CHAPTER 4

COMPUTER SCIENCE IN FOUR-YEAR COLLEGES AND UNIVERSITIES

In this year's Survey serious attempts were made to get more information concerning the status of computer science in undergraduate instruction. The titles of the Survey and questionnaire were changed to reflect the Survey's concern with undergraduate programs in the mathematical sciences and in the computer sciences. A special supplemental one page computer science questionnaire (see Appendix D) was sent to "those departments which offer undergraduate programs (not necessarily degree programs) in computer science."

COMPUTER SCIENCE REFERENCES

Specific references to various aspects of computing and computer science will also be found in Tables: 1-1, 1-6A, 1-6B, 1-8, 1-9, 1-10, 2-3, 2-4, 2-5, 2-7, 2-8, 2-9, 2-10, 2-11, 2-13, 2-15, 2-16, 2-17, 2-18, 2-19, 2-21, 3-3, 3-5, 3-6, 5-2, 5-3, 5-4, and 5-5.

The reader should refer to the beginning of Chapter 2 for explanations of faculty terms used in this report.

HIGHLIGHTS IN 1985

- Two-thirds of all universities, one-third of all public four-year colleges, and more than one-sixth of private four-year colleges have separate computer science departments. In the public four-year

college category the number is five-thirds that for 1980.

- There were 5,651 members of the full-time total computer science faculty of whom 3,605 were in computer science departments. There were 5,342 part-time computer science faculty of whom 1,984 were in computer science departments.

- Of the 3,754 doctorates who teach computer science full-time, 1,291 have their degrees in computer science and 1,555 in mathematics. Of the 2,231 doctorates who teach computer science part-time, 181 have their degrees in computer science whereas 1,369 have their degrees in mathematics.

- Half of all part-time computer science faculty teach full-time in the same institution, almost a third are employed outside education and a tenth are not employed full-time anywhere.

- Half (49%) of all computer science sections are taught in mathematics departments, the other 51% in computer science departments.

- In a substantial number of institutions, some computer science is taught outside mathematics and computer science departments, chiefly in business, engineering and education academic units.

- Total reported enrollments in computer science have climbed from 107,000 in 1975 to 321,000 in 1980 to 558,000 in 1985.

- There were 29,107 computer science undergraduate degrees in fiscal year 1984-85, with 8,646 of these in mathematics departments. In addition there were 3,084 joint majors with mathematics. The number of computer science degrees reported in the 1980 Survey for fiscal year 1979-80 was 8,917.

- About two-thirds of all institutions require calculus for computer science majors, one-half require linear or matrix algebra and more

than two-fifths require discrete mathematics.

- The most common problems reported by computer science departments are salary levels and patterns, departmental support services, the need to use temporary faculty, and the upgrading and maintenance of computer facilities.

NUMBERS OF SEPARATE COMPUTER SCIENCE DEPARTMENTS

In all, 155 of the special computer science questionnaires were returned with the following overall distribution

	Univ.	Pu. 4-Yr.	Pr. 4-Yr.
By Math. Depts.	13	42	36
By Comp. Sci. Depts.	35	22	7

reflecting the fact that in the universities there are many separate computer science departments whereas in the colleges some computer science is taught in many mathematics departments. These numbers are not identical with the numbers of such departments that returned the main questionnaire.

Based on estimates from reports from all institutions responding to any aspect of the questionnaire, the numbers of computer science departments in the various categories of institutions are given in Table 4-1 along with comparable data from the 1980 report.

TABLE 4 - 1

NUMBERS OF SEPARATE COMPUTER SCIENCE DEPARTMENTS
With Numbers of Institutions

	1980	1985
Univ.	94 of 160	105 of 157
Pu. 4-Yr.	85 of 407	141 of 427
Pr. 4-Yr.	48 of 830	150 of 839

COMPUTER SCIENCE FACULTY IN FALL 1985

Using data from both the special computer science questionnaire and the main questionnaire, we can identify many characteristics of those who taught computer science in 1985. We have numbers and various characteristics for the computer science departmental faculty and for the total computer science faculty, both full and part-time. The departmental faculty numbers are obtained from computer science departments on the main questionnaire. The total or overall faculty numbers are obtained from the special computer science questionnaire. The numbers for the faculty teaching computer science but not in computer science departments are obtained by subtracting the former from the latter. See Appendices B and D for copies of the questionnaires.

