amihood Amir, Theory of Computing

  - Ph.D.:
  - Asst Professor, 1985-1991,
- Howard Elman, Numerical Analysis
  - Ph.D.: Yale University 1982
  - Asst Professor, 1985-1990
  - Assoc Professor 1990-1996
  - Professor 1996-
  - National Science Foundation Presidential Young Investigator Award, 1989-1994
- Christos Faloutsos, Database Systems
  - Ph.D.: University of Toronto, 1985
  - Asst Professor, 1985-1991
  - Assoc Professor 1991-2000
- Richard K. Furuta, Hypermedia, Electronic Publishing, Digital Libraries
  - Ph.D.: University of Washington, 1986
  - Asst Professor, 1985-1993,
  - University of Maryland Institute for Advanced Computer Studies, (UMIACS) 1987-1989, 1990-1993
- William Gasarch, Theory of Computing
  - Ph.D.: Harvard University 1985
  - Asst Professor, 1985-1991
  - Assoc Professor 1991-1998
  - Professor 1998–
- James Hendler, Artificial Intelligence
  - Ph.D.: Brown University, 1985
  - Asst Professor, 1986-1992
  - Assoc Professor 1992-1999
  - Professor 1999-
  - Fulbright Scholar, 1995
  - Fellow, American Association for Artificial Intelligence (AAAI), 1999
  - Member, Air Force Science Board, 1999–2002
  - AAAI Expository Writing Award, 2000
  - Exceptional Civilian Service Medal, presented by the US Air Force, October 9, 2002
  - Member, NASA Earth Science Advisory, Technology Subcommittee, 2003–
- Joseph J'aJ'a, Algorithms and Parallel Computing
  - Ph.D.: Harvard University, 1977
  - Associate Professor 1983–1987
  - Associate Professor, Department of Electrical Engineering and UMIACS 1985–1987
  - Professor 1987-, Department of Electrical Engineering and UMIACS
  - Affiliate Associate Professor, Department of Computer Science 1985–1987
  - Affiliate Professor, Department of Computer Science 1987–
  - Associate Director for Research, ISR, 1988–1994

  - Director, UMIACS, 1994-
  - Fellow, Institute for Electrical and Electronic Engineers (IEEE), 1996
  - Fellow, Association for Computing Machinery (ACM), 2002
  - 1997 R&D 100 Award by R&D Magazine
  - Maryland Industrial Partnership Award of Excellence, 1992
- Pankaj Jalote, Software Engineering
  - Ph.D.: University of Illinois at Urbana-Champaign, 1985
  - Asst Professor, 1985-1991
- Clyde Kruskal, Theory of Computing,
  - Ph.D.: New York University, 1981
  - Asst Professor, 1985-1988
  - Assoc Professor 1988–
- Leo Mark, Database System Architecture, Database Systems
  - Ph.D.: Aarhus University (Denmark), 1985
  - Asst Professor, 1986-1992
- Beverly Sanders, Computer Systems
  - Ph.D.: Harvard, 1985
  - Asst Professor, 1985-1988
- Paul David Stotts, Jr., Programming Languages
  - Ph.D.: University of Virginia, 1985
  - Asst Professor, 1985-1991

Year 1986, Department of Computer Science

- John (Yiannis) Aloimonos, Computer Vision,
  - Ph.D.: University of Rochester 1987
  - Asst Professor 1986-1992
  - Assoc Professor 1992-1998
  - Professor, 1998–
  - National Science Foundation Career Award, 1990
- Scott Carson, Computer Systems
  - Ph.D.: University of Virginia, 1986
  - Asst Professor 1986-1992
- Gregory F. Johnson
  - Ph.D.: University of Wisconsin, 1983
  - Asst Professor 1986-1990
- James Purtilo, Software Engineering
  - Ph.D.: University of Illinois at Urbana-Champaign, 1986
  - Asst Professor 1986-1992
  - Assoc Professor 1992–
- Dieter Rombach, Software Engineering

  - Ph.D.: Computer Science Department, University of Kaiserslautern, Germany, 1984
  - Asst Professor 1986-1992
  - National Science Foundation Presidential Young Investigator Award, 1990
- Timoleon K. Sellis, Database Systems
  - Ph.D.: University of California at Berkeley, 1986
  - Asst Professor 1986-1992
  - Assoc Professor 1992-1993
  - Presidential Young Investigator Award, 1990

Year 1987, Department of Computer Science

- Louiqa Raschid, Databases
  - Ph.D.: University of Florida, 1987
  - Asst Professor, Smith School of Business and UMIACS 1987-1993
  - Assoc Professor, Smith School of Business and UMIACS 1993-2002
  - Affiliate Assoc Professor, Department of Computer 1993-2002 Science
  - Professor, Smith School of Business and UMIACS 2002–
  - Affiliate Professor, Department of Computer Science 2002–
- Gwen Kaye, Computer Science Education and Advising
  - M.S.: University of Houston at Clear Lake, 1981
  - Asst Lecturer, 1987-1988
  - Instructor, 1988-1990
  - Advisor/Counselor for Graduate Students, 1990

Year 1988, Department of Computer Science

- Sarit Kraus, Artificial Intelligence
  - Ph.D.: Hebrew University, 1989
  - Post Doctoral Fellow, UMIACS and CS, 1988-1990
  - Adjunct Assistant Professor during academic year and visiting Asst Professor during the summer, 1990-1995
  - Adjunct Associate Professor during academic year and visiting Associate Professor during the summer 1995-2001
  - 1997-1998: Visiting Associate Professor
  - Adjunct Professor during academic year and visiting Professor during the summer 2001–
  - Computers and Thought Award of the AAAI, 1995
  - Fellow, American Association for Artificial Intelligence (AAAI), 2002
  - IBM faculty award, 2001
  - ATAL98 Best paper award, 1998
- Raymond E. Miller$^{(**)}$, Theory of Computing,
  - ph.D.: University of Illinois at Urbana, 1957
  - Professor, 1988-2002
  - Director CESDIS 1988-1993,

  - Professor Emeritus, 2002-
  - Fellow, American Association for the Advancement of Science (AAAS), 1990
  - Fellow, Association for Computing Machinery (ACM), 1997
  - Fellow, Institute for Electrical and Electronic Engineers (IEEE), 1969
  - IBM Invention Award, First Plateau, 1966
  - IBM Invention Award, Second Plateau, 1980
  - IEEE Computer Society, Outstanding Contributions Award, 1985
  - Computing Sciences Accreditation Board, Distinguished Contributions, 1990
  - Computing Research Association, Certificate of Appreciation, 1992
  - IEEE Computer Society Golden Core Member, 1996
  - IEEE Third Millenium Medal, 2000
  - ACM Distinguished Service Award, 2003
- William Pugh, Programming Languages
  - Ph.D.: Cornell University, 1988
  - Asst Professor, 1988-1994,
  - Assoc Professor, 1994-2001,
  - Professor, 2001–
  - National Science Foundation Presidential Young Investigator Award, 1991
  - Packard Fellow, 1991
- Kenneth Salem, Database Systems
  - Ph.D.: Princeton, 1989
  - Asst Professor, 1988-1994
  - CS Dept. Award for Teaching Excellence, 1990
- Uzi Vishkin, Analysis of Algorithms, Parallel Computing
  - Ph.D.: Technion, 1981
  - Professor, Department of Electrical and Computer Engineering and UMIACS 1988–
  - Affiliate Professor, Department of Computer Science 1988–
  - Fellow, Association for Computing Machinery (ACM), 1996
- Amy Weinberg, Linguistics
  - Ph.D.: Massachusetts Institute of Technology, 1988
  - Asst Professor, Department of Linguistics and UMIACS 1988-1995
  - Affiliate Asst Professor, Department of Computer Science, 1990-1995
  - Assoc Professor, Department of Linguistics and UMIACS 1995-2002
  - Affiliate Assoc Professor, Department of Computer Science 1995-2002

