

5-1-1992

Computer Science Education at WKU

Malcolm Stallings
Western Kentucky University

Follow this and additional works at: http://digitalcommons.wku.edu/stu_hon_theses



Part of the [Computer Sciences Commons](#)

Recommended Citation

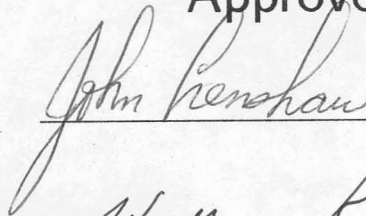
Stallings, Malcolm, "Computer Science Education at WKU" (1992). *Honors College Capstone Experience/Thesis Projects*. Paper 61.
http://digitalcommons.wku.edu/stu_hon_theses/61

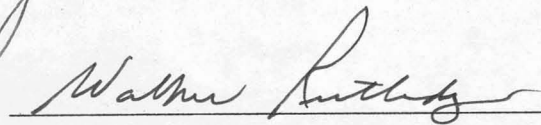
This Thesis is brought to you for free and open access by TopSCHOLAR®. It has been accepted for inclusion in Honors College Capstone Experience/Thesis Projects by an authorized administrator of TopSCHOLAR®. For more information, please contact connie.foster@wku.edu.

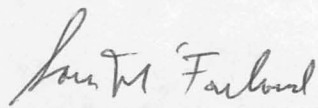
Computer Science Education at Western Kentucky University

by
Malcolm Stallings
Spring Semester, 1992

Approved by







THESIS STATEMENT

Computer Science students at Western Kentucky University should concentrate on both the theory and applications of mainframe computers and personal computers.

**COMPUTER SCIENCE EDUCATION
AT WESTERN KENTUCKY UNIVERSITY**

I. Overview of computers at Western Kentucky University

- A. Personal computers
 - 1. Basic description
 - 2. General history
 - 3. History at Western Kentucky University
- B. Mainframe computers
 - 1. Basic description
 - 2. General history
 - 3. History at Western Kentucky University

II. Criteria for Computer Science education and its relation to personal computers and mainframe computers

- A. Curricula guidelines
 - 1. Curriculum '78
 - 2. The Computer Science Accreditation Board
- B. Alumni Feedback
- C. Skill-levels
 - 1. Knowledge of algorithm design skills
 - 2. Knowledge of programming language specifics
 - 3. Knowledge of computer organizations
 - 4. Knowledge of computer operating systems

III. Financial concerns and Computer Science education at Western Kentucky University

Table of Contents

| | |
|--|----|
| Computer Science Education at Western Kentucky University | 1 |
| Appendix A: WKU Department of Computer Science Alumni Questionnaire and Statistics | 25 |
| Appendix B: Computing Sciences Accreditation Board Criteria for Accrediting Programs in Computer Science in the United States | 31 |
| Appendix C: Interview Questions | 49 |
| Annotated Bibliography | 51 |

Computers have become a part of everyday life. In the past decade, they have been built to calculate the cost of a grocery bill, help someone telephone another person, and even allow someone to withdraw money from an automatic teller machine. Because of this increase in computer usage, there has been a demand for people educated in computer science, which studies the use of computers to solve human problems in areas ranging from research to education.

Of course, students in the field of computer science study computer hardware and use it as a tool in the study of related topics, such as program design and algorithms. There are two basic types of computer hardware used today at Western Kentucky University: the mainframe computer and the personal computer. A mainframe computer is a large computer system used for massive tasks linking many terminals in numerous locations. Mainframes are used to run airline reservation systems, provide electronic banking, or run large corporations, universities, or government agencies (Arnold 444).

The history of mainframes can be traced back to 1946. After spending about \$400,000, Dr. John W. Mauchly and J. Presper Eckert, Jr. completed the Electronic Numerical Integrator and Computer (ENIAC), the first large-scale electronic digital computer ever

built. The ENIAC contained 18,000 vacuum tubes and could multiply two numbers in three-hundredths of a second.

After the work was completed on the ENIAC (which was mostly experimental), Eckert and Mauchly formed a company (the Eckert-Mauchly Computer Corporation) and began working on the design of the UNIVersal Automatic Computer, called the UNIVAC I. After completion, the first UNIVAC I was used by the U.S. Bureau of the Census, "marking this as the first computer dedicated to business applications as opposed to scientific, military, or engineering processing. For almost five years following its installation, the UNIVAC I was considered one of the best large-scale computers available."

The first transistorized computer (TRADIC), built in 1954 by Bell Laboratories, established the beginning of the second-generation computers. The first generation had used vacuum tubes, which generated tremendous heat and were not very reliable. The UNIVAC II, the newer model of the UNIVAC I, contained transistors. Companies such as International Business Machines Corporation (IBM), which had been making computers since the late 1930s, began using the transistor to control the circuitry of a computer.

The third generation of computers was introduced with the IBM System/360 computer systems. The System/360 contained a family of six computers, all compatible, with 40 different input/output and auxiliary storage devices, and a variety of memory sizes ranging from 16,000 to over one million memory positions. Also, IBM used new techniques such

as Solid Logic Technology, whereby electronic components which make up the controlling circuitry of the computer are stored on small chips rather than discrete components such as transistors on a board.

By 1970, "large-scale integration" was being used in the large computers. This was the process by which over 15,000 circuit elements could be contained on a single chip. This use of large-scale integration on computers, including the IBM System/370, is considered the beginning of the fourth generation of computer systems. No major change has occurred in large-scale computers since then as far as hardware is concerned.

In the mid 1960s, Western Kentucky University (WKU) received its first mainframe, the IBM 1401. It was a card/batch system in which individuals could punch programs using keypunches. This machine was slow to return results. For example, it took twenty-four hours for a student to receive the results of running his program on the computer.

By 1973, WKU offered students access to a DEC10 at the University of Louisville (UL) and an IBM System/360 mainframe at the University of Kentucky (UK). This was part of an effort by the state of Kentucky to provide computer services to the various universities without having to purchase a computer for each university. This network was known as the Kentucky Educational Computing Network (KECNET). Under this agreement, universities in Kentucky could access the machines at UK and UL by the use of remote terminals. Each university was charged money for disk storage, but central processing unit (CPU) time was

free. Also in 1973, WKU purchased a DEC PDP 11/45, but it provided no disk storage for student users, and programs had to be stored on paper rolls.

In 1980, the machines at UK and UL had become obsolete and a major upgrade was needed. The state refused to make appropriations for the new computers, so UK and UL had to begin charging the other universities for CPU time as well as disk space. WKU paid a CPU bill of \$80,000 in 1980; by 1981, the bill had increased to over \$100,000. Needing to do something to continue its computer services at a reasonable cost, WKU added a DEC PDP 11/44. Then in 1982, an IBM 4331 with 3270 terminals was purchased. By 1984, the school had acquired a VAX 11/780 and another DEC PDP 11/44; also, the administrative department upgraded its IBM 4341 and started providing computer services to students. The total equipment picture thus included an IBM 4331, a VAX 11/780, two DEC PDP 11/44s, a DEC PDP 11/45, and an IBM 4341 supplying computer services to students (Sloan).

By the end of 1985, the IBM 4331 and the DEC PDP 11/45 had become obsolete, and both were discarded. The VAX 11/780 was upgraded to a VAX 11/785, and the two DEC PDP 11/44s were still in use. In 1986, the administrative department purchased an IBM 4381 to replace the IBM 4341. Both the IBM 4381 and the VAX 11/785 were the primary mainframes used for student computing until recent years. Currently, WKU supplies a DEC VAX 6320 (which replaced the VAX 11/785 in 1989), an IBM 9120-260 (which replaced the IBM 4381 in 1990), and one of the DEC PDP 11/44s for use by the

students (Goatley).

The 6320 is used primarily by the students for classwork. It has several languages, such as Pascal, BASIC, FORTRAN, C, and XLISP, which can be used in the students' education. It is also used by faculty for research in areas of physics and geography. The 9120-260, on the other hand, is used primarily by the faculty and staff for the purposes of billing, grade-reporting, and other administrative work. The 9120-260 is also used in some classes to teach assembly language for the IBM System/370 architecture, which is found in the 9120-260.

In contrast to a mainframe, a personal computer is a general-purpose computer system that is usually single-user oriented and performs smaller tasks than its mainframe counterpart. It can be used by families to keep track of bills or by corporations to utilize software that can create publications or run graphics programs. Texas Gas Corporation (Owensboro, Kentucky) uses several communication packages, such as Carbon Copy, on personal computers to contact bulletin boards containing information regarding price indexes and detailed current events in the gas industry. Texas Gas also uses a MacIntosh personal computer to run graphics programs, such as Aldus PageMaker, to create reference maps, newsletters, and memorandums. All of the administrative work (i.e. storing each student's grades) at Brescia College (Owensboro, Kentucky) is done on personal computers.