It is very important to note the implied definitions of the full-time and part-time components of the total computer science faculty. In Tables 4-2A through 4-6B, full-time (or part-time) refers to faculty teaching computer science full-time (or part-time). It does not refer to full-time (or part-time) faculty members at the institution. Table 4-5 makes it clear that about half of all part-time computer science faculty are, in fact, full-time at the same institution. In Table 4-8, there is a different analysis of computer science teaching phenomena wherein, for example, a full-time mathematics department faculty member teaching computer science part-time in the mathematics department would be classified as a full-time faculty member. It is worthwhile to compare the faculty and teaching divisions in Tables 4-2A to 4-6B with those in Table 4-8.

We begin by giving the numbers of the full-time and the part-time total computer science faculty in Tables 4-2A and 4-2B.

TABLE 4 - 2A

FULL-TIME TOTAL COMPUTER SCIENCE FACULTY

	Univ.	Pu. 4-Yr.	Pr. 4-Yr.	Total
C.S. Depts.	1,448	1,554	603	3,605
Other Depts.	91	853	1,102	2,046
Total	1,539	2,407	1,705	5,651

TABLE 4 - 2B

PART-TIME TOTAL COMPUTER SCIENCE FACULTY

	Univ.	Pu. 4-Yr.	Pr. 4-Yr.	Total
C.S. Depts.	491	862	631	1,984
Other Depts.	178	1,454	1,726	3,358
Total	669	2,316	2,357	5,342

The figures above are not surprising in light of the distribution of computer science departments as shown in Table 4-1. The part-time faculty will in many instances represent faculty in other departments at the same institution. See Table 4-5 for sources of part-time faculty. The fact that the number of part-time faculty is almost as large as the number of full-time faculty is of interest.

It should also be noted that in universities and colleges without computer science departments it would be expected that most, or in some cases all, of those who teach computer science would be part-time and generally borrowed from other departments.

FIELDS OF HIGHEST DEGREE FOR COMPUTER SCIENCE FACULTY

In Tables 4-3A and 4-3B are given (1) the numbers of full-time and part-time computer science faculty with highest degrees in various categories and (2), in parentheses, the percentages of those counted who have the doctoral degree. Thus, in Table 4-3A, 83% of the 796 full-time computer science faculty in universities with highest degree in computer science have doctoral degrees in computer science. Of course, the numbers of faculty with highest degree in various areas can be read independently of the percentages of doctorates.

Tables 4-4A and 4-4B below give the numbers of doctorates on the total computer science faculty with degrees in various areas. The numbers in the "other" categories may seem large but "other" includes the various physical and social sciences.

TABLE 4 - 3A

FULL-TIME TOTAL COMPUTER SCIENCE FACULTY BY FIELD OF HIGHEST DEGREE

The Parenthetical Percentages Show Those With Doctorates

Field of Highest Degree	Univ.	Pu. 4-Yr.	Pr. 4-Yr.	Total
Comp. Sci.	796 (83%)	990 (51%)	627 (20%)	2413 (54%)
Math.	388 (91%)	899 (83%)	670 (68%)	1957 (80%)
Engin.	131 (85%)	89 (87%)	37 (22%)	257 (76%)
Educ.	45 (69%)	56 (75%)	114 (68%)	215 (70%)
Stat.	32 (75%)	32 (0%)	21 (0%)	85 (29%)
Other	147 (88%)	341 (81%)	236 (56%)	724 (74%)
Total	1539 (85%)	2407 (68%)	1705 (47%)	5651 (67%)

From the last column in Table 4-3A we compute that 43% of the full-time faculty teaching computer science have their highest degree in computer science. From Table 4-4A, we may note that only 34% of the doctorates teaching computer science have their doctorates in that field.

TABLE 4 - 3B

PART-TIME TOTAL COMPUTER SCIENCE FACULTY BY FIELD OF HIGHEST DEGREE

The Parenthetical Percentages Show Those With Doctorates

Field of Highest Degree	Univ.	Pu. 4-Yr.	Pr. 4-Yr.	Total
Comp. Sci.	319 (25%)	820 (10%)	472 (4%)	1,611 (11%)
Math.	133 (65%)	845 (60%)	1,251 (62%)	2,229 (61%)
Engin.	68 (57%)	117 (32%)	122 (48%)	307 (41%)
Educ.	18(100%)	88 (67%)	21(100%)	127 (77%)
Stat.	23 (48%)	42 (36%)	68 (68%)	133 (55%)
Other	108 (65%)	404 (16%)	423 (57%)	935 (40%)
Total	669 (45%)	2,316 (33%)	2,357 (49%)	5,342 (41%)

The data in Tables 4-3A and 4-3B strongly support the evidence from Table 4-5 that a substantial part (50%) of the part-time total faculty in computer science is full-time faculty in the same institution and from Table 4-8 that it has a large component which is full-time mathematics faculty teaching computer science courses within the mathematics department.