Year 1989, Department of Computer Science

- Venkatramana (VS) Subrahmanian, Artificial Intelligence
  - Ph.D.: Syracuse University, 1989
  - Asst Professor, 1989-1995
  - Assoc Professor, 1995-2000
  - Professor, 2000–
  - National Science Foundation Career Award, 1992-1998

  - Maryland Distinguished Young Scientist Award, Maryland Science Center, Maryland Academy of Science, 1997

Year 1990, Department of Computer Science

- John F. Horty, Philosophy and Logic
  - Ph.D.: University of Pittsburgh, 1986
  - Asst Professor, Department of Philosophy and UMIACS 1989-1994
  - Assoc Professor, Department of Philosophy 1994-1998
  - Affiliate Assoc Professor, Department of Computer Science 1994-1998
  - Professor, Department of Philosophy and UMIACS 1998–
  - Affiliate Professor, Department of Computer Science 1999–
  - Fellow, National Endowment for the Humanities, 1993/4
- Charles Lin, Lecturer
  - M.S.(Electrical Engineering): University of Maryland, Park, 1993
  - M.S. (Computer Science): University of Maryland, College Park, 2001
  - Lecturer, 1998–
- Jan Plane, Computer Science Education
  - M.S.: University of Wisconsin, Milwaukee, 1989
  - Instructor, 1990–

Year 1991, Department of Computer Science

- Ramalingam Chellappa, Image Processing, Computer Vision and Pattern Recognition
  - Ph.D.: Purdue University, 1981
  - Professor, Department of Electrical Engineering and UMIACS 1991–
  - Affiliate Professor, Department of Computer Science, 1991–
  - NSF Presidential Young Investigator Award, 1985
  - IBM Faculty Development Award, 1985
  - Excellence in Teaching Award, USC School of Engineering, 1990
  - Fellow, Institute for Electrical and Electronic Engineers (IEEE), 1992
  - Best Industry Related Paper (with Q. Zheng), International Assn. of Pattern Recognition, 1992
  - Fellow, International Association of Pattern Recognition, 1996
  - Distinguished Faculty Research Fellow, University of Maryland, 1996-1998
  - IEEE Signal Processing Society Technical Achievement Award, 2001
- Richard Gerber, Real Time Systems,
  - Ph.D.: University of Pennsylvania, 1991
  - Asst Professor, 1991-2001,
  - Assoc Professor 1996-2001
  - National Science Foundation Young Investigator Award, 1993
- Adam Porter, Software Engineering
  - Ph.D.: University of California at Irvine, 1991
  - Asst Professor, 1991-1998

- Assoc Professor, 1998–
- National Science Foundation Career Award, 1995
- Deans Award for Teaching Excellence, 1995

Year 1992, Department of Computer Science

- Bonnie J. Dorr, Natural Language Processing and Artificial Intelligence,
  - Ph.D.: Massachusetts Institute of Technology, 1990
  - Asst Professor, 1992-1998,
  - Assoc Professor 1998-,
  - Post Doctoral Fellow, UMIACS, 1990-1992,
  - National Science Foundation Young Investigator, 1993-1997,
  - Alfred P. Sloan Research Fellow, 1994-1996.
  - Maryland Distinguished Young Scientist, 1996,
  - National Science Presidential Faculty Fellow, 1997-1999,
- Samir Khuller, Theory of Computing,
  - Ph.D.: Cornell University, 1990
  - Asst Professor, 1992-1997
  - Assoc Professor 1997–
  - National Science Foundation Career Award, 1995
  - Dean's Award for Excellence in Teaching, Univ of Maryland 1996
  - Lilly Teaching Fellow 1997–1998
- Joel Saltz, High Performance Computing
  - MD: Duke University, 1985
  - Ph.D.: Duke University, 1986
  - Assoc Professor 1992-1997
  - Professor, 1997-2001
  - Director High Performance Systems Software Laboratory, 1997-2001
- Alan Sussman, High Performance Computing
  - Ph.D.: Carnegie Mellon University, 1991
  - Research Associate, 1992-1997
  - Assistant Research Scientist, 1997-2001
  - Assistant Professor, 2002-