As for the history of personal computers, the discussion begins as late as 1976 when

Steve Jobs and Steve Wozniac designed a single-board computer. The computer quickly won the praise of colleagues, and a local computer store wanted to buy some of these computers. This single-board computer became the Apple II computer in May 1977. In July of that same year, the National Computer Conference startled the computing world by announcing a fully assembled microcomputer (personal computer) in a single housing called the Personal Electronic Transactor (PET).

The PET consisted of a keyboard, processor unit, cathode ray tube (CRT), and a built-in cassette tape recorder for \$595.00. The programming language BASIC was built into the system. Thus, a fully programmable, powerful computer system was now available for home or personal use. In 1977, Radio Shack announced the TRS-80 computer, and by the end of 1977, Apple, Commodore, and Radio Shack had complete personal computers on the market.

By 1981, it was clear that the personal computer was going to have an impact on homes, schools, small businesses, and large corporations. In August 1981, IBM announced its IBM Personal Computer. With this announcement, the personal computer took its place as a tool for use in solving problems for big and small businesses. Digital Equipment Corporation (DEC), Wang, National Cash Register (NCR), Honeywell, and others announced personal computers on the market by the end of the year. Now, many managers and business executives have access to personal computers to help with their day-to-day business affairs.

The history of personal computers at WKU is shorter than the history of mainframes, but not less complicated. The first personal computers arrived at WKU in 1979 when Dr. Tom Madron bought two early Tandy models that were used as terminal emulators and word-processors. There was no class work done on these computers. Personal computers would not be a factor in computer services at WKU until the fall of 1986 when Academic Computing and Research Services (ACRS) purchased about 50 Xerox personal computers and installed them in the labs located in Grise Hall Second Floor and Thompson Complex Central Wing (TCCW). At the same time, the College of Business bought about 40 personal computers for the lab installed on the third floor at Grise Hall.

In the summer of 1988, ACRS bought about 15 ITT personal computers to install in the lab on the second floor of Grise. At this time, the College of Business asked ACRS to assume management of the lab on the third floor of Grise Hall. When ACRS took over this lab, it became obvious that the personal computers would need to be networked to provide a more efficient environment for computing. So, in the summer of 1989, ACRS bought three Local Area Networks (LAN) and installed them at the labs at Science and Technology Hall (STH), TCCW, and Grise Hall Third Floor.

By 1990, the computers in existence in the ACRS labs had become very unreliable and their failure rate became unacceptable. It was apparent that ACRS would have to replace the existing machines. In the fall of 1990, ACRS purchased 94 new Zenith 286 machines along with new furniture and servers for the new labs at Downing University

Center (DUC), Helm Library, and Hugh Poland Hall. By the end of 1991, ACRS had upgraded and refurbished the labs at TCCW, STH, Grise Hall Third Floor, and the new lab at Cherry Hall with 130 new machines (Zenith 386 SX). The new lab at Cherry Hall was managed by the English department but financed by ACRS.

This brief history of personal computers at ACRS by no means covers the full details of all personal computers provided by WKU, for many departments on campus provide personal computers. For example, the journalism department provides about 50 MacIntosh computers for its majors to use. However, this brief history covers the bulk of personal computer services provided by WKU.

Currently at WKU, there are about 50 personal computers linked to LANs for use by the students. There are five LANs, each containing software, such as WordPerfect and WordStar (word-processors), GW-BASIC (programming language), Lotus123 (spreadsheet producer), and DBase III (database).

The main differences between the personal computers and the mainframe computers are size and speed. "Whereas a typical personal computer may contain computer memory large enough to store 512,000 characters," a mainframe computer "may have memory in excess of 8 million storage positions. Many personal computers have an auxiliary storage device (a hard disk) that can store 10 million characters." Mainframes, on the other hand, "typically contain auxiliary storage devices capable of storing in excess of 5 billion

characters" (Shelly 1.13).

A mainframe can execute instructions considerably faster than a personal computer. "For example, a typical personal computer can execute 100,000 instructions in one second while a mainframe can execute more than 10 million instructions per second. Because of the larger storage capacities and the faster speeds, minicomputers and mainframes are capable of storing and executed more complex programs at considerably faster rates. In addition, on most large computers many programs can be executing concurrently; and a large number of people can use the computer at the same time" (Shelly 1.13). Personal computers are usually single-user oriented and provide a more independent environment compared to the mainframe environment, where one is "just one of the bit players" (Jones).

At colleges and universities, a problem has arisen: what computer system does a student of computer science need to direct his education? Some schools, such as WKU, concentrate on the mainframe computer systems in their computer science education program, while others, such as Brescia College, rely mainly on the personal computer. Ideally, computer science students at WKU should concentrate on both the theory and applications of mainframe computer systems and personal computers. But it would be the ideal student who would know everything about every computer system. This, of course, is unreasonable but draws attention to the matter of deciding where to focus the education. No university has the ability to have every computer and teach everything about computers in today's changing computer world. Since no computer science department can provide

every computer system ever built, how does it decide which systems to use?

An obvious academic mission is to provide students with the education needed for graduate school and for job placement. But there are several points that need to be considered when starting or modifying a curriculum in the area of computer science, including specific guidelines of the curriculum, alumni feedback (if possible), and elements of computer science that the department wants to insure are known by the student : algorithm design, programming language specifics, computer organizations, and computer operating systems.

In 1978, the computer science department at WKU adopted guidelines set forth by the Association for Computing Machinery Curriculum Committee, known collectively as Curriculum '78. These measures for the organization of an undergraduate computer science program are divided into six categories: an introduction followed by a recommended core curriculum, a suggested list of computer science electives, an outline for an undergraduate program, a description of service courses, and a mention of such considerations as the physical facility and the staffing of courses. Curriculum '78 does not, however, directly specify which computer systems should be used in what area of the curriculum, but it does suggest that a wide range of computer facilities be used in computer science education. This range includes personal computers and mainframe computers.

According to Curriculum '78, "data entry devices, microcomputers, minicomputers,

and medium or large-scale computer systems all play separate and important roles in the development of the computer scientist" (Austing 163). Western Kentucky University has tried to incorporate this thought into its computer science curriculum, and thus the debate between personal computers and mainframe computer systems begins. What roles does each play in a computer science education?

In response to this question, the computer science department at WKU has begun the process of updating its curriculum requirements by looking toward the Computing Sciences Accreditation Board (CSAB) for new guidelines. The purpose of the CSAB "... is to advance the development and practice of the computing sciences in the public interest through the enhancement of quality educational programs in the computing sciences" (Appendix B 33). More generally, CSAB has provided the opportunity for computer science departments to conform to certain standards, thus providing a better rounded education for computer science students.

The curriculum laid out by the CSAB provides an "...emphasis over the areas of theoretical foundations of computer science, algorithms, data structures, software design, the concepts of programming languages, and computer elements and architecture. Within this portion of the program, analysis and design experiences with substantial laboratory work, including software development, should be stressed" (Appendix B 41). However, the CSAB does not outline what hardware should be used for what area of curriculum. This is the same problem encountered with Curriculum '78. The CSAB, like Curriculum '78, does

give general suggestions in this area: "...resources will normally involve a blend of computer facilities of varying capabilities. Sufficient facilities must be available so that each student has adequate and reasonable access to the appropriate system for each course." And yet, the "appropriate system for each course" is never explained to the department by the CSAB. So the question of which computer system (personal computer or main-frame computer system) is still unanswered, even though the curriculum has a good set of guidelines to follow.

A computer science department can also look toward alumni for feedback to answer questions about the department's curriculum. If the university or college has graduates from its program, the department may survey those graduates to determine areas in the curriculum which may need modifying. WKU has had such an opportunity and relies upon this alumni feedback in assessing its computer science program. As of June 1991, WKU had 413 computer science graduates distributed in 28 different states. The computer science department distributed a questionnaire to these graduates to receive information on several topics ranging from courses that should be installed into the curriculum to the strengths of the curriculum. As of June 26, 1991, twenty-two of the 413 alumni members had responded to the questionnaire. Even though the response was low (5.3%), the responses did give some helpful information.

According to the graduates that responded, Western's computer science program excelled in preparing them for their current positions outside of college life. Seventy-five

percent of those graduates surveyed answered "YES" to the question "Did you leave WKU CS program prepared for current position?" The survey also made the department aware of deficiencies in the WKU CS program, some of which are directly related to the lack of personal computer knowledge. Graduates stated that personal computer courses should be included in the curriculum and that Disk Operating System (DOS) and personal-computer-based languages should be more fully covered (Appendix A 26). While some classes may use the personal computer, approximately four computer science classes offered in the fall of 1992 will focus on it and its environment. Yet, it is possible for a computer science student to finish his baccalaureate degree without attending one personal computer class.

According to Dr. John Crenshaw, the WKU CS curriculum only provides a good basis in "running software on a personal computer, not writing it." The student needs to "be given background, instead of just running" the software (Crenshaw). Dr. Robert Crawford states that it is the computer science department's responsibility to "insure all graduates get out with personal computer experience."

Alas, the question of which computer system should be used for computer science education is still unanswered. Guidelines for the curriculum have been set by the Curriculum '78, and alumni have helped in showing some deficiencies in the curriculum, but the computer science department still has no direction in what computer hardware should be used with that curriculum. One other source can be used in solving this problem: the educational program itself. Basically, the computer hardware needed may be determined

by evaluating what the education of computer science demands.

Every department at WKU has a set of objectives used to direct majors in their education. The objectives of the computer science department are geared toward an understanding of four main areas: algorithm design skills, programming language specifics, computer organizations, and computer operating systems. These four areas encompass the education needed by a computer science student upon graduation.

The basis of problem solving is algorithm design skills. An algorithm is a precise set of steps to follow in order to solve a problem. An example of an algorithm is a recipe to bake cookies. Algorithm design skills are essential to computer programming, for the better algorithm design skills a student has, the better programmer he will be. However, this area of computer science education may be taught on a mainframe computer or a personal computer. Gaining knowledge of algorithm design skills does nothing to help decide what computer hardware should be used in computer science education.

Computers need languages to express algorithms, languages which are interpreted by the computer to perform a specific task. Languages can be categorized into three general groups: machine languages, assembly languages, and high-level languages.

A machine language is a very low-level language. Usually computers are built from electronic circuitry with fundamental components that can represent and recognize only two states, often written 0 and 1. This basic circuitry uses binary numbers (base 2, using

digits 0 and 1). All programs and data must eventually be written using machine language for the computer to be able to use them.

The next type of language, assembly language, can be defined by abbreviating instructions and using operands (quantities and locations of computer memory to be manipulated). This language is called an assembly language because it requires a piece of software called an assembler to translate the abbreviations into the machine language used by the computer.

A higher level of languages is used more commonly by programmers. These languages include Pascal, BASIC, COBOL, and others. These languages are easier to use than the assembly languages or the machine languages, although they require a compiler to translate the written code into a lower-level language (usually an assembly language or machine language) to be used further by the computer.

An understanding of the process involved in all of these language areas and the languages themselves is vital to computer science education. This is where some demand of specific computer hardware is noted. Many high-level languages, such as C and Bliss, are portable; that is, they can be used on several different computers, including mainframe computers and personal computers. On the other hand, personal computers have, in recent years, provided a more friendly environment (using items such as menus) when using high-level languages than mainframe computers. Also, many assembly languages are not

portable: the assembly language for an IBM System/370 will not work on an IBM Personal Computer. Each model of computer interprets binary sequences (machine language) in different ways and thus defines its own machine language. Even though many programmers do not write programs in machine language or assembly language, it is still to the advantage of the programmer to have knowledge of both personal computer environments and mainframe computer environments. Knowledge in these areas provides insight to how a computer works internally, leading one to a better understanding of how to approach problems.

An area of computer science that gives direction to the computer hardware question is the area of computer organizations. Computer science involves the understanding of computer architecture: how a computer is made, what its essential components are, and how it operates. These topics are covered by the broad category of computer organization. Although computers are usually different from one another in some areas of organization, the major differences are found between personal computers and mainframe computers. Once again it is advantageous for computer science students to have knowledge of the organization of both personal computers and mainframe computers.

The final area of computer science education is the area of computer operating systems. A computer operating system is a system program that is responsible for the overall control of the computer, with the primary responsibility being the management of the computer's resources (memory, external and internal devices, and the central processing

unit are examples of resources). "Except for very early computers or a few special-purpose categories, almost every computer is provided with some type of operating system" (Lane 2).

Since each computer does have its own operating system, the study of operating systems is necessary for the complete understanding of computers. Once again, there are differences between most computers in the operating system area, but the main differences are between personal computers and mainframe computers. Obviously, it is advantageous for a student to be familiar with both styles of operating systems.

According to Dr. Robert Crawford, nothing in computer science should be taught "purely theoretically, because computer science is not a theoretical discipline." Computer science needs a practical aspect as well. The above four areas of computer science education, therefore, should not only be taught in reference to computer systems, but also applied to computer systems. The two prevalent computer systems today are the personal computer and the mainframe computer.

Dr. Ken Modesitt states that "personal computers and mainframe computers should be used in a mixture. Hopefully no one is 100% personal computers or 100% mainframe computers." Also, "students need to know aspects of both personal computers and mainframe computers and the interaction between them" (Shindhelm).

In summary, computer science students should be educated in the areas of algorithm

design, programming language specifics, computer organizations, and computer operating systems. Both the theory and the applications of personal computers and mainframe computers should be dealt with in covering these topics. However, there is one other consideration: money.

Financial concerns are always an issue in supplying students' computer needs at educational institutions. Some universities, such as the UL and WKU, have set up student fees for the purpose of supplying computer services to students. Currently, the student fee at WKU is ten dollars per student per semester. This money is allocated for equipment in any ACRS lab, and for software, student labor, operations costs (i.e. supplies and maintenance) in any of the new facilities at DUC, Hugh Poland Hall, Cherry Hall, and Helm Library. All necessary items for pre-existing labs (there are five labs that existed before the student fee collection process began in the fall of 1990) are supplied through the ACRS budget directly. The student fee is projected to yield \$200,000 each year. In the 1990-1991 fiscal year, ACRS spent approximately \$249,000 on 100 personal computers, printers, networking, software, furniture, labor, and supplies for the four new facilities at DUC, Poland Hall, Cherry Hall, and Helm Library.

The student fee does not provide any funding for the mainframe division of computing services provided by ACRS, which receives its money directly from the ACRS budget (which is approximately \$800,000 per year). While there is hope that this student fee at WKU will take care of the personal computer and LAN services (i.e. upgrading and

maintenance) in the future, there is no such future allocation of money for upgrading the mainframe (VAX 6320). ACRS is planning to upgrade the VAX 6320 in three years, but if the money is not available at that time, the replacement will have to be delayed until the money is available. If the delay is longer, the mainframe services will become outdated and of little benefit to a student's education.

What is evident is that there is a dual-process of allocating funds for computer services at WKU. Money for new equipment for any ACRS lab and software, supplies, maintenance, and student labor for the three new labs comes from the student fee, while money for pre-existing labs and the mainframe comes from the ACRS budget. In contrast to this system, UL uses only the money allocated by the student fee process to supply computer services, a student fee of forty dollars per student per semester.

Despite the attractiveness of the UL program, it would be unwise for WKU to imitate it. The program depends too much on student enrollment and is capped at a certain amount. WKU has the benefit of additional money provided by the student fee with the security of a budget provided for by ACRS.

It makes sense, then, to do a comparative study of the cost-efficiency of personal computers versus mainframe computers. Whichever computer system is more cost-efficient is the better one for the university to supply. While this view may be taken, it is certainly not in the best interest of the students at the university. On the surface, the mainframe

would be the more cost-efficient system. The computer itself is never in direct use by the students. The cheapest part of the mainframe system, the terminal, is the only part of the system that is heavily exposed to the students. This allows maintenance costs to be lower as a total over the life of the computer. Considering costs over a period of years, including personnel costs, one discovers that the personal computer looks even less cost-efficient than the mainframe because the personnel costs become dispersed over a wide range of areas, including time used learning to run software, in the personal computer viewpoint. But, mainframes are a very high expense when it comes to professional support (time spent by analysts and maintenance).

In an educational environment, it is not a good idea to compare mainframes and personal computers in the area of cost-efficiency. The question of which computer system to use is not a hunt for saving pennies. The education should be the key issue when dealing with the decision. Both systems need to exist in the university computer science program to provide the student with the proper tools for a basic understanding of computers and their applications.

WKU computer services will be adequate in the future assuming, in the next four to five years, approximately 250 personal computers are replaced, 75 to 100 compact disk ROM (read only memory) servers are installed, and new generation multi-media workstations are purchased. This new equipment will most likely be paid for by the student fee money, but it may require an increase in the student fee.

Unfortunately, there is no provision for the mainframe upgrade. Within the next three years, DEC will market its Alpha series of computers, and WKU does not have the money to purchase the upgrade unless it comes directly from the ACRS budget. Also, the budget has no carryover policy. That means ACRS cannot save money over a period of years to provide for the purchasing of the upgrade. Whatever money in the budget that is not spent within the fiscal year becomes part of the general fund. It would be easier to allocate money for such systems as the VAX 6320 if budgets could carry over in a special case such as this. But, in systems in which carryover is allowed, departments that do not spend the money allocated to them in a year usually find their budgets reduced the following year.

The current system seems in jeopardy for keeping an updated mainframe system. An alternative solution may exist. If the student fee were to become a part of the ACRS budget (and the ACRS budget before the addition was not permitted to fall below the current amount), then money could be allocated year-to-year based on need between the personal computers and the mainframe system. If the proper rotation exists, maybe such that the personal computers are updated every four years and the mainframe every five years, a balance could possibly be met to keep current facilities in both the personal computer and mainframe areas. If this budget is not carefully allocated, then inadequate computers could be found in both the personal computer and mainframe areas. Plus, this would mean sacrificing some money that would be used for personal computers to the mainframe updating. Inevitably, there is some risk of either the personal computers or the mainframe system getting too much attention at the expense of the other.

In the 1990-1991 fiscal year, WKU spent approximately 2.5% of its annual budget on computing services, but the national mean was 3.5%. Compared to other Kentucky universities, WKU falls behind UL and UK, but is very close to the remaining universities. UL offers students computer services on a VAX Cluster which is made up of a VAX 6410, a VAX 8650, and a VAXStation compared to the one VAX 6320 at WKU. UL also offers about a dozen Unix workstations for student use, which WKU does not offer. UK offers computer use on an IBM 3090 and a Prime machine (both are mainframe computers), about 100 various workstations, and numerous personal computers.

It is not totally the fault of WKU for being behind UL and UK in providing computer services to students. The state of Kentucky gives more funding to UK and UL. In October of 1991, all state-funded schools were to have funding decreased by 5%. UK lost \$15 million compared to WKU's \$2.3 million.

To help ensure students are receiving the proper computer science education to prepare them for post-graduation activities, WKU has set the following student goals:

1. greater than or equal to 90% of those who initially choose employment in the field of computer science are hired within six months of graduation,
2. greater than or equal to 90% of those who choose graduate school are accepted and greater than or equal to 90% of those

complete their advanced degree,

3. greater than or equal to 80% of the first employers of our graduates rate them above average relative to their peers after one year,

4. greater than or equal to 90% of our graduates rate our program favorably within the first three years after graduation,

5. and greater than or equal to 90% of our graduates are self-sufficient in terms of giving more to society than what they take from it.

It is becoming an increasingly important job for universities to provide students with the appropriate technology for learning. In computer technology, many changes will occur in the years to come. Increasingly, the availability of information will come from compact disk ROM. Likewise, distributed computing, the process of a workstation communicating to a central file serving mainframe, will become more important in industry.

Granted, WKU is upgrading the theory component of its computer science program, is attempting to gain accreditation from the CSAB, and is setting goals for its graduates, but the university must add some personal computer course requirements to provide students with a more balanced computer science education. While the proper scope and number of

personal computer course requirements may be debated, WKU should make a strong effort to address these needs. Simultaneously, the teaching of theory requires an expenditure for current technology. If WKU does not take such actions as increasing its student fee by at least 20 dollars and making future arrangements to supply computer services to students, the university will be crippling its computer science graduates.

WKU Department of Computer Science
Alumni Questionnaire
and Statistics

APPENDIX A

WKU Department of Computer Science Alumni Questionnaire and Statistics

Department of Computer Science
Western Kentucky University

Alumni Questionnaire

6/26/91: Responses = 22

| | | |
|--------------------------------|-----------|------------------|
| 1. DEGREE & DATE OF GRADUATION | YEAR:76=1 | 85=5 |
| BS = 21 | MS = 1 | 77=1 86=2 |
| SPRING=17 | SUMMER=1 | FALL=3 78=1 87=2 |
| | | 81=1 88=1 |
| | | 83=1 89=4 |
| | | 84=1 |

2. JOB TITLES

ARMY COMMANDER
DATABASE SYSTEM ADM.
DIRECTOR OF INFO. SYSTEMS
LARGE SOFTWARE DEVELOPER
MARKETING ASSOC.
MATHEMATICIAN
MODEL SIMULATION
PROGRAMMER(2)
RESEARCH SYSTEMS ENGIN.

SOFTWARE ANALYST
SOFTWARE CONSULTANT
SR. ASSOCIATE PROGRAMMER
SR. INTERNAL POLICY ANLYT.
SR. PROGRAMMER
SYSTEMS ENGINEER
SYSTEMS PROGRAMMER(2)
SYSTEMS PROJECT MANAGER
TECHNICAL CONSULTANT

3. CS OPTION

SCIENTIFIC = 8 BUSINESS = 5 SYSTEMS = 6

4. CS COURSES (OR OTHERS) THAT ALUMNI WOULD LIKE TO HAVE TAKEN THAT WERE NOT IN CURRICULUM.

ALGORITHMS
ARTIFICIAL INTELLIGENCE
BOOLEAN ALGEBRA

PC COURSES
OBJECT ORIENTED PRGRMMG.
RPG

| | |
|--------------------------------|----------------------------|
| CASE | SOFTWARE ENGINEERING |
| C LANGUAGE | SOFTWARE TESTING METHODS |
| BUSINESS APPL.(PCs) | STRUCTURED DESIGN |
| DATABASE(5): ANALYSIS, RDBMS | STUDENT CONSULTING |
| DEBUGGING TECHNIQUES | SYSTEM OPERATOR |
| GRAPHICS(3): FRACTALS | UNDER-GRAD COMPILER COURSE |
| IND. SR. PRJCT. W/PRESENTATION | UNIX(3) |
| MODELING | |

5. CS COURSES THAT ALUMNI FEEL SHOULD NOT BE INCLUDED IN CS MAJOR.

BASIC; DEC PDP MACRO ASSEMBLER; PHYSICS;
PROGRAMMING LANGUAGES.

6. MOST HELPFUL CS COURSE(S)

| | |
|-----------------------------|----------------------------|
| BASIC(2) | CS 448 SYSTEMS ANALYSIS(3) |
| BUSINESS SYSTEMS | CS 475 UNIX |
| 'C' | CS 338 DISCRETE MATH |
| COBOL(4) | LANGUAGE CLASSES(2) |
| COOPERATIVE EDUCATION | LINEAR ALGEBRA |
| CS 242 | PROGRAMMING LANGUAGES(2) |
| CS 442 DATA STRUCTURE(4) | STRUCTURED PROGRAMMING |
| CS 443 DATABASE(4) | TECHNICAL WRITING |
| CS 445 OPERATING SYSTEMS(3) | TELECOMMUNICATIONS |

7. STRENGTHS OF THE CS PROGRAM

| | |
|----------------------------------|------------------------|
| CONTINUED GROWTH | OPTIONS |
| GOOD STUDENT/INSTRUCTOR RELATION | PROFESSORS(10) |
| "HANDS ON" EXPERIENCE | SMALLER CLASSES |
| LAB PROJECTS | STRUCTURED PROGRAMMING |
| LANGUAGE VARIETY | |

8. WEAKNESSES OF CS DEPARTMENT.

CO-OP NEEDS MORE ENCOURAGEMENT
 CO-OP SHOULD BE REQUIRED
 DOS AND PC BASED LANGUAGE SHOULD BE BETTER TAUGHT
 HARD TO KEEP GOOD PROFESSORS
 JCL SHOULD BE REQUIRED
 MORE COORDINATION NEEDED
 MORE EMPHASIS ON SPECIFIC PROGRAMMING
 MORE EMPHASIS ON UNIX VARIANTS
 NEED MORE C LANGUAGE
 NEED TO READY STUDENTS FOR REAL WORLD
 NEED UPDATED EQUIPMENT
 NOT ENOUGH TEAM PROJECTS
 SLOW REACTION TO TECHNOLOGY
 SR. PROJECT SHOULD BE REQUIRED
 TOO MUCH EMPHASIS ON TECHNOLOGY
 TOO MUCH INTEREST IN IBM

9. ALUMNI RESPONDENTS RECOMMENDING PROGRAM TO SIBLINGS AND/OR OTHERS.

YES = 18 NO = 0

10. CURRENT POSITION DESCRIPTION.

ADMINISTRATOR FOR DATABASE SYSTEM
 ANALYZES DATA
 AIX NETWORK MANAGEMENT DEVELOPER
 CONSULTANT
 DATA PROCESSOR
 DEVELOP LARGE SOFTWARE PROGRAMS FOR GOV'T CONTRACTS
 MAINTAIN & MODIFY SOFTWARE
 MAINTAINS EXISTING SOFTWARE PACKAGES
 MAINTENANCE OF WANG PALE dp
 MANAGER FOR CASE DEVELOPMENT EFFORT
 MANAGER OF SYSTEMS STAFF
 MANAGE SUCCESSFUL DESIGNS
 MARKETING OF UNIX SYSTEMS

PROGRAMMER(2)
 PROJECT MANAGER
 SOFTWARE ANALYST
 SOFTWARE DEVELOPMENT TEAM
 SR. PROGRAMMER
 SYSTEMS ANALYST
 SYSTEMS ENGINEERING(2)
 U.S. ARMY COMMUNICATIONS OFFICER

11. DID YOU LEAVE WKU CS PROGRAM PREPARED FOR CURRENT POSITION.

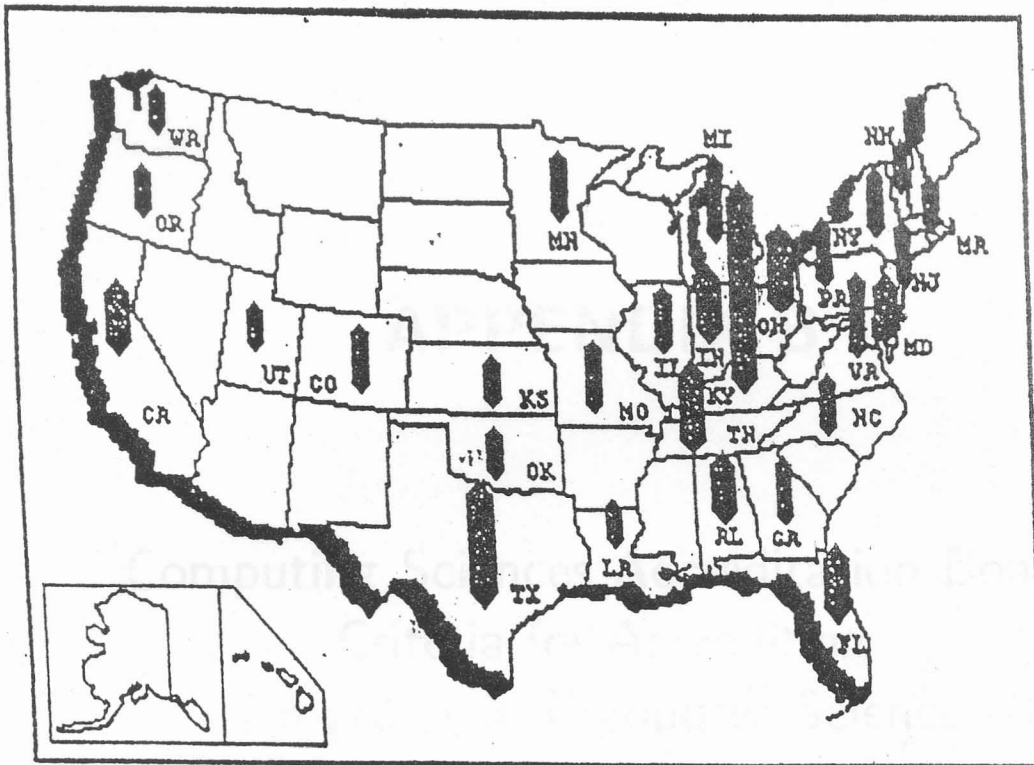
YES = 15 NO = 2 KIND OF = 3

12. HARDWARE, OPERATING SYSTEMS, SOFTWARE USED IN CURRENT POSITION.

| | |
|---------------|---------------------------------|
| ADA | IBM MVS/TSO(2) |
| ALTOS | IBM PCs/COMPATIBLES(2) |
| AS/400 | IBM PS/2(3) |
| AIX | IBM RISC 6000(3) |
| B20 | IBM SYSTEM/36 |
| B70 | IBM 30XX |
| C LANGUAGE | IBM 370 |
| CLIX | IBM 3090(3) |
| CLONES | IBM 43XX |
| COBOL(2) | ICC COMMUNICATIONS |
| COLOR MONITOR | IMPS |
| CRAY | INFORMIX |
| CTT | INGRES |
| DBASE 3 PLUS | INTGPH. MACHNES, CLIPPERED BSD. |
| DB2 | INTGPH.(RISC BSD)220,2020, |
| DOS(4) | KERMIT |
| DOS 6 XENIX | LAN (386) |
| DOS 3.3 & 4.0 | LOTUS(2) |
| DPCX | MAC-PAC |
| DPPX | MAINFRAME |
| ENABLE | MICROFOCUS COBOL |
| ENVIRON | MODEMS |

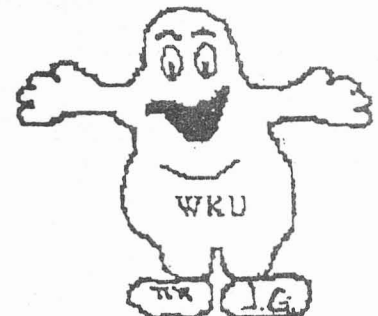
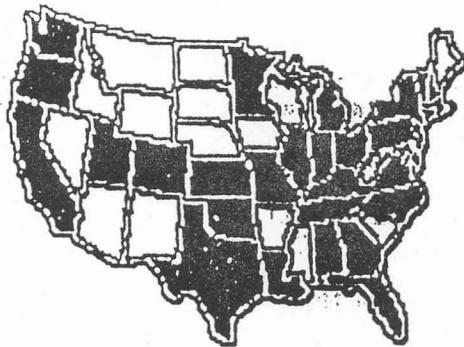
WESTERN KENTUCKY UNIVERSITY Computer Science Alumni Nationwide

JUNE 1991



The large map graphically shows the number of alumni per state, taken from the data below.

| | | |
|---------|----------|-------------|
| AL = 15 | KY = 191 | NJ = 4 |
| CA = 16 | LA = 1 | NY = 3 |
| CO = 3 | MA = 2 | OH = 17 |
| FL = 11 | MD = 15 | OK = 1 |
| GA = 3 | MI = 5 | OR = 1 |
| IL = 5 | MN = 3 | PA = 2 |
| IN = 16 | MO = 4 | TN = 28 |
| KS = 1 | NC = 4 | TX = 53 |
| | NH = 1 | UT = 1 |
| | | VA = 6 |
| | | WA = 1 |
| | | <hr/> |
| | | Total = 413 |
| | | States = 28 |



APPENDIX B

COMPUTING SCIENCES ACCREDITATION BOARD
CRITERIA FOR ACCREDITING PROGRAMS
Computing Sciences Accreditation Board
Criteria for Accrediting
Programs in Computer Science
in the United States



COMPUTING SCIENCES
ACCREDITATION BOARD, INC.

345 East 47th Street • New York, N.Y. 10017 • (212) 705-7314

CRITERIA FOR ACCREDITING PROGRAMS

IN COMPUTER SCIENCE

IN THE UNITED STATES

January 23, 1987

CRITERIA FOR ACCREDITING PROGRAMS IN COMPUTER SCIENCE
IN THE UNITED STATES

I. INTRODUCTION

A. Purposes

The purpose of the Computing Sciences Accreditation Board (hereafter referred to as CSAB) as delineated in the Constitution "...is to advance the development and practice of the computing sciences in the public interest through the enhancement of quality educational programs in the computing sciences. The term 'computing sciences' is defined to include the broad spectrum of computer disciplines."

Section II of the Constitution states, CSAB shall:

- organize and conduct accreditation activities for educational programs in the computing sciences.
- determine evaluation criteria for educational programs to assure competence of graduates at the specific levels for which the programs are designed.
- define minimum program requirements for accreditation in cooperation with member organizations.
- provide accreditation-related information to academic institutions and others planning educational programs.
- promote intellectual development and understanding of subject areas which impact accreditation in the computing sciences.
- provide for regular and orderly communication among its members on matters related to accreditation.
- act jointly with other recognized accrediting bodies in developing, reviewing, and improving educational programs related to the computing sciences.
- organize and conduct forums for the consideration of accreditation issues of interest to its members and the public at large.

B. Responsibilities

1. CSAB carries out its accreditation activities through standing committees or commissions, one of which is the Computer Science Accreditation Commission (hereafter referred to as CSAC or CSAC/CSAB.) The accreditation commissions are charged with the following responsibilities:
 - a. The accreditation commissions shall propose policies, procedures, and criteria to the CSAB Board of Directors for approval. The Board of Directors shall review policies, procedures, and accreditation criteria and may specify changes to be made in them on the appropriate accreditation commissions.
 - b. The accreditation commissions shall administer the accreditation process based on policies, procedures, and criteria approved in advance by the CSAB Board of Directors and shall make final decisions on accreditation actions.
2. Procedures and decisions on all appeals to accreditation actions shall be the responsibility of the CSAB Board of Directors.

C. Objectives of Computer Science Accreditation

The purpose of accreditation is to identify those institutions which offer post-secondary computer science programs worthy of recognition. In keeping with the broad purpose of CSAB as given above, accreditation is intended to accomplish the following specific objectives:

1. To identify to the public; to prospective students; to educational institutions; to professional educational, and scientific societies; to potential employers; and to governmental agencies; those institutions and specific programs that meet minimum criteria for accreditation.
2. To provide guidance for the improvement of the existing educational programs in computer science and for the development of future programs.
3. To stimulate the improvement of computer science education in the United States.
4. To ensure that, in addition to achieving technical competence, graduates of accredited programs have completed a significant segment of broad studies to prepare them for the future.

-3-

II. POLICIES

A. Accreditation Policies

CSAB has established the following basic policies:

1. To accredit educational programs rather than institutions, since it is well recognized that programs of quite different quality may sometimes be found at the same institution. In order for a program to be accredited, all routes to completion of the program must be accreditable.
2. To require, as a prerequisite to CSAC evaluation and accreditation of its computer science educational programs, that the institution be in one of the following categories:
 - a. Institutions currently accredited by a regional or national institutional accrediting agency or formally approved by a State authority recognized by the Council on Post-secondary Accreditation (COPA) and/or the U.S. Department of Education.
 - b. Institutions that offer computer science programs whose accreditation would further the objectives of CSAB.
3. To favor broad basic programs in computer science that will prepare a student to take advantage of as many different opportunities as possible. CSAB prefers to minimize the number of specially designated programs to be considered for accreditation.
4. To invite institutions to submit programs without persuasion or pressure.
5. To grant accreditation only if students have been graduated from a program by the time CSAC takes action.
6. To avoid applying minimum standards in a way that would discourage well-planned experimentation.
7. To deny accreditation to programs which omit instruction in a significant portion of a subject in which computer science specialists may reasonably be expected to have competence. This policy is intended to be a safeguard to the public. It should not entail the setting of rigid standards. It should be noted that programs which are perhaps contiguous to computer science but do not develop the basic abilities of the computer science specialist are not eligible for accreditation as computer science programs, however excellent and useful they may be.

-4-

8. To assess qualitative as well as quantitative factors in making an accreditation decision. These factors are assessed by a competent team of CSAC evaluators visiting the institution.
9. To submit the findings and recommendations of the visiting team for review by officers of CSAC, by the full membership of CSAC, and by the CSAB Board of Directors.
10. To publish a list of accredited programs only. If a program or institution is not on the accredited list, information as to whether it has been under consideration by CSAC/CSAB will not be made available except to the appropriate officials of the institution in question.
11. To assure that the title of CSAB accredited program is properly descriptive of the content of the program. Although the selection of program titles is the prerogative of educational institutions, CSAB discourages the proliferation of computer science program titles, because different titles for essentially the same programs are confusing or misleading to the public, including students, prospective students, and employers. Also, similar titles for essentially different programs are equally confusing and misleading.

B. Revocation of Accreditation

Questions regarding the continued compliance of programs during the period of accreditation may be directed to CSAB. If it appears that an accredited program is not in compliance with CSAB criteria, the institution is so notified. If the response from the institution is not adequate, CSAB may institute revocation-for-cause procedures. The institution is notified as to the cause why revocation is to be instituted. An on-site visitation is scheduled to determine the facts. A comprehensive document showing the reasons for revocation is provided to the institution for its analysis and its response. If the institution's response is not adequate, revocation for cause is implemented. The institution is promptly notified by the President of CSAB of such action together with a supporting statement showing cause. A revocation constitutes a "not to accredit" action and is appealable. Accreditation is continued until the appeal procedure is terminated.

C. Appeal

Provision is made for appeal of "not to accredit" actions to the CSAB Board of Directors. (see VI.E. below)

D. Public Release Policy

1. Accreditation by CSAB is based on satisfying minimum educational criteria. As a measure of quality, it assures only that an accredited program satisfies the minimum standards. The various periods or terms of accreditation do not represent a relative ranking of programs in terms of quality. At no point is an institution allowed to publish or imply the term or period of accreditation. Public announcement of the accreditation action should only relate to the attainment of accredited status. Because accreditation is specific to a program, all statements on accreditation status must refer only to those programs that are accredited. No implication should be made by an announcement or release that accreditation by CSAB applies to any programs other than the accredited ones.
2. College catalogs and similar publications must clearly indicate the programs accredited by CSAB as separate and distinct from any programs or other kinds of accreditation. No implication should be made in any listing that all programs are accredited because of an institution's regional or institutional accreditation. Accredited computer science programs should be specifically identified as "accredited by the Computing Sciences Accreditation Board".
3. Direct quotation in whole or in part from any statement by CSAC or CSAB to the institution is unauthorized. Correspondence and reports between the accrediting agency and the institution are confidential documents and should only be released to authorized personnel at the institution. Any document so released must clearly state that it is confidential. Wherever institution policy or state or federal laws require the release of any confidential document, the entire document must be released.

III. METHODS OF EVALUATION

A. Questionnaire

An institution's computer science education program will be initially evaluated on the basis of data submitted by the institution as a result of a thorough, comprehensive self-study in which administrators, key faculty members, and selected students participate. The results of self-study findings will be prepared in the form of answers to a CSAC/CSAB questionnaire. Questionnaires that do not have the self-study foundation will not be considered.

B. On-site Visit

The questionnaire answers will be supplemented by a report of an on-site visit by a carefully selected team representing CSAC. The on-site visit aims:

1. To assess factors that cannot be adequately described in the questionnaire. The intellectual atmosphere, the caliber of the staff and student body, and the character of the work performed are examples of intangible qualitative factors that are difficult to assess from a written description.
2. To help the institution assess its weak as well as its strong points.
3. To examine in further detail the material compiled by the institution on:
 - a. Auspices, control, and organization of the institution and of the unit offering the computer science program.
 - b. Educational programs offered and degrees conferred.
 - c. Basis of and requirements for admission of students.
 - d. Number of students enrolled:
 - (1) in the unit offering computer science, as a whole, and
 - (2) in the individual computer science program.
 - e. Teaching staff and teaching loads; environment and opportunities for professional development of the teaching staff.
 - f. Physical facilities--particularly the educational plant devoted to computer science.
 - g. Finances--investments, expenditures, sources of income.
 - h. Curricular content of the program.
 - i. Instructional materials, including examples of student work.
 - j. Experiences of graduates of the program.

IV. CRITERIA

A. Program Design and Level

In order to be considered for accreditation, computer science programs must be designed to give graduates a broad general education at the baccalaureate levels that also prepares them to become professionals in Computer Science. Programs designed to prepare graduates for supporting roles in computer science (e.g. technician), are not eligible, nor are programs which do not provide an adequate base for the application of fundamental concepts to the discipline of computer science. To assist in the identification and recognition of characteristics of computer science programs for accreditation purposes, the criteria that follow have been adopted by CSAB.

B. Intent of Criteria

These criteria are intended to assure an adequate foundation in science, mathematics, the humanities and social sciences, and computer science fundamentals; and to assure appropriate preparation in advanced computer science. They are designed to be flexible enough to permit the expression of an institution's individual qualities and ideals. They are to be regarded as a statement of principles to be applied with judgment rather than as rigid and arbitrary standards. Finally, they are intended to encourage and stimulate (and not to restrain) creative and imaginative programs.

CSAB has used words and phrases such as "must", "should", and "is desirable" in an attempt to denote the degree of flexibility with which specific criteria requirements are to be interpreted. Departure from a requirement will be considered to the extent that the institution demonstrates that particular strengths of its program provide an educational experience of equivalent value in meeting the objectives of the criteria. CSAC/CSAB will also give sympathetic consideration to departures from the criteria in any case where the institution demonstrates that well-considered experimentation or innovation is under way.

C. Faculty Requirements

The strength of the computer science program lies with its faculty. There must be enough faculty to provide course offerings that allow the students to complete the program in a timely manner. The interests and qualifications of the faculty must be sufficient not only to teach the courses but also to plan and modify the courses and curriculum. Faculty members must remain current in the discipline.

The number of FTE faculty required by the program will be influenced by such factors as the number of students in the program, the number of courses required by the program, the demand for computer science courses by non-computer science majors, and the teaching load of the faculty. There must be sufficient FTE faculty with primary commitment to the program to provide continuity and stability. Qualified instructors other than full-time faculty may be used in a supplemental role, but full-time faculty should oversee all coursework and should cover at least 70% of the total classroom instruction. Typically, a program should have a minimum of 5 full-time-equivalent faculty, of which 4 should be full-time faculty with primary commitment to the program, in order to meet the teaching needs of the program, to meet the needs for ongoing curriculum development, and to provide depth and breadth of faculty expertise.

The professional competence of the faculty must span a broad range of interests in computer science. It is highly desirable that a majority of the faculty hold a terminal degree and that some hold a terminal degree in computer science. Each faculty member should have at least the equivalent of some graduate work in computer science. Furthermore, each faculty member with primary commitment to the program must be sufficiently competent in computer science to be able to teach a broad range of fundamental computer science courses and to make a scholarly contribution to the computer science discipline.

All faculty members must remain current in the profession and some should regularly contribute to the discipline. Faculty members must have sufficient time for scholarly activities and professional development. On the average, 25 per cent of the faculty time should be devoted to scholarly activities. In no case should teaching loads exceed the equivalent of 12 semester-hour credits per semester. If they do become that high, the load must not exceed four courses per semester and two preparations. It must also be recognized that scholarly activity can not be expected of a faculty member with such a high teaching load.

Upper division class sizes should not normally exceed 30 students, but it is recognized that, with appropriate resources such as teaching assistants and graders, classes larger than 30 can sometimes be handled effectively. Lower division classes may be larger, but effective interaction between faculty/teaching assistants and students must be assured.

A faculty member should not be assigned more than 25 undergraduate advisees without appropriate release time. Faculty should have adequate support services, particularly secretarial, word processing, and copying.

D. Curriculum

For this section, requirements are specified in terms of years of study. For a baccalaureate program requiring 120 semester hours (180 quarter hours), one year of study equals 30 semester hours (45 quarter hours). For a program requiring more than 120 semester hours (180 quarter hours), 30 semester hours (45 quarter hours) may be considered to constitute one year of study in any of the curricular components specified. For a baccalaureate program requiring fewer credit hours, or a program using a different credit system, one year of study is considered to be one-fourth of the total credit requirements for the program.

40 yrs-
The curriculum must integrate technical computer science requirements with general education requirements and electives to prepare the students for a professional career in the computer field, for further study in computer science, and for functioning in modern society. The computer science program must provide the student with both breadth and depth in computer science. The program should have at least one and one-third years of study in computer science topics. It should also contain at least two additional years of study as specified in (2.) below. The remaining two-thirds year of the program is unspecified by CSAB and may be used as appropriate to fulfill the objectives of the student or the institution.

1. Computer Science

The computer science segment of the program must contain a broad-based core of fundamental material that is required of all students and that makes up 40 to 60 percent of the computer science requirement. This core must provide reasonably even emphasis over the areas of theoretical foundations of computer science, algorithms, data structures, software design, the concepts of programming languages, and computer elements and architecture. Within this portion of the program, analysis and design experiences with substantial laboratory work, including software development, should be stressed. In addition the student must be exposed to a variety of programming languages and systems and must become proficient in at least one higher-level structured language. The social implications of computing should be included in the program.

The remaining 40 to 60 percent of the computer science segment of the program should be advanced courses in computer science. These courses are to be selected in such a manner as to insure that depth of knowledge is obtained in at least one-half of the core material.

Some of these topics in the computer science segment could be covered in courses offered in other departments.

2. Additional Requirements

Certain areas of mathematics and science are particularly important for the study of computer science. These areas must be included in all programs.

15 hrs. The curriculum must include one-half year study of mathematics. This material must include discrete mathematics, differential and integral calculus, and probability and statistics; and may include additional areas such as linear algebra, numerical analysis, combinatorics, and differential equations. Some of this material may be covered in the courses of the computer science department.

The curriculum must include the equivalent of a) a two-semester sequence in a laboratory science for science majors and b) two additional one-semester courses in science and/or courses with strong emphasis on quantitative methods.

The curriculum must include the equivalent of at least one year's study in humanities, social sciences, arts, and other disciplines that serve to broaden the background of the student. These courses are frequently specified by institutional requirements.

The communication skills of the student, both oral and written, must be developed and applied in the program.

E. Laboratory and Computing Resources

Programs in computer science require substantial laboratory and computing resources for class work and individual projects. Such resources will normally involve a blend of computer facilities of varying capabilities. Sufficient facilities must be available so that each student has adequate and reasonable access to the appropriate system for each course. Where scheduled laboratory instruction is required, sufficient equipment must be available so that no more than two students share a laboratory station.

Appropriate facilities must also exist to support the scholarly activities of the faculty. Depending on the nature of such activities, this work may require additional and separate facilities, and in any event, this requirement must be considered in addition to the equipment required to support the student activities. At a minimum, all faculty members should have some form of computing access available in their offices for class preparation and research purposes.

Adequate and reasonable software to support the program must be available. Typically, this includes current versions of at least one structured language, one or more languages in "common" use, one or more assembly languages, an operating system, and a database management system. Students must have appropriate expendables to work with the system. Complete documentation of available hardware and software must be readily accessible to faculty and students.

-11-

It is critical that adequate support personnel be provided to implement and maintain the laboratory component of the program. Adequate instructional assistance must be provided for the laboratories.

F. Students

The quality of a computer science program is dependent on the quality of the students as well as the faculty and the institutional resources. There must be established standards and procedures throughout the program in order to insure that graduates of the program have the requisite qualifications to function effectively as computer science professionals by meeting the department's graduation requirements.

It is the responsibility of the faculty to monitor the progress of the students. Appropriate measures, consistent with the institutional mission, must be devised to guide students toward completion of the program in a reasonable amount of time. The advisory function of the faculty must be recognized by the institution and must be given appropriate administrative support.

G. Institutional Support

The organizational structure, fiscal policies, and instructional philosophy of an institution must be such that they provide reasonable assurance that an accredited program will, in fact, retain its strength throughout the period of accreditation. Areas of institutional support that are considered especially important include:

- recruitment and continued support of a well-qualified faculty;
- recruitment and continued support of well-qualified administrators;
- creation and maintenance of a library, staffed with qualified professional librarians, including technical and nontechnical material;
- provision for sufficient secretarial support, office equipment, and maintenance of such equipment;
- acquisition and maintenance of laboratory equipment, including computing equipment, and associated support personnel. (See IV.E., Laboratory and Computing Resources.)

1. Faculty Support

Many factors affect faculty recruitment and retention. Sabbatical and other leave programs, reasonable teaching loads, and competitive salaries are important in attracting and retaining faculty of high quality. Travel support sufficient to allow each faculty member to attend at least one national technical meeting a year is essential. Support and recognition of scholarly activities are also essential.

-12-

2. Administration

All levels of the college/university administration are relevant to the program. Positive, constructive leadership by the dean of the college/school and the head/chairperson of the program is important in maintaining its quality. Adequate time must be assigned for the administration of the program. At a minimum, the department administrative support should be proportional to other similar departments. Upper levels of administration must provide the program with the resources and atmosphere to function effectively with the rest of the institution.

3. Library

The library that serves the Computer Science program must be adequately staffed with professional librarians and support personnel. Sufficient financial support must be provided to acquire and maintain an adequate technical collection and an appropriate nontechnical collection. The technical collection must include up-to-date textbooks, reference works, the journals and transactions of the IEEE Computer Society and the Association for Computing Machinery, and publications of other professional societies and major research organizations in the United States. The collection must also include a representative number of trade journals.

4. Office Secretarial Support

The institution must provide modern office equipment such as word processors and duplicating equipment. In addition, secretarial support must be consistent with the type of program, level of research activity, and so forth.

H. Innovative, Experimental, And Non-Day Programs

These criteria are intended to allow experimentation and innovation. Flexibility in meeting changing situations, the needs of a variety of students, and the local environment, are to be encouraged. However, it is the responsibility of the institution to demonstrate that experimental and/or innovative programs meet or exceed the intent of the criteria.

Although these criteria do not, at this time, address the special circumstances of evening or cooperative baccalaureate programs, CSAC will consider such programs if they meet or exceed the intent of the criteria.

Nothing contained herein should be interpreted as constraining an institution in any way in the development of its educational programs.

-13-

V. APPLICATION OF CRITERIA

- A. Information published for students, prospective students, and the general public on a computer science program should provide sufficient definition of the program to show that it meets the CSAB accreditation criteria. For example, if some fraction of the total elective courses must be taken in one curricular area in order for the criteria to be met, this requirement should be published, even though adequate counseling of students by faculty members may be shown to achieve the same objective.

VI. PROCEDURE

A. Application and Preparation for Visit

1. CSAC evaluation of computer science educational programs for possible accreditation must start with a specific request from the institution. CSAC is prepared to examine any programs that appear likely to satisfy its criteria.
2. An institution that wishes to have any or all of its computer science programs considered for accreditation may communicate directly with the CSAB Executive Director. Arrangements will then be made to furnish self-study guidelines, to receive the self-study questionnaire data, and to evaluate the educational facilities of the institution by sending a team chaired by a member or recent member of CSAC. It is suggested that an institution contemplating an accreditation evaluation for the first time contact CSAB prior to making the formal request. The formal request should be made not later than January 15th of the calendar year in which the campus visit is desired.

B. Confidentiality of Information

Information supplied by the institution is for the confidential use of CSAB and its agents. It will not be disclosed without the specific written authorization of the institution concerned.

C. Visit and Report

1. Each visiting team is selected from lists provided by CSAB Member Societies. The visiting team reports its preliminary findings and recommendations in writing to the officers of CSAC for editing and transmission to the institution visited.

-14-

2. Between the time of the visit and the annual meeting of CSAC, the responsible administrative officer of the institution may submit to the Commission any supplemental information that he or she believes may be useful to the Commission in its consideration and appraisal of the visiting team's report. In considering formal responses from institutions to the preliminary statements, the CSAC will retain a flexible attitude but, in general, will base its accreditation actions on the status of the programs at the time of the on-site visit. The primary purpose of the response is to correct errors of fact or observation that may have been inadvertently made at the time of the visit. Deficiencies existing at the time of the visit are considered to have been corrected only when (a) the correction or revision has been made effective during the year of the visit and (b) is substantiated by official documents signed by responsible administrative officers. Where action has been initiated to correct a problem but has not yet taken full effect, or where only indications of good intent are given, the effectiveness of the corrective action (e.g., planned employment of a new faculty member; proposed addition of new course work; expected provision of additional funding or new equipment) cannot be considered until the next scheduled visit or progress report.

D. Accreditation Action

1. Final decision on accreditation rests with CSAC, which considers information from the institution's self-study report, the CSAC Team's reports of its campus interviews and investigations, the institution's response to the Preliminary Statement, and the Team Chairperson's oral report to the entire CSAC membership.
2. Accreditation of a program is granted for a specific period, usually three or six years, with the understanding that the term of accreditation is subject to review for cause at any time during the period of accreditation. Accreditation is granted if current conditions are judged to be meeting or exceeding the minimum requirements. If, for any reason, the future of a program appears precarious, or definite weaknesses exist, the accreditation period will be shortened, usually to three years. Factors which might limit the term of accreditation include uncertainty about financial status; uncertainty about the nature of the administrative organization; pressing needs for additions to, or improvements in, staff or equipment; a new or changing curriculum; or undue dependence upon a single individual.

-15-

3. A "not to (re)accredit" action on a currently accredited program is effective as of the beginning of the academic year closest to September 30 of the calendar year following the year of the "not to accredit" decision by CSAC. The notification to the institution shall indicate (a) that the termination supersedes the accredited status listing of the program in the current annual report and (b) that CSAB expects the institution to formally notify students and faculty affected by the termination of the program's accredited status, not later than September 30 of the calendar year of the "not to accredit" action.
4. CSAC will conduct a comprehensive evaluation of an institution's total program under its purview, including all computer science programs accredited or seeking accreditation and supporting offerings, at intervals not exceeding six years.
5. A list of programs which have been accredited by CSAC is prepared annually and printed in the Annual Report of CSAB. The accredited status of a program listed in the Annual Report applies to all graduates who completed the program during the preceding academic year. In order to keep the list dependable and up-to-date, reevaluations based on campus visits are made as required at intervals of six years or less.
6. The functions of CSAB are restricted by its Member Societies to the granting of accreditation and to the publication of a list of those programs that are approved. Neither CSAC nor CSAB has authority to impose any restrictions or standardizations upon institutions. They have no desire to do so. On the contrary, they aim to preserve the independence of action of individual institutions and thereby to promote the general advancement of computer science education.

E. Appeal

In the event an institution wishes to appeal an action of "not to accredit" taken by CSAC, written notice of intent to appeal and proposed grounds for the appeal must be given to the Executive Director of CSAB within thirty days of the date of notification of the action. The only permissible grounds for appeal are (a) allegations of errors in fact or observation, (b) allegations that CSAC did not follow CSAB's published criteria; or (c) allegations that CSAC did not follow its published procedures. Upon receipt of such notice, the President of CSAB will appoint a special committee of the CSAB Board of Directors that will have a minimum of three members. This special committee will schedule a meeting at CSAB Headquarters or other location as soon as practical and convenient for all parties to the appeal. Appropriate administrative officers of the institution and representatives of CSAC shall be present at this meeting to assist the special committee in considering the weight and relevance of statements submitted in support of the appeal. The findings of the special committee will be reported at the next scheduled meeting of the Board of Directors where final action on the appeal will be taken.

-16-

F. Changes During Periods of Accreditation

It is the obligation of the institution's administrative officer responsible for the computer science program to notify the CSAB Executive Director of any changes in staffing, administration, content and/or title of curriculum during the period of accreditation and to submit catalog revisions of accredited programs to CSAC, through the CSAB Executive Director, when the catalog revisions are published.

G. Further Information

Requests for further information on CSAB, CSAC, or computer science accreditation may be addressed to the Executive Director, Computing Sciences Accreditation Board, 345 East 47th Street, New York, NY 10017.

APPENDIX C

Interview Questions

INTERVIEW QUESTIONS

1. Name?
2. Degree(s) (highest), when received, where received?
3. What computer systems have you used in the work place, during formal education, or for personal use?
4. Which computer systems do you prefer?
5. Response to this statement-

Computer Science students at Western Kentucky University should concentrate on both the theory and applications of mainframe computers but only the theory of personal computers.

6. How important are pcs/mainframes to the education of:
 - a. Knowledge of algorithm design skills
 - b. Knowledge of programming language specifics
 - c. Knowledge of computer organizations
 - d. Knowledge of computer operating systems
7. Are CS students prepared for employment or graduate school after fulfilling undergraduate degree at WKU?

Annotated Bibliography

Arnold, David O. *Computers and Society Impact!* New York: McGraw Hill, 1991.

This textbook emphasizes personal computers but provides background information about mainframe computers. The book reviews computer basics, the uses of computers, and the impact of computers on society.

Austing, R.H., et al. "Curriculum '78: Recommendations for the undergraduate Program in Computer Science - A Report of the ACM Curriculum Committee on Computer Science." *Communications of the ACM* Volume 22.3 (March 1979): 147-165.

As a set of guidelines, this report outlines the organization of an undergraduate computer science program.

Computing Sciences Accreditation Board, Inc. *Criteria for Accrediting Programs in Computer Science in the United States*. New York, 1987.

In outline form, this piece of literature sets guidelines for enhancement of quality educational programs in the computer sciences.

Crawford, Robert. Interview. October 24, 1991.

Since Dr. Crawford has had much personal computer experience, he was helpful in demonstrating the need for personal computers in a computer science curriculum.

Crenshaw, John. Interview. October 10, 1991.

After stating some flaws in the current curriculum, Dr. Crenshaw gave opinions as to how the curriculum should be designed.

Goatley, Hunter. Interview. February 19, 1992.

As a former student of WKU and now the VMS Systems Programmer for the university, Mr. Goatley gave some history of computer services provided by WKU, some comparisons to other regional schools, and predictions on the course of computers.

Jones, Jeff. Interview. October 28, 1990.

As a Programmer/Consultant for WKU, Mr. Jones provided information concerning WKU's status, some history of computing at WKU, and the future of computer services.

Lane, Malcolm G., and James D. Mooney. *A Practical Approach to Operating Systems*. Boston: PWS-KENT Publishing Company, 1989.

A study of computer operating systems, this work set forth criteria for selecting and designing such systems.

Modesitt, Ken. Interview. October 31, 1991.

Dr. Modesitt, the Computer Science Department Head, provided material concerning the curriculum at WKU and the relationship between personal computers and mainframes in industry.

Shelly, Gary B., and Thomas J. Cashman. *Computer Fundamentals with Application Software*. Boston: Boyd and Fraser Publishing Company, 1986.

The purpose of this textbook is to provide an introduction to basic computer concepts and instruction on how to use electronic spreadsheet, database management, and word processing software.

Shindhelm, Arthur. Interview. October 24, 1991.

Dr. Shindhelm was helpful in providing information about the relationship between personal computers and mainframes in the computer science curriculum and in industry.

Sloan, Jay. Interview. February 19, 1992.

Dr. Sloan, Director of Academic Computing and Research Services, provided information concerning the history of computing at WKU and figures concerning the money allocated to providing computer services to students. Dr. Sloan was also helpful in predicting computer needs that the university will have in the near future.

Western Kentucky University Computer Science Department. *Alumni Questionnaire*. June 26, 1991.

This compilation of questions surveys graduates of the computer science department at Western Kentucky University on various computer-related topics.