DOCTORATE-HOLDING COMPUTER SCIENCE FACULTY

From the numbers and percentages in Tables 4-3A and B we can get a detailed analysis by their fields of degrees of those doctorates who teach computer science. Tables 4-4A and B below give these counts summed both ways. As in Tables 4-3A and B the counts are for all faculty teaching computer science.

TABLE 4 - 4A

DOCTORATES ON FULL-TIME TOTAL COMPUTER SCIENCE FACULTY

Field of Doctorate	Univ.	Pu. 4-Yr.	Pr. 4-Yr.	Total
Comp. Sci.	661	505	125	1,291
Math.	353	746	456	1,555
Engin.	111	77	8	196
Educ.	31	42	78	151
Stat.	24	0	0	24
Other	129	276	132	537
Total	1,309	1,646	799	3,754

There are two noteworthy observations from Table 4-4A.

(1) Of the doctorates who teach computer science full-time in universities, slightly more than half have their degrees in computer science and more than half of the rest have their degrees in mathematics.

(2) Of the doctorates who teach computer science full-time in the public and private colleges, almost half have their degrees in mathematics and more than half of the rest have their degrees in computer science.

TABLE 4 - 4B

DOCTORATES ON PART-TIME TOTAL COMPUTER SCIENCE FACULTY

Field of Doctorate	Univ.	Pu. 4-Yr.	Pr. 4-Yr.	Total
Comp. Sci.	80	82	19	181
Math.	86	507	776	1,369
Engin.	39	37	59	135
Educ.	18	59	21	98
Stat.	11	15	46	72
Other	70	65	241	376
Total	304	765	1,162	2,231

Almost two-thirds of the doctorates who teach computer science part-time in the public and private four-year colleges have their degrees in mathematics. A large number of part-time faculty with doctorates, particularly in the private college category, presumably are faculty from the same institution. Many of those with degrees in mathematics will be in mathematics departments as such, since mathematics departments in the college sectors teach a great deal of computer science. Note Table 4-5 where it is shown that 59% of all part-time computer science faculty in the private college sector are employed full-time in the same institution.

SOURCES OF PART-TIME COMPUTER SCIENCE FACULTY

The sources of part-time computer science faculty in terms of their full-time employment is given in Table 4-5. Each column adds to 100%.

TABLE 4 - 5

SOURCES OF REGULAR EMPLOYMENT OF PART-TIME TOTAL COMPUTER SCIENCE FACULTY
Columns sum to 100%

Employed Full-Time at:	Univ.	Pu. 4-Yr.	Pr. 4-Yr.	All
Own Institution	52%	42%	59%	50%
Other Univ. or College	7%	2%	5%	4%
High School	1%	3%	5%	4%
Outside Education	23%	41%	23%	31%
Not Employed Full-time Anywhere	17%	12%	8%	11%

It seems reasonably clear that part-time computer science faculty members are selected from whatever resources are available. Many private colleges are in small towns where the source of part-time faculty would be the same institution. Public colleges are perhaps more likely to be in or near larger centers where non-academic personnel are available. The data tend to support this analysis.

About half of the part-time faculty in computer science are employed full-time in the same institution, with more than three-tenths employed full-time outside academia and more than one-tenth not employed full-time anywhere. Some retired persons or faculty spouses employed to teach part-time may be in this last category.

THE BROADER COMPETENCE OF COMPUTER SCIENCE FACULTY

A question was designed to find how broadly competent the computer science faculty was judged to be: specifically, what percentages of the computer science faculty teach only lower-level courses or only specialty courses. It should be expected that much of the part-time faculty would be in such categories. From the responses recorded in Table 4-6B below it would appear that most chairpersons reported limits in qualifications in one or the other but not both "lower level" and "specialty" course categories.

TABLE 4 - 6A

PERCENTAGES OF FULL-TIME TOTAL COMPUTER SCIENCE FACULTY TEACHING ONLY LOWER LEVEL OR SPECIALTY COURSES

	Univ.	Pu. 4-Yr.	Pr. 4-Yr.	Total
Lower Level Courses	11%	18%	31%	20%
Specialty Courses	13%	18%	17%	16%

TABLE 4 - 6B

PERCENTAGES OF PART-TIME TOTAL COMPUTER SCIENCE FACULTY TEACHING ONLY LOWER LEVEL OR SPECIALTY COURSES

	Univ.	Pu. 4-Yr.	Pr. 4-Yr.	Total
Lower Level Courses	43%	58%	42%	49%
Specialty Courses	21%	11%	10%	12%

From Tables 4-6A and B we conclude that perhaps one-third of the full-time and three-fifths of the part-time computer science faculty teach only lower level or specialty courses.

FACULTY MOBILITY

Data on faculty mobility from academic year 1984-85 to academic year 1985-86 is available for the national faculty in computer science departments. Separate data for computer science faculty within mathematics departments is not available - the figures given in Table 2-20 are for faculty mobility in mathematics and statistics departments, including those who teach computer science there.

The data show an increase for the one year of 60 doctorate faculty and 88 non-doctorate faculty in computer science departments. From the nature of the question (#9 on the main questionnaire) it is likely that figures from departments newly created for 1985-86 are not included. Thus the total size of the national computer science departmental faculty should have increased somewhat more. It is interesting that the outflow/inflow ratios to/from non-academic employment are 52/32 for doctorates and 70/48 for non-doctorates. The ratios for mathematics and/or statistics departments are 157/76 and 33/116. At the doctorate level the ratios are not dissimilar. There were also approximately 120 doctorates and 40 non-doctorates who went from one computer science department (school) to another.

TABLE 4 - 7

MOBILITY OF THE FULL-TIME COMPUTER SCIENCE DEPARTMENTAL FACULTY
1984-85 To 1985-86

	Doctorates	Non-Doctorates
Faculty Inflow		
From Graduate School	91	165
From Post-Doctoral or Research Appts.	21	0
From Non-Academic Positions	32	48
From Other Sources	6	0
Total Inflow	150	213
Faculty Outflow		
Died or Retired	5	21
Returned to Graduate School	23	34
To Non-Academic Positions	52	70
To Other Status	10	0
Total Outflow	90	125

Data on the field of study of either doctorates or non-doctorates is not available in this mobility study. Presumably the doctorates (and the non-doctorates as well) who are going back to graduate school are seeking training in computer science, per se.

The net outflow to non-academic positions was about 1.2% of the total departmental faculty.

WHERE AND BY WHOM IS COMPUTER SCIENCE TAUGHT?

The number of sections of computer science taught by various components of the nation's four-year college and university faculty is shown in Table 4-8 below. The total number of sections taught in mathematics departments, 9,744, is just under the total number taught in computer science departments, 10,102.

The definitions of "full-time and part-time faculty" are not the same as those used in Tables 4-2A and B and 4-3A and B and elsewhere in this chapter. The data for Table 4-8 came from the main questionnaire and part-time would refer to part-time in the department reporting. Thus mathematics department chairpersons would report a full-time departmental faculty member as "full-time" even though he/she taught only one or two computer science sections.

TABLE 4 - 8

PERCENTAGE OF SECTIONS OF COMPUTER SCIENCE TAUGHT
(Columns sum to 100%)

	Univ.	Pu. 4-Yr.	Pr. 4-Yr.	Total
Math. Depts.				
By Full-time Faculty	15%	36%	56%	39%
By Part-time Faculty	3%	10%	15%	10%
C.S. Depts.				
By Full-time Faculty	66%	45%	19%	40%
By Part-time Faculty	16%	9%	10%	11%

From the 36% and 10% figures for public colleges and the 56% and 15% figures for private colleges it follows that in both public and private four-year college mathematics departments almost four-fifths of the computer science taught there is taught by full-time mathematics department faculty members. The data above seems generally consistent

with the data in Tables 4-2A and B to 4-4A and B. In part, it corroborates the preponderance of mathematically trained faculty among the teachers of computer science.

The percentage of all computer science sections taught in computer science departments ranges from 82% in universities, to 54% in public four-year colleges to 29% in private four-year colleges. These data agree reasonably well with the current ratios of numbers of computer science departments to numbers of institutions, Table 4-1, with the caveat that institutions with separate computer science departments would be expected to teach relatively more computer science than would those without computer science departments.

OTHER UNITS TEACHING UNDERGRADUATE COMPUTER SCIENCE COURSES

Departments were asked to identify units other than mathematics or computer science departments within the institution which taught computer science courses. The responses are summarized in the following table.

TABLE 4 - 9

OTHER UNITS TEACHING SOME UNDERGRADUATE COMPUTER SCIENCE COURSES
Percentages Of All Institutions Responding

	Univ.	Pu. 4-Yr.	Pr. 4-Yr.
Business	56%	53%	22%
Engineering	47%	22%	15%
Education	20%	27%	9%
~~Other~~ Natural + Physical Science	17%	6%	15%
Computer Center	8%	10%	2%
Social Science	4%	10%	4%
Humanities & Arts	4%	2%	0%
Library	0%	5%	0%

The figures reported do not seem surprising. Some forms of computer science are taught rather widely in the institutions. Since elementary data processing is not listed as a computer science course, per se (See Appendix A or E), it seems likely that data processing in some form may account for much of the high incidence of teaching in the "business" category.

COMPUTER SCIENCE COURSE ENROLLMENTS

Since computer science as a subject has developed only over the past quarter century as the computer age has gone from a few very expensive mainframes to minis and micros and hand calculators, there have, of course, been massive changes in student enrollments. Indeed, the nature of computer science and of specific course content continues to change with the changing technology. It was only in the 1970 Survey (after the curriculum guidelines of ACM-68 were issued) that a detailed listing of computer science courses (more than 2 at any level) was used by the Survey. It was only with this year's Survey that a name distinction was made between the mathematical and computer sciences and that a separate chapter on computer science was introduced in the report.

Table 4-10 gives the trend in enrollments in computer science. The course numbers refer to courses listed in Appendix E.

TABLE 4 - 10

TRENDS IN COMPUTER SCIENCE COURSE ENROLLMENTS BY LEVEL
(in Thousands)

	1960	1965	1970	1975	1980	1985
Lower (55-61)	-	2	64	63	206	350
Middle (62-65)	-	12	12	19	35	66
Upper (66-92)	9	8	30	31	80	142
Total	9	22	106	113	321	558

The computing or computer science courses for 1960 and 1965 were listed along with mathematics courses. The titles "Programming for Digital Computers" and "Other Computer Science Mathematics" suggest subject matter now identified chiefly with elementary and middle level courses.

The distribution of enrollments by level for 1970 to 1980 are "best estimates" from specific course enrollments given in the Survey reports. Only with the current Survey were the lower, middle and upper level designations used.

Computer science, along with mathematics and statistics, has a major service component for other disciplines. The fact that 63% of the 1985 course load is at the elementary level supports this view. However, the very large number of majors in computer science, Table 4-11, means that unlike mathematics and statistics, a sizable part of the upper level enrollment is for those within the discipline.

COMPUTER SCIENCE STUDENTS

As noted in Chapter 1, Table 1-9, there were 29,107 computer science undergraduate degrees reported in 1984-85 plus another 3,084 joint majors with mathematics and 157 with statistics. Of the (single) computer science majors 20,416 were from computer science departments, 8,646 were from mathematics departments and 45 were from statistic departments. Of the joint majors with mathematics, 2,519 were from mathematics departments and 565 from computer science departments. Of the joint majors with statistics, all but nine were from computer science departments. As shown in Table 1-8, the reported numbers of computer science majors went from 3,636 in 1974-75 to 8,917 in 1979-80 to 29,107 in 1984-85.

The division of the computer science majors among universities, public four-year colleges and private four-year colleges is given in Table 4-11.

TABLE 4 - 11

1984-85 COMPUTER SCIENCE UNDERGRADUATE DEGREES BY CATEGORY OF INSTITUTION AND DEPARTMENT
(Does not include joint majors)

Department	Univ.	Pu. 4-Yr.	Pr. 4-Yr.	Total
Comp. Sci.	9,122	8,335	2,959	20,416
Mathematics	1,865	3,175	3,606	8,646
Statistics	45	0	0	45
Total	11,032	11,510	6,565	29,107

The 2,519 joint mathematics-computer science majors from mathematics departments were distributed as follows: 605 in universities, 1,102 in public four-year colleges and 811 in private colleges. Of the 565 joint mathematics-computer science majors from computer science departments, 136 were in universities, 169 in public and 260 in private four-year colleges.

MATHEMATICS AND STATISTICS COURSES TAKEN BY COMPUTER SCIENCE MAJORS

The special computer science questionnaire sought information on (1) the total number of mathematics and statistics semester or quarter courses (at the calculus level or above) normally taken by computer science majors and (2) the mathematics and statistics courses required of computer science majors. The average (mean) numbers of mathematics and statistics courses normally taken by computer science majors are shown below in Table 4-12. Thus computer science majors take very little more mathematics and statistics courses than do engineering majors.

Robert M. Aiken, Chair of the Education Board of the ACM, who reviewed this report, expressed some surprise at the data in Tables 4-12 and 4-13 and their implications. He states, "My experience in consulting

with a number of programs and participating in computer science accreditation efforts leads me to believe that computer science majors take a minimum of two (mathematics and statistics) courses beyond the freshman-sophomore level." But he suggests that the fact that courses such as discrete mathematics (discrete structures) and numerical analysis are frequently taught within computer science departments and thus may be classified as computer science courses in this Survey may help explain the apparent discrepancy of his experience with Survey data.

TABLE 4 - 12

NUMBER OF SEMESTER OR QUARTER COURSES IN MATHEMATICS OR STATISTICS NORMALLY TAKEN BY COMPUTER SCIENCE MAJORS

Number of Courses Taken in	Univ.	Pu. 4-Yr.	Pr. 4-Yr.
Math/Statistics	5.4	4.3	4.5

The table below lists the percentages of schools in the university and college categories which require various mathematics and statistics courses for computer science majors. The courses are listed in approximate decreasing order of frequency of being required. All courses for which at least 10% of departments in any category of institution require the course are listed. The course numbers are those identifying the courses in the Survey questionnaire (Appendix B or E).

TABLE 4 - 13

PERCENTAGES OF INSTITUTIONS REQUIRING THE GIVEN MATHEMATICS OR STATISTICS COURSE FOR COMPUTER SCIENCE MAJORS

		Univ.	Pu. 4-Yr.	Pr. 4-Yr.
15	Calculus (Math, Phys. Sci., Eng.)*	88%	61%	69%
19	Linear Alg. & Matrix Theory	65%	44%	43%
18	Discrete Mathematics	48%	34%	47%
37	Numerical Analysis	27%	24%	24%
47	Math. Statistics (Calc. prereq.)	29%	15%	13%
27	Discrete Structures	21%	13%	17%
17	Differential Equations	22%	9%	6%
22	Combinatorics	13%	5%	0%
45	Elem. Stat. (no Calc. prereq.)	6%	13%	12%
46	Prob. & Stat. (no Calc. prereq.)	3%	2%	12%
48	Probability (Calc. prereq.)	12%	5%	11%
50	Applied Statistical Analysis	5%	10%	0%

* The questionnaire does not reveal explicitly whether one, two or more semesters (quarters) of calculus are required.

The results rather clearly support the view that undergraduate computer science has evolved (or is evolving) into a discipline quite distinct from mathematics. Only about 70% of institutions require computer science majors to take calculus, about 60% to take discrete mathematics or discrete structures, only about 50% to take linear algebra/matrix theory, about 50% to take some statistics course and 25% to take numerical analysis. Differential equations and combinatorics are required of only a small percentage of majors.

Furthermore, the fact that the average computer science major takes five or fewer semester (or quarter) mathematics or statistics courses suggests that only a fairly small percentage of computer science majors

opt for (or are advised to take) more than core courses in freshman-sophomore mathematics. (But see the comments preceding Table 4-12).

TYPES OF COMPUTER SCIENCE DEGREES

Schools (departments) teaching computer science were asked to identify the type of degree, if any, offered in computer science. Some institutions have several types of degrees. Because the questionnaire was directed to departments offering computer science, per se, it is likely that many business-oriented data processing programs were simply not included as respondents.

TABLE 4 - 14

PERCENTAGES OF SCHOOLS WHICH OFFER COMPUTER SCIENCE HAVING VARIOUS TYPES OF DEGREE PROGRAMS (Columns Do Not Sum to 100%)

Type of Comp. Sci. Degree	Univ.	Pu. 4-Yr.	Pr. 4-Yr.
None	17%	22%	18%
Science	79%	64%	77%
Business	9%	14%	28%
Engineering	18%	5%	5%
Education	1%	2%	0%
Other	0%	6%	2%

STUDENT USE OF MICROS OR MINIS/MAINFRAMES

In computer science courses with programming projects, mini-computers and mainframes were used much more widely than micro-computers. The use reported is given in Table 4-15.

TABLE 4 - 15

USE OF TYPES OF COMPUTERS IN COMPUTER SCIENCE PROGRAMMING PROJECTS
Percentage of Students Enrolled at Given Levels

	Univ.	Pu. 4-Yr.	Pr. 4-Yr.
Lower Level C.S. Courses			
Micros	35%	40%	39%
Minis/Mainframes	65%	60%	61%
Middle or Upper Level C.S. Courses			
Micros	21%	26%	30%
Minis/Mainframes	79%	74%	70%

Thus about three-eighths of lower level students and one-fourth of middle or upper level students used micros in programming projects in computer science, the rest used minis or mainframes.

CONTROL OF WORK STATIONS

Data on the control of student work stations used in computer science courses are given in Table 4-16.

TABLE 4 - 16

PERCENTAGE OF TEACHING DEPARTMENTS HAVING CONTROL OF STUDENT WORK STATIONS

	Univ.	Pu. 4-Yr.	Pr. 4-Yr.
Micros	53%	39%	61%
Minis/Mainframes	21%	28%	51%

Clearly departments teaching computer science in private colleges are much more likely to have control of student work stations, particularly for minis or mainframes. As expected, the teaching departments are more likely to control micro work stations than those for larger computers.

STUDENT ENROLLMENTS PER WORK STATION

For students taking computer science courses and using the computer in Fall 1985 we have the following pattern of work station availability.

TABLE 4 - 17

ENROLLED AND ACTIVE COMPUTER SCIENCE STUDENTS PER WORK STATION
Percentage of Departments by Category
Columns sum to 100%

No. of Students Per Work Station	Univ.	Pu. 4-Yr.	Pr. 4-Yr.
0-5	12%	24%	18%
6-10	33%	29%	60%
11-15	38%	15%	19%
16-20	9%	17%	0%
20 or more	8%	15%	3%

Thus in terms of the number of students sharing a work station, the private four-year colleges are, on the average, noticeably better off than the universities or public colleges.

DEPARTMENTAL CONCERNS IN COMPUTER SCIENCE DEPARTMENTS

The Survey included two lists of questions, one on professional activities of faculty and how they affect faculty advancement and/or salary decisions and the second on problems of the mid-80's as seen by department chairpersons. Each question had a scale of 0 to 5 with zero representing no importance and 5 representing major importance. The results tabulated here are in the university, public four-year college and private four-year college categories for computer science departments. The numbers shown in the following tables in this chapter are (1) the projected percentage of all departments giving a 4 or 5 response for the particular question and (2), in parentheses, the projected percentage giving a 0 or 1 response for the same question. Obviously the percentage giving a 2 or 3 response can be found by subtracting the sum of the two percentages given from 100. The difference of the two numbers given is a measure of the preponderance of departmental attitudes regarding the issue as important.

The responses of departments in the mathematical sciences are given at the end of Chapter 3 in similarly designed tables. To assist the reader in comparing the two sets of data, the grouping and order of listing of issues for the mathematical sciences and computer science departments are the same. The issues are listed in approximate decreasing order of importance as viewed by departments in mathematics and statistics. Thus the grouping and order for computer science departments may seen unnatural.

TABLE 4 - 18

IMPORTANCE OF PROFESSIONAL ACTIVITIES IN FACULTY ADVANCEMENT AND/OR SALARY DECISIONS

	Computer Science Departments		
	Univ.	Pu. 4-Yr.	Pr. 4-Yr.
Classroom Teaching Performance	48 (1)	90 (0)	67 (0)
Published Research	96 (0)	60 (5)	25 (33)
Service to Department and/or University (College)	37 (5)	54 (0)	46 (0)
Giving Talks at Profess. Mtgs.	39 (8)	43 (11)	9 (49)
Professional Activities in Profess. Societies and/or Pub. Service	36 (0)	21 (5)	9 (16)
Supervision of Graduate Students	40 (10)	47 (16)	-------
Undergraduate/Graduate Advising	5 (31)	31 (12)	21 (33)
Years of Service	5 (54)	42 (22)	63 (0)
Expository and/or Popular Articles	10 (26)	21 (14)	9 (16)
Textbook Writing	27 (25)	14 (35)	4 (66)

Classroom teaching performance is relatively more important in college departments than in university departments whereas published research is much more important in university departments. Professional activities including talks and textbook writing are of considerable importance in university departments and of little importance in college departments whereas years of service are generally important only in college departments.

Generally the computer science departmental responses on professional activities were quite similar to the mathematics department responses given separately in Table 3-7.

PROBLEMS OF THE MID-EIGHTIES

In the 23 questions on problems of the mid-80's there were several concerns where the responses stood out significantly. The results for four concerns are given separately in Table 4-19A. The remaining results are given in three tables, (1) those dealing with student issues, Table 4-19B, (2) those dealing with faculty issues, Table 4-19C and (3) those dealing with support issues, Table 4-19D. The concerns <u>not</u> commonly considered as major problems are almost as interesting as those considered important. Note that high percentages do <u>not</u> measure the intensity of feeling, as such, but rather the breadth of concern. Generally, those concerns identified as major problems are those which need addressing by the community. As is to be expected, for some concerns wide variations were reported among departments in the various types of universities and colleges and between departments in the mathematical and computer sciences. The responses for mathematics and statistics departments are summarized separately in Tables 3-8A to D.

The broad emphasis on salary and support issues identified in Table 4-19A means there is continuing pressure for upward salary adjustments and that there should be continuing pressure for better departmental support services. Clearly the larger community should be concerned with departmental support practices.

As in Table 4-18, the percentages of departments identifying the concerns as of major (minor) importance are given in Tables 4-19A to D.

TABLE 4 - 19A

MAJOR PROBLEMS

	Computer Science Departments		
	Univ.	Pu. 4-Yr.	Pr. 4-Yr.
Salary Levels/Patterns	61 (1)	89 (6)	58 (0)
Departmental Support Services (Travel, Secretarial, etc.)	81 (1)	60 (3)	54 (14)
Research Funding	60 (14)	73 (14)	58 (26)
Maintaining Faculty Vitality	32 (24)	38 (3)	25 (66)

TABLE 4 - 19B

STUDENT ISSUES

	Computer Science Departments		
	Univ.	Pu. 4-Yr.	Pr. 4-Yr.
Lack of Quality of Undergraduate Majors	14 (46)	28 (25)	37 (16)
Lack of Quantity of Undergraduate Majors	5 (80)	9 (57)	16 (34)
Lack of Quality of Department Graduate Students	29 (18)	12 (38)	------*
Lack of Quantity of Department Graduate Students	18 (43)	14 (56)	------*
Remediation	4 (46)	5 (48)	26 (37)
Class Size	49 (22)	40 (20)	30 (66)

* Since relatively few of the departments in this category have graduate programs, the responses are not given.

TABLE 4 - 19C

OTHER FACULTY ISSUES

	Computer Science Departments		
	Univ.	Pu. 4-Yr.	Pr. 4-Yr.
Teaching Load of Full-Time Faculty	43 (13)	39 (19)	51 (33)
The Need to Use Temporary Faculty	58 (13)	44 (19)	51 (0)
Promotion-Tenure Process Above Departmental Level	42 (20)	63 (20)	33 (59)
Advancing Age of Tenured Faculty	5 (60)	3 (51)	4 (86)
Lack of Experienced Senior Faculty	52 (24)	54 (10)	63 (33)
Losing Full-Time Faculty to Industry/Government	32 (20)	38 (21)	41 (49)

TABLE 4 - 19D

OTHER SUPPORT ISSUES

	Computer Science Departments		
	Univ.	Pu. 4-Yr.	Pr. 4-Yr.
Upgrading/Maint. of Computer Facilities	59 (21)	60 (0)	33 (30)
Office/Lab Facilities	54 (0)	54 (12)	4 (49)
Computer Facilities (Classroom)	33 (17)	50 (0)	21 (21)
Classroom Lab Facilities	44 (5)	40 (12)	4 (70)
Computer Facilities (Faculty Use)	30 (32)	59 (14)	21 (79)
Networking Facilities	33 (41)	49 (24)	41 (59)
Library: Holdings, Access, etc.	15 (34)	17 (28)	21 (0)

The issue of maintaining faculty vitality (see Tables 3-8A and 4-19A) was a major problem in mathematics departments but not in computer science departments. The quality and quantity of undergraduate majors and of graduate students were minor problems in computer science but important problems in the mathematical sciences. It is interesting that losing faculty to industry or government was not considered a major concern for most computer science departments. Generally, the responses were consistent with commonly perceived faculty age and supply and demand phenomena in computer science. There were major differences in responses on several support issues between university and public college departments of computer science on the one hand and private college departments on the other. Generally private college departments are much better satisfied with computer access and availability, class size and facilities.