Year 1993, Department of Computer Science

- Michael J. Franklin, Internet-scale Distributed Database Systems, Mobile and Pervasive Computing, DBMS Architecture and Performance Evaluation
  - ph.D.: University of Wisconsin, Madison, 1993
  - Asst Professor 1993-1999
  - Assoc Professor 1999-2001

Year 1994, Department of Computer Science

- Jeffrey Hollingsworth, Computer Systems,

  - ph.D.: University of Wisconsin, Madison, 1994
  - Asst Professor 1994-2000
  - Assoc Professor 2000–
  - National Science Foundation Career Award, 1997
- Peter J. Keleher, Computer Systems,
  - Ph.D.: Rice University, 1995
  - Asst Professor 1994-2001
  - Assoc Professor 2001–
  - National Science Foundation Career Award, 1996

Year 1995, Department of Computer Science

- Evan Golub, Computer Science Education
  - Ph.D.: University of Maryland, 1999
  - Instructor, 1993-1995
  - Lecturer, 1995-
  - Lilly-CTE Fellow 2002-2003
- Chau-Wen Tseng, Software Engineering and Programming Languages,
  - Ph.D.: Rice University, 1993
  - Asst Professor 1995-2001
  - Assoc Professor 2001–
  - National Science Foundation Career Award, 1996

Year 1996, Department of Computer Science

- Larry Herman, Computer Science Education
  - M.S.: University of Maryland, 1990
  - Instructor 1996–

Year 1997, Department of Computer Science

- Benjamin B. Bederson, Human-Computer Interaction,
  - Ph.D.: New York University 1992
  - Asst Professor 1997-,
  - Director, Human-Computer Interaction Laboratory, 2001–
- James Glenn, Computer Science Education and Advising
  - Ph.D.: University of Maryland - College Park, 1998
  - Lecturer, 1997-2000
- Leana Golubchik, Computer Systems,
  - Ph.D.: University of California, Los Angeles, 1995
  - Asst Professor, 1997-2001,
  - Assoc Professor 2001-2002
  - National Science Foundation Career Award, 1996-2001
  - Member of IFIP WG 7.3, elected 2000.

Year 1998, Department of Computer Science

- Sudarshan S. Chawathe, Database Systems,
  - Ph.D.: Stanford University 1999
  - Asst Professor 1998-,
  - National Science Foundation Career Award, 2000
- Donald Yeung, Computer Architecture
  - Asst Professor, Department of Electrical and Computer Engineering (ECE) and UMIACS 1998–
  - Affiliate Asst Professor, Department of Computer Science 1998–
  - National Science Foundation Career Development Award, January 2001
  - George Corcoran Teaching Award (ECE), June 2000

Year 1999, Department of Computer Science

- Samrat Bhattacharjee, Computer Systems,
  - Ph.D.: The Georgia Institute of Technology 1999
  - Asst Professor 1999–
  - Affiliate Asst Professor, Electrical and Computing Engineering, 1999–
  - National Science Foundation Career Award, 2001
- James J. Maybury, Computer Science Education and Advising
  - M.S.: University of Maryland, 2002
  - Lecturer, 1999-2001
  - Advisor/Consultant, Undergraduate Education, 2001-

Year 2000, Department of Computer Science

- William Arbaugh, Computer Security,
  - Ph.D.: University of Pennsylvania 1999
  - Asst Professor 2000–
  - Signals Intelligence Medal (for significant technical accomplishment. First time the award given to member of the Research organization), NSA, 1996
  - Science and Technology Award, NSA, 1997
  - Louis W. Tordella Award (for excellence in cryptography), NSA, 1997
  - IBM University Partnership Award, 2000
  - IBM University Partnership Award, 2001
- Allison Druin, Human-Computer Interaction
  - Ph.D.: University of New Mexico, 1997
  - Asst Professor College of Information Studies and UMIACS 1998–
  - Affiliate Asst Professor, Department of Computer Science 2000–
  - Lilly-Center for Teaching Excellence Teaching Fellow Award 1999-2000
  - Institute of Museum and Library Services (IMLS) Award 2002-2005
  - NSF Career Award 2001-2006
  - NSF ITR Award 2002-2007
  - Outstanding UMD Faculty of the Year Award 2001

  - Nominated for a Presidential Commission (National Commission of Library and Information Science), 2003–
- Steve Scolnik, Lecturer
  - M.S. Computer Science: University of Maryland, 1979
  - M.S. Meteorology: MIT, 1974
  - Lecturer, 2000-present
- Amitabh Varshney, Computer Graphics and Scientific Visualization
  - Ph.D.: University of North Carolina at Chapel Hill, 1994
  - Assoc Professor 2000–
  - National Science Foundation Career Award 1995
  - Honda Research Initiation Award 1997

Year 2001, Department of Computer Science

- Michael Hicks, Programming Languages, Distributed Systems
  - Ph.D.: University of Pennsylvania, 2001
  - Asst Professor, 2002–
- Atrif M. Memon, Software Engineering,
  - Ph.D.: University of Pittsburgh, 2001
  - Asst Professor 2001–
- Aravind Srinivasan, Algorithms and Theory of Computing
  - Ph.D.: Cornell University, 1993
  - Assoc Professor 2001–

Year 2002, Department of Computer Science

- Lise C. Getoor, Artificial Intelligence
  - Ph.D.: Stanford University 2001
  - Asst Professor 2002–
- Fran cois Guimbretière, Human Computer Interaction
  - Ph.D.: Stanford University, 2002
  - Asst Professor 2002–
- Liviu Iftode, Computer Systems,
  - Ph.D.: Princeton University, 1998
  - Asst Professor, 2002-2003
  - NSF CAREER Award, 2002-2007
- David Jacobs, Computer Vision
  - Ph.D.: MIT, 1992
  - Assoc Professor 2002–
- Jonathan Katz, Cryptography, Theory of Computing
  - Ph.D.: Columbia University, 2002
  - Asst Professor 2002–

Year 2002, Department of Computer Science

- Jeffrey Foster, Software Engineering
  - Ph.D.: University of California at Berkeley, 2002
  - Asst Professor 2002–

(*)— Deceased
(**)– Retired

Appendix 5

STAFF OF THE COMPUTER SCIENCE CENTER – 1968

(A) **Administrative Personnel**

William F. Atchison, Ph.D.	Director and Professor
John P. Menard, B.A.	Associate Director
Robert L. Jones	Manager and Assistant Director
Health Science Computer Center	
George E. Miller, M.Ed.	Chief of User' Services
John Bielec, B.S.	Chief of Operations

(B) **Research and Instructional Faculty**[169]

James R. Ruddell, B.S.	Computer Program Librarian
Sam Steinberg, B.A.	Asst. Computer Program Librarian
George A. Gottwals, B.S.	Faculty Research Assistant
Peter A.. Kolmus	Faculty Research Assistant
Anthony F. Norcio, B.S., B.A.	Faculty Research Assistant
Andrew Pilipchuk, A.S.	Faculty Research Assistant
Dawn F. Shifflett, B.S.	Faculty Research Assistant
Timothy R. Wells, B.A.	Faculty Research Assistant
Neil R. Yoder, Ph.D.	Faculty Research Assistant

(C) **Research Consultants**

Nancy S. Anderson, Ph.D.	Professor of Psychology
William M. Benesch, Ph.D.	Professor of Molecular Physics
Thomas B. Day, Ph.D.	Professor of Physics
George R. Green, Ph.D.	Professor of Economics
Albert Hybl, Ph.D.	Assistant Prof. of Biophysics
Sigekatu Kuroda, Dr. Sci.	Professor of Mathematics
James M. Stewart, Ph.D.	Professor of Chemistry
Clayton S. Stunkard, Ph.D.	Professor of Education
Leopold O. Walder, Ph.D.	Professor of Psychology

(D-1) **Programming Personnel - Systems Programmers**

Alfred E. Beam, B.S.	Senior Computer Systems Analyst
Walter J. Gilbert, B.S.	N.S.F. Computer Systems Analyst
John McNary	D.P. Systems Analyst I

[169]See Appendix **??** for Professorial and Instructional Faculty engaged in research and education

(D-2) **Programming Personnel - Research Programmers**

Charles K. Mesztenyi, M.S.	Senior Research Programmer
Richard B. Thomas, M.A.	Senior Research Programmer
Kenneth E. Kloss, M.A.	Senior Research Programmer
Edgar Butt, B.S.	Research Programmer
Emily Johnston, B.S., M.S.	Research Programmer
Y.H. Leff, M.A.	Research Programmer
Erroll J. Michener, M.S.	Research Programmer
Health Sciences Computer Center	
Sidney J. Tennenberg, B.S.	Research Programmer
Health Sciences Computer Center	
Steven Gibson, B.S.	Junior Research Programmer
Health Sciences Computer Center	
Robbins, Barry J., B.S..S.	Junior Research Programmer
Health Sciences Computer Center	
M.A.P. Young, B.A.	Junior Research Programmer
Health Sciences Computer Center	

(D-3) **Programming Personnel - Data Processing Programmers**

Bertha Butler, B.A.	Data Processing Programmer II
David Filler, B.A.	Data Processing Programmer II
Michael C. Frame, B.A.	Data Processing Programmer I
Steven P. Bayard,	Data Processing Programmer I
Health Sciences Computer Center	

(E) **Operating Personnel**

Ronald S. Borgenicht	D.P. Computer Operator IV
William S. Bird	D.P. Computer Operator III
Ronald A. Sabloswki	D.P. Computer Operator III
Dennis Shankle	D.P. Computer Operator III
Roy Angus	D.P. Computer Operator II
Michael Burke	D.P. Computer Operator II
Robert Cronin	D.P. Computer Operator II
Charles Green	D.P. Computer Operator II
Bruce Kleiman	D.P. Computer Operator II
David Moller	D.P. Computer Operator II
Richard G. Ogden, B.S.	D.P. Computer Operator II
George Schroeder	D.P. Computer Operator II
Ramon Stockman	D.P. Computer Operator II
Carl Ulich	D.P. Computer Operator II
Augustus Williams	D.P. Computer Operator II
Albert E. Capps	D.P. Computer Operator I
Frederick Griffin	D.P. Computer Operator I
Robert C. Long, Jr.	D.P. Computer Operator I
Gail Vanmeter	D.P. Magnetic Tape Librarian
Lillian B. Dory	D.P. Control Clerk I
Carl F. Felton	D.P. Control Clerk I
Thomas E. Hill, Jr.	D.P. Control Clerk I
Dorothy L. Kohne	D.P. Control Clerk I
Martha E. King	D.P. Control Clerk I
Health Sciences Computer Center	
Patricia McDaniel	D.P. Control Clerk I
Daniel Ries	D.P. Control Clerk I
Raymond C.F. Vollmer	D.P. Control Clerk I
Betty A. Schwan	Program Library Assistant I
M.E. Kitler	Program Library Assistant I

Appendix 6

LIST OF DEPARTMENT EQUIPMENT AS OF JUNE 30, 1979

1 PDP-11/40, 16K memory, 2.5M cartridge disk

1 PDP-11/45, 40K memory, 2.5M cartridge disk
1 PDP-11/45, 40K memory, 5M cartridge disk, 256K fixed disk,
Cassette drives, tape drive

1 VAX-11/780, 512KB MOS Memory, 176 MB Disk, 8 lines, console,
tape drive, VAX/VMS OS, Writable Control Store KU780,
FORTRAN License, FLOATING POINT ACCELERATOR FP-780-AA,
Memory 512 KB MS780-BC, Memory 128 KB MS780-AA,
Memory 128 KB MS780-BA, Line Printer WA, Disk RP06

1 GT40 display

1 Printonix serial line printer

3 TI 700 terminals

1 Datamedia 2500 terminal

1 Techtronix T-4002 display

1 Qualterm (Diablo) terminal

1 paper-tape reader

1 paper-tape punch

1 Votrax

Appendix 7

DOCTORAL STUDENTS - 1973–1979

DEPARTMENT OF COMPUTER SCIENCE

DATE	STUDENT	ADVISOR	THESIS TITLE
1973	Fishman, Daniel H.	J. Minker	Experiments with a Resolution-Based Deductive Question-Answering System and a Proposed Clause Representation for Parallel Search
	Milgram, David	A. Rosenfeld	Web Automata
1974	Cook, Craig M.	A. Rosenfeld	Grammatical Inference by Heuristic Search
1975	Rauscher, Tomlinson G.	A. Agrawala	Dynamic Problem Oriented Redefinition of Computer Architecture via Microprocessing
	Yeh, Jeffrey W.	M. Zelkowitz	Modeling of Concurrent Control and Parallel Processing
1976	Kulkarni, Ashok, V.	L. Kanal	Optimal and Heuristic Synthesis of Hierarchical Classifiers
	Lemmer, John F.	L. Kanal	Algorithms for Incompletely Specified Distributions in a Generalized Graph Model for Medical Diagnosis
	McSkimin, James R.	J. Minker	The Use of Semantic Information in a Question Answering System
	Turner, Albert J.	V. Basili	Iterative Enhancement: A Practical Technique for Software Development
	Wilson, Gerald A.	J. Minker	The PAR Technique - An Approach to Parallel Search in Problem Solving Systems
1977	Carmichael, Arthur B.	V. Basili	Semantic Classification of Features of Programming Languages
	Davis, Larry S.	A. Rosenfeld	Shape Representation and Matching
	Nagel, Roger N.	A. Rosenfeld	Computer Detection of Freehand Forgeries
	Parikh, Jo Ann	A. Rosenfeld	Automatic Cloud Classification and Segmentation
	Stockman, George C.	L. Kanal	A Problem-Reduction Approach to the Linguistic Analysis of Waveform
	Tung, Immanuel	H.P. Edmundson	A Language-Acceptor Type of Probabilistic Cellular Automata
1978	Ford, Gary A.	H.P. Edmundson	An Investigation of Embedding of Cellular Spaces for Cellular Automata
	Fredrickson, Greg	M. Hecht	Approximation Algorithms for NP-Hard Routing Problem
	Gishen, Jeffrey S.	R.E. Noonan	A Method for the Formal Derivation of Programs and its Application to Automatic Program Synthesis
	Hill, Eric	G.W. Stewart	Computer Solution of Large Dense Linear Problems
	Lemkin, Peter	A. Rosenfeld	Bone Marrow Smear Image Analysis
	VanderBrug, Gordon	A. Rosenfeld	Linear Feature Detection and Matching

DATE	STUDENT	ADVISOR	THESIS TITLE
1979	Ahuja, Narendra	A. Rosenfeld	Mosaic Models for Image Analysis and Synthesis
	Dunsmore, Hubert E.	J. Gannon	Influence of Programming Factors on Programming Complexity
	Dyer, Charles R.	A. Rosenfeld	Automated Cellular Automata for Image Analysis
	London, Philip	C.J. Rieger III	Dependency Networks as a Representation for Modeling in General Problem Solvers
	Lowe, George F.	W.C. Rheinboldt	Heuristic Approaches to the Decomposition of Sparse Matrices
	Peleg, Shmuel	A. Rosenfeld	Ambiguity Reduction in Probabilistic Networks
	Shaffer, Jeffrey B.	M. Hecht	Automatic Subroutine Generation in an Optimizing Compiler
	Shapiro, Bruce A.	A. Rosenfeld	Shape Description Using Boundary Descriptions
	Wu, Angela Y.	A. Rosenfeld	Cellular Graph Automata