DOCUMENT RESUME

ED 439 254 CE 079 875

AUTHOR Veneri, Carolyn M.
TITLE Here Today, Jobs of Tomorrow: Opportunities in Information Technology.
INSTITUTION Bureau of Labor Statistics, Washington, DC.
PUB DATE 1998-00-00
NOTE 15p.; Reprinted from the fall 1998 issue of the "Occupational Outlook Quarterly".
PUB TYPE Information Analyses (070)
EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Adults; *Careers; Computer System Design; *Computers; Databases; Educational Needs; *Employment Projections; Employment Qualifications; Higher Education; *Information Technology; *Labor Market; *Occupational Information; Salaries; Technological Advancement
IDENTIFIERS *Computer Related Occupations

ABSTRACT

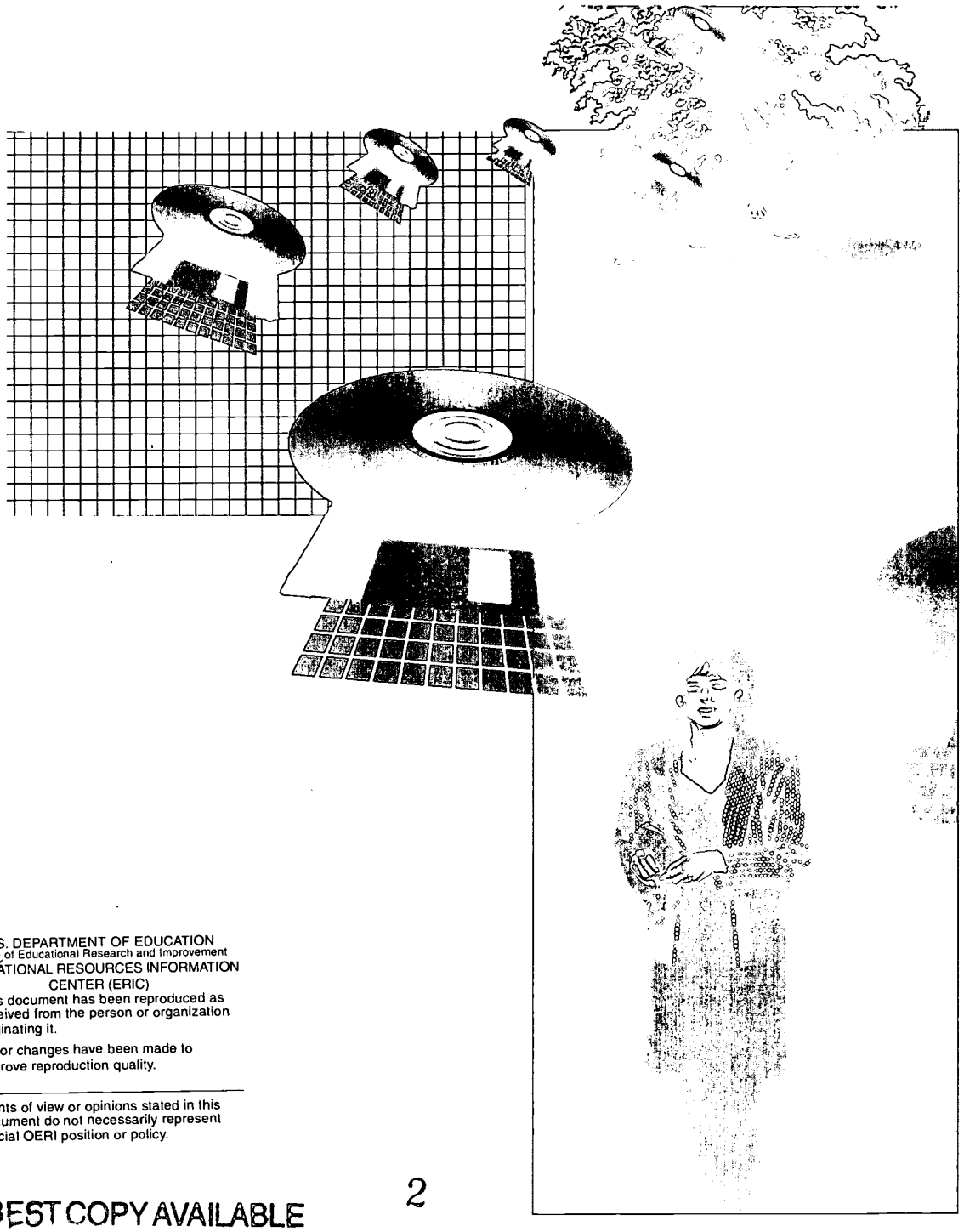
This report outlines job opportunities in the field of computer information technology and the requirements for jobs in this field. Jobs profiled include computer programmers, systems analysts, computer engineers, and database administrators, computer support specialists, and other computer scientists. The report then summarizes the labor market for the past few years and into the future, detailing future demand, where the jobs are, and the labor supply. The report also provides average job salaries and suggestions for preparing for a computer-related career. (KC)

CE

Here Today, Jobs of Tomorrow: Opportunities in Information Technology

U.S. Department of Labor
Bureau of Labor Statistics

Reprinted from the Fall 1998 issue
of the *Occupational Outlook Quarterly*



Here Today, Jobs of Tomorrow: Opportunities in Information Technology

by Carolyn M. Veneri

Now hiring: Computer engineers, systems analysts, programmers, database administrators, computer support specialists, and other computer scientists for jobs in technology firms, government agencies, corporate offices, and educational institutions. Requires: strong technical skills, relevant training, and experience, plus associate, bachelor's, master's, or doctoral degree.

Computer personnel want ads, like the fictional one above, are plentiful in nearly every newspaper across the country. In some large cities, these high-tech classifieds are so numerous they garner their own section. Companies across the Nation are scrambling for workers with the requisite technical skills.

Some researchers warn of severe economic implications for U.S. competitiveness if the trend continues. Reports by groups such as the Information Technology Association of America and the U.S. Department of Commerce's Office of Technology Policy identify what they consider strong evidence of the United States' inability to keep up with the high demand for information technology workers. As a result, highly qualified personnel enjoy rising starting salaries, multiple job offers, creative recruiting efforts, and a hiring climate that some have equated with a pro sports draft.

There has been explosive growth in the software and services industries. Consequently, technology and nontechnology companies alike are competing for the same workers as businesses integrate new technologies. Firms need skilled computer professionals to maintain a competitive edge and cost-efficient operations. In addition to describing who the information technology field comprises, this article examines the labor market and earnings prospects for trained workers and how to prepare for one of these high-tech careers. It also provides suggestions for finding more information about careers, education and training, and professional development.

Carolyn M. Veneri is an economist in the Office of Employment Projections, BLS, (202) 606-5714.

The Workers and Their Jobs

The Information Technology Association of America has defined information technology as "the study, design, development, implementation, support, or management of computer-based information systems, particularly software applications and computer hardware."

The Bureau of Labor Statistics (BLS) uses different terminology to classify occupations for this type of work. BLS classifies professional and technical computer-related occupations as computer programmers, computer systems analysts, computer engineers, database administrators, computer support specialists, and all other computer scientists. These occupations are described below.

Computer programmers. *Computer programmers* write, test, and maintain the detailed instructions—called pro-

grams or software—that computers must follow to perform their functions. Programmers write these commands by breaking down each step into a logical series, converting specifications into detailed flow charts for coding in a language the computer understands.

The programming language might be a conventional one, such as Cobol; an artificial intelligence one, such as Prolog; or a more advanced function or object-oriented one, such as C++ or Java. Programmers are often identified by the programming language they know, such as *Java programmer*, or by the type of environment they usually work in, such as *mainframe* or *Internet programmer*.

Programmers may also be grouped into one of two programming types: applications or systems. *Applications programmers* usually focus on business, engineering, or science. They write software for jobs within an organization, such as a program used for tracking inventory, or they may revise existing software. *Systems programmers* maintain and control computer systems software. These workers make changes as needed in the computer's instructions for directing how networks, workstations, and central processing units operate or communicate with other equipment such as printers. Because of their knowledge of the entire system, systems programmers often help applications programmers with troubleshooting.

Systems analysts. *Systems analysts* study business, scientific, or engineering data processing problems and use computers to design solutions; *business systems analysts*, for example, work with managers and users to solve computer problems and meet the technology needs of individual businesses. Other titles for systems development workers include *systems developer* and *systems architect*. These workers may plan new computer systems or apply an existing system's resources to another operation. They might design new systems, including both software and hardware—the computer itself along with associated physical equipment. Or, they may add a single software application to an existing system.

Software quality assurance analysts do more in-depth testing of products. In addition to running tests, these individuals may be involved in diagnosing problems, recommending solutions, or determining if program requirements have been met.

In some organizations, workers called *programmer-analysts* design and update the software that runs a computer. Because they are responsible for both programming and systems analysis, these workers must be proficient in both areas.

Computer engineers. These workers design and develop new hardware and software. Computer engineers often work as part of a team that designs new computing devices or related equipment, systems, or software.

Hardware engineers usually design, develop, and test computer hardware and supervise production—for example, assembly of computer chips. *Software engineers* or *software developers* develop software systems for control and automation in manufacturing, business, and other areas. They research, design, and test operating system software, compilers—software that converts programs for faster processing—and network distribution software. Software engineers working in applications development analyze users' needs. They also design, create, and modify general computer applications software or specialized utility programs. Some software engineers develop both packaged and systems software or create customized software applications for clients.

Database administrators, computer support specialists, and all other computer scientists. Within the BLS classification system, the occupational title of computer scientist applies to a wide range of professionals with varying education and training backgrounds. BLS draws together any other workers who design computers or the software that runs them, develop technology, and create new uses for computers. This group includes *database administrators*, *computer support specialists*, and *all other computer scientists*.

Some of these professionals work on multidisciplinary projects, such as developing and advancing uses of virtual reality in robotics, while others develop specialized languages or programming tools. They conduct research and develop solutions to hardware and software problems.

Database administrators set up computer databases and test and coordinate changes to them. Database administrators also determine ways to organize and store data. They may also be responsible for planning, coordinating, and implementing data security measures.

Computer support specialists provide technical assistance, support, and advice to customers and users. This group of occupations includes workers with a variety of titles, such as *technical support specialists*, *help desk technicians*, and *customer service representatives*. These are the troubleshooters responsible for interpreting problems and providing technical support. They answer phone calls, use automated diagnostic programs, and resolve recurrent problems. Support specialists may work within an organization or directly for a computer or software vendor. Many work as contractors, providing customer assistance for help-desk or support services firms.

Other computer scientists include workers who specialize in a particular

Table 1
Employment projections, 1996-2006

Occupation	Employment			
	Number (thousands)		Projected change, 1996-2006	
	1996	2006, projected	Number (thousands)	Percent
Total, all occupations	132,353	150,927	18,574	14
Database administrators, computer support specialists, and all other computer scientists	212	461	249	118
Computer engineers	216	451	235	109
Systems analysts	506	1,025	520	103
Computer programmers	568	697	129	23

type of systems analysis, application, or design. *Network* or *computer systems administrators,* or *network specialists,* for example, design, install, and support an organization's local area network (LAN), wide area network (WAN), network segment, or Internet system. They maintain network hardware and software, analyze problems, and monitor the network to ensure availability to system users. Administrators also may plan, coordinate, and implement network security measures. In some organizations, *computer security specialists* may be responsible for the organization's information security.

Growth of the Internet and expansion of the World Wide Web, the graphical portion of the Internet, have generated a variety of occupations relating to design, development, and maintenance of Web sites and their servers. For example, *webmasters* are responsible for all technical aspects of the Web site, including performance issues such as speed of access, and for approving site content. *Web developers,* also called *Web designers,* are responsible for day-to-day site design and creation.

Network and data communications analysts—also known as *network engineers, network technicians,* or *Internet developers*—design, test, and evaluate network systems such as LAN, WAN, Internet, and other data communications systems. These specialists perform modeling, analysis, and planning; they may also research related products and make hardware and software recommendations. *Telecommunications specialists* focus on the interaction between computer and communications equipment.

Job tasks and occupational titles in the computer field evolve rapidly. Changing titles reflect new areas of specialization or changes in technology, as well as employer preferences. Many narrow specializations exist, and individuals who work on a contract or consulting basis may be referred to simply as computer specialists or consultants.

The Labor Market

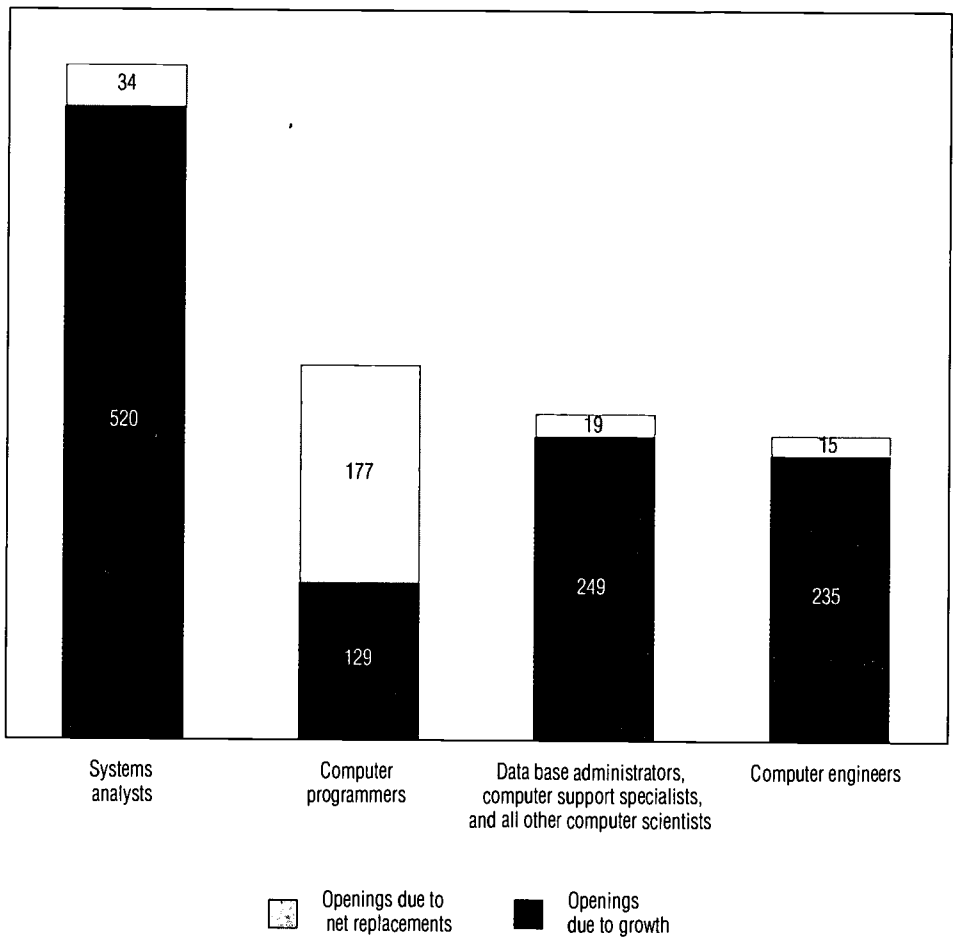
Overall employment of computer scientists, engineers, systems analysts and programmers is more than double what it was in 1983. However, employment has not grown at the same rate for all computer-related occupations. Employment has increased dramatically for computer engineers, scientists, and systems analysts, while employment of computer programmers has been relatively flat.

There are two reasons for the faster rate of growth for the first group. The first is that many of these jobs are highly sophisticated; the other is that all new and emerging computer-related occupations are usually lumped there.

The flattening trend in employment of computer programmers, on the other hand, may be a result of the occupation's narrow definition and worker displacement by technology. Employment growth of programmers has been moderated by consolidation of systems and applications, developments in packaged software, advanced programming languages and tools, and the growing number of users who design, write, and implement more of their own programs.

Chart 1

Total job openings due to growth and net replacements, 1996-2006 (projected)



Future demand. Database administrators, computer support specialists, and all other computer scientists, computer engineers, and systems analysts are projected to be the fastest growing occupations between 1996 and 2006, and job openings should be plentiful. (See table 1.) New growth areas usually arise from the development of new technologies. The expanding use of Internet technologies by businesses, for example, has resulted in a growing demand for skilled professionals to develop and support Internet and World Wide Web applications. As the amount of computing power increases and the price of technology continues to fall, organizations will seek help from specialists for their computing needs.

Employment of computer programmers is also projected to grow faster than the average for all occupations but much more slowly than that of other computer professionals. Many of the reasons for faster than average growth are the same as those cited above. Despite numerous openings for computer programmers between 1996 and 2006, the consolidation of systems and applications should continue to moderate growth, as will developments in packaged software, programming languages and tools, and the design and implementation abilities of users.

The proportion of computer scientists, computer engineers, systems analysts, and computer programmers who are self-employed has been rising along with the demand for technical expertise. In 1996, there were about 78,000 self-employed computer scientists, engineers, systems analysts, and programmers. By the year 2006, this number is projected to grow to about 131,000, an increase of over 60 percent. Much of this growth is the result of an increasing demand for specialized technical expertise.

In addition to new jobs created by

Table 2
Percent distribution of workers, by highest level of education completed, 1997

Educational level	Occupational distribution		
	Total, computer-related occupations	Computer systems analysts and scientists	Computer programmers
Total	100.0	100.0	100.0
High school graduate or equivalent or less	7.0	5.3	10.2
Some college, no degree	16.0	14.1	19.6
Associate degree	9.0	7.8	11.6
Bachelor's degree	47.9	49.7	44.3
Master's and higher degrees	20.1	23.1	14.2

growth, thousands of openings should result each year from the need to replace workers who transfer to other occupations or leave the labor force—an average of around 25,000 jobs annually for computer engineers, scientists, systems analysts, and programmers. For most computer professionals, the majority of the jobs created through 2006 should be the result of growth in the occupation. However, in the case of computer programmers, more job openings are expected to result from the need to replace workers who leave the occupation or the labor force. (See chart 1.)

Where they work. The prevailing assumption is that the majority of information technology workers are employed in the information technology, or IT, industry. But no such industry exists in the Federal Standard Industrial Classification (SIC) structure. So where are these workers employed?

A major portion of the so-called IT industry appears to be within the SIC-defined industry of computer and data processing services. This industry provides computer services on a contract or customer basis. It includes the prepackaged software industry; customized computer programming services; applications and systems software design; integrated systems design and development; data processing, preparation, and information retrieval services, including online databases; rental, leasing, and repair of computers and related equipment; and specialized consulting services.

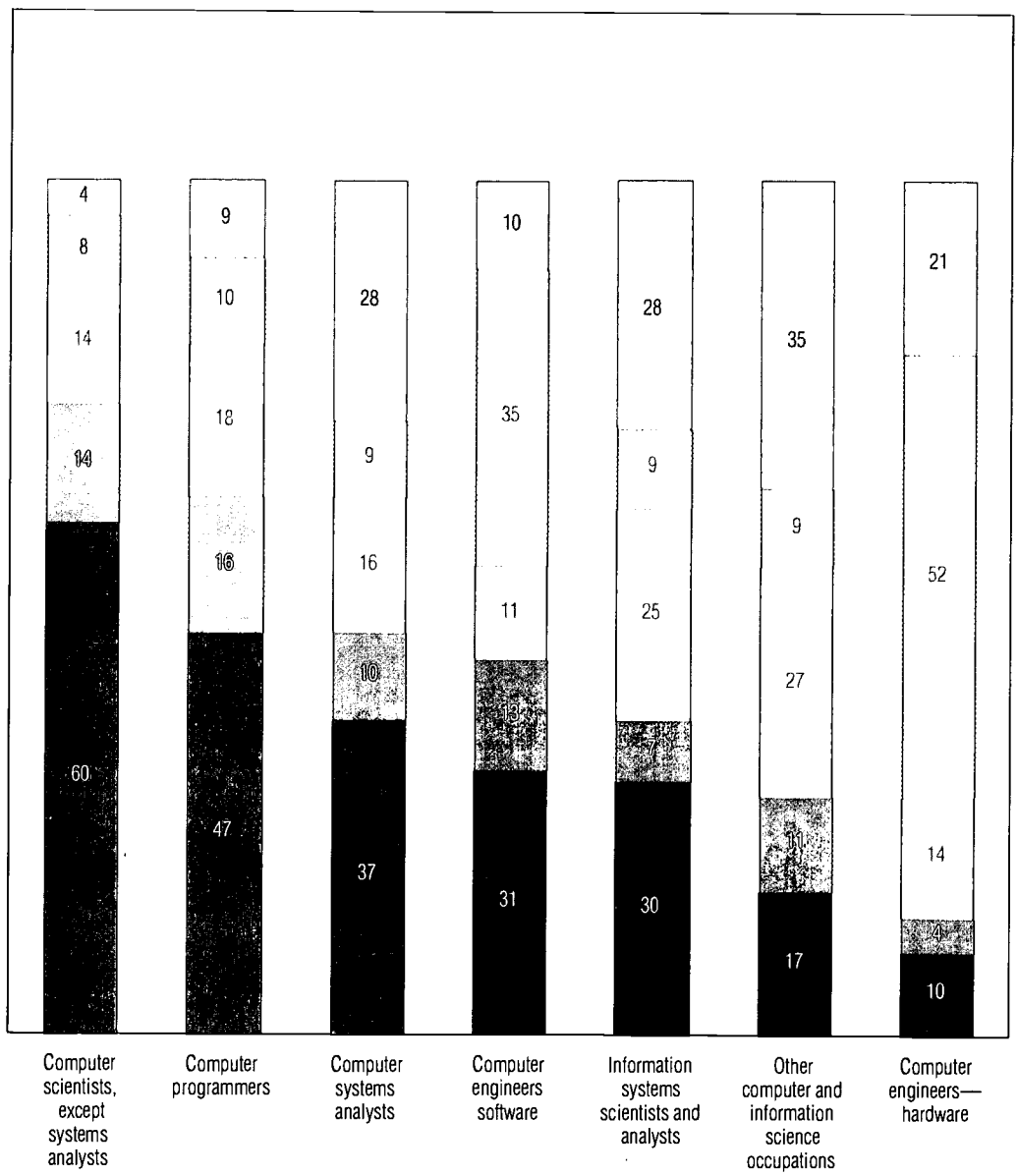
BLS projects employment in computer and data processing services will grow 108 percent between 1996 and 2006, making this the fastest growing industry. Growth of this industry is expected to drive growth of occupations such as computer engineers, computer scientists, systems analysts, and programmers. For example, almost all of the employment growth for computer programmers is expected to be in the computer and data processing services industry, as is 77 percent of the growth for computer engineers and 50 percent of the growth for systems analysts. Employment growth in all these occupations will account for 49 percent of new jobs in the industry.

However, information technology workers are in nearly every industry. And demand for technology and skilled workers is growing in all industries, not just in those considered high-tech. Many computer scientists, computer engineers, systems analysts and computer programmers work for government agencies, insurance companies, financial institutions, and universities. About 18 percent of all database administrators, computer support specialists, and all other computer scientists, for example, work in wholesale and retail trade.

As might be expected, 24 percent of all systems analysts work in the computer and data processing services industry. However, another large portion is disbursed among 3 different industries: about 16 percent work in manufacturing; about 14 percent in finance, insurance and real estate; and another 12 percent for the Federal government. Similarly, a

Chart 2

Percent distribution of graduates with a bachelor's degree working in computer occupations, by field of study



Source: National Science Foundation/SRS. 1995 SESTAT Integrated Data System. The SESTAT Web site is **srsstats.sbe.nsf.gov**

Note: Percentages do not include graduates who hold nonscience and nonengineering bachelor's degrees earned after 1993 and who started working in a science or engineering occupation after April 1993.

Table 3

Percent distribution of 1992-93 bachelor's degree recipients in computer-related fields, by occupation, April 1994

Occupation	Baccalaureate degree major	
	Computer programming	Computer and information science
Total	100.0	100.0
Administrative and clerical support	10.4	12.4
Business and management	6.8	9.4
Computer science and programming	63.8	52.2
Engineering	—	15.0
Mechanic, operator, and laborer	5.8	.4
Sales	11.0	1.2
Other	2.3	9.3

— = Data not available
Source: U.S. Department of Education, National Center for Education Statistics

large portion—around 21 percent—of all computer engineers work in the electronic equipment manufacturing industry, but about 38 percent work in the computer and data processing services industry and another 16 percent in engineering and management services. And 35 percent of all programmers work in computer and data processing services, with another 14 percent in finance, insurance, and real estate.

A growing number of computer scientists and engineers, systems analysts, and programmers are employed on a temporary or contract basis. These specialists work for companies that provide skilled professionals to clients. According to the National Association of Computer Consultant Businesses, temporary employment of skilled technical professionals is one of the fastest growing trends in high-tech hiring. The practice enables companies to bring in highly skilled workers to complete a particular project, rather than to spend time or money training existing workers.

Supply. The apparent preference for college graduates and the tight labor market in recent months has focused attention on the ability of computer science degree programs to meet current and future demands for IT workers. One assumption about IT workers is that the supply of new workers is limited to bachelor's degree recipients in computer science each year. Many people find it alarming that the number of these graduates declined between 1986 and 1995. However, new graduates with a bachelor's degree in computer science are not the only source of workers for computer-related jobs. As table 2 shows, 9 percent of all computer systems analysts and scientists and computer programmers employed in 1997 had an associate degree, 16 percent had some formal college education but no degree, and another 7 percent had a high school diploma or less.

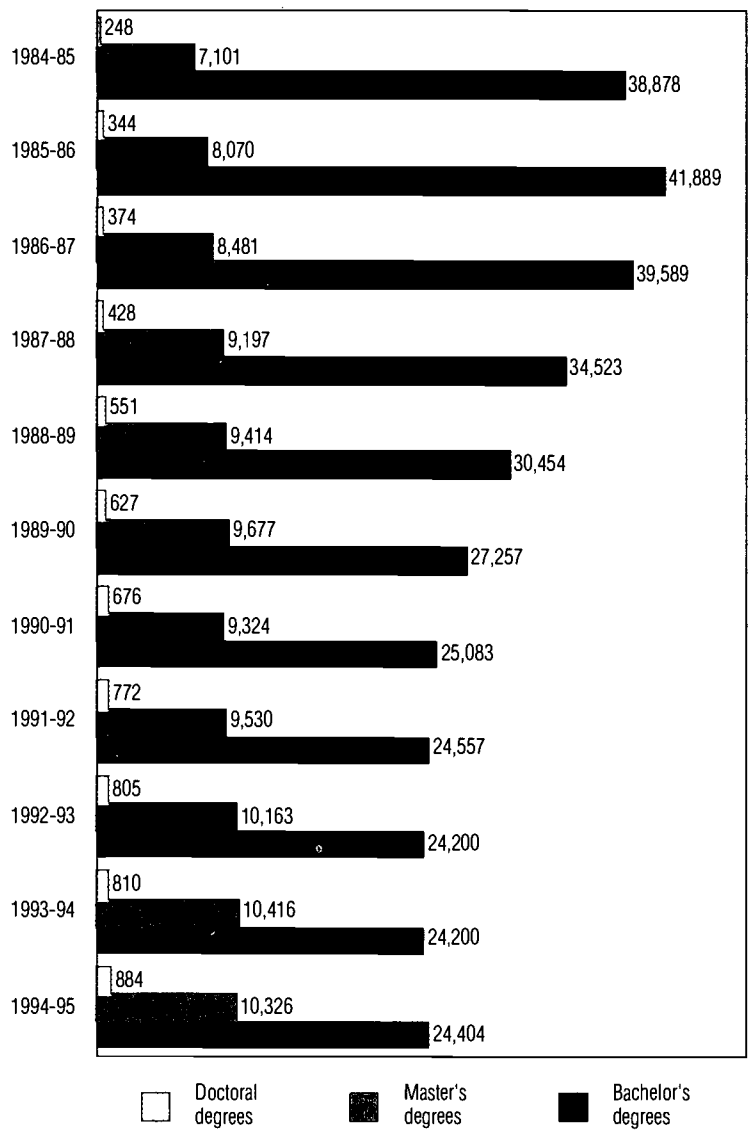
Most significantly, however, data on college graduates indicate that persons with degrees in a variety of majors find employment in a computer-related occupation. National Science Foundation (NSF) data from 1995 reveal that only 37 percent of all systems analysts with a bachelor's degree and 47 percent of all computer programmers obtained a degree in computer and information sciences. (See chart 2.) In fact, 28 percent of those graduates employed as computer systems analysts and 9 percent employed as computer programmers received a degree in a nonscience or nonengineering related field. Although most computer hardware engineers—52 percent—indicated they held a bachelor's degree in engineering, nearly a fourth—21 percent—had a degree in a nonscience or nonengineering field. And the most common majors of graduates working as a software engineer were engineering (35 percent) and computer science (31 percent); however, 10 percent held nonscience or nonengineering bachelor's degrees.

Furthermore, data on 1992-93 college graduates 1 year after graduation, from the U.S. Department of Education's National Center for Education Statistics, show that the majority of graduates working in computer-related jobs in April 1994 held degrees in areas other than computer and information sciences, predominantly business management and engineering. Only about half of the graduates with degrees in computer and information science were employed in computer-related positions in 1994. (See table 3.)

The number of bachelor's degrees conferred in computer and information sciences declined 42 percent from 1986 to 1995, as shown in chart 3. Despite this decline, employment of computer professionals in the United States has nearly doubled since 1986. Given the employment growth and the premium companies place on a computer science educa-

Chart 3

Degrees awarded in computer and information sciences, bachelor's level or higher, 1984-85 to 1994-95



Source: U.S. Department of Education. National Center for Education Statistics

tion, it seems illogical that students have been staying away from this field of study.

Several theories have been proffered to explain this behavior, although nothing is conclusive. One is that many students find computer science too challenging. These students, drawn to computer science's image as an exciting field, may enter their studies with little idea of what to expect and then realize there is more math and less multimedia than they had thought. Another hypothesis is that the diminishing numbers can be attributed to the overall performance of U.S. students in math and science. Still another theory cites the more rapidly declining proportion of women and minorities obtaining bachelor's degrees from 4-year computer science programs over the 1986-95 period.

The climate of downsizing, consolidation, and layoffs that prevailed a decade ago may also have contributed to declining interest in the field. In a draft of their Stanford Computer Industry Project paper *Strategies for Survival: The Software Talent Shortage,* Avron Barr and Shirley Tessler write that "during the late [19]80's, downsizing of IT staff was a common cost-cutting strategy in corporations in many industries." As a result, they add, "during the early 1990's, corporate computing did not look like a very attractive career to young people, and enrollments in computer science programs in the U.S. dropped."

Much attention has focused on the number of degrees in computer and information sciences awarded since 1986. However, the National Center for Education Statistics also collects separate data on awards of degrees in computer engineering and in business information systems, which are usually not included in the computer and information sciences numbers. Computer engineering programs may be under the engineering school and may be closely allied with electrical and electronics engineering degree programs. A concentration in information systems is usually available to students through business schools, such as an undergraduate management information systems major, or graduate degrees, such as the so-called techno-MBA.

Overall engineering degrees have exhibited trends similar to those in computer science. The number of degrees awarded in engineering has declined between 1986 and 1995 for similar reasons, including the performance of students in math and science and the climate of downsizing during the late 1980s. In business information systems, the number of degrees awarded has risen, but these programs still account for a small number of students overall.

In contrast to declining degree awards, enrollment in selected computer fields has been increasing in recent years. Survey results from the Computing Research Association indicate that enrollments in computer science and engineering programs were up 39 percent in 1997, an increase of about 40 percent for the second straight year.

Anecdotal evidence on computer science fields also suggests that enrollments are rising, and some departments are unable to keep up with demand. According to John Werth, formerly the Associate Dean for Information Technology at the University of Texas at Austin, "Enrollments in computer science are so large now that we can no longer allow noncomputer science graduates to take computer science classes." And at Rensselaer Polytechnic Institute, the number of students enrolled in the computer science program has doubled over the past four years.

As the data have indicated, however, a bachelor's degree in computer science is not always necessary to work in a computer-related occupation. A January report by the National Association of Colleges and Employers found the demand for computer science workers is so strong that about 54 percent of employers—in both technical and nontechnical firms—indicated they would accept associate degree holders to fill technical positions that usually require a higher degree. Other employers said they were willing to hire "well-educated bodies" they could train. As a result, many students take computer courses as noncomputer science majors, and colleges and universities are developing programs to prepare students in all majors for entry into computer-related fields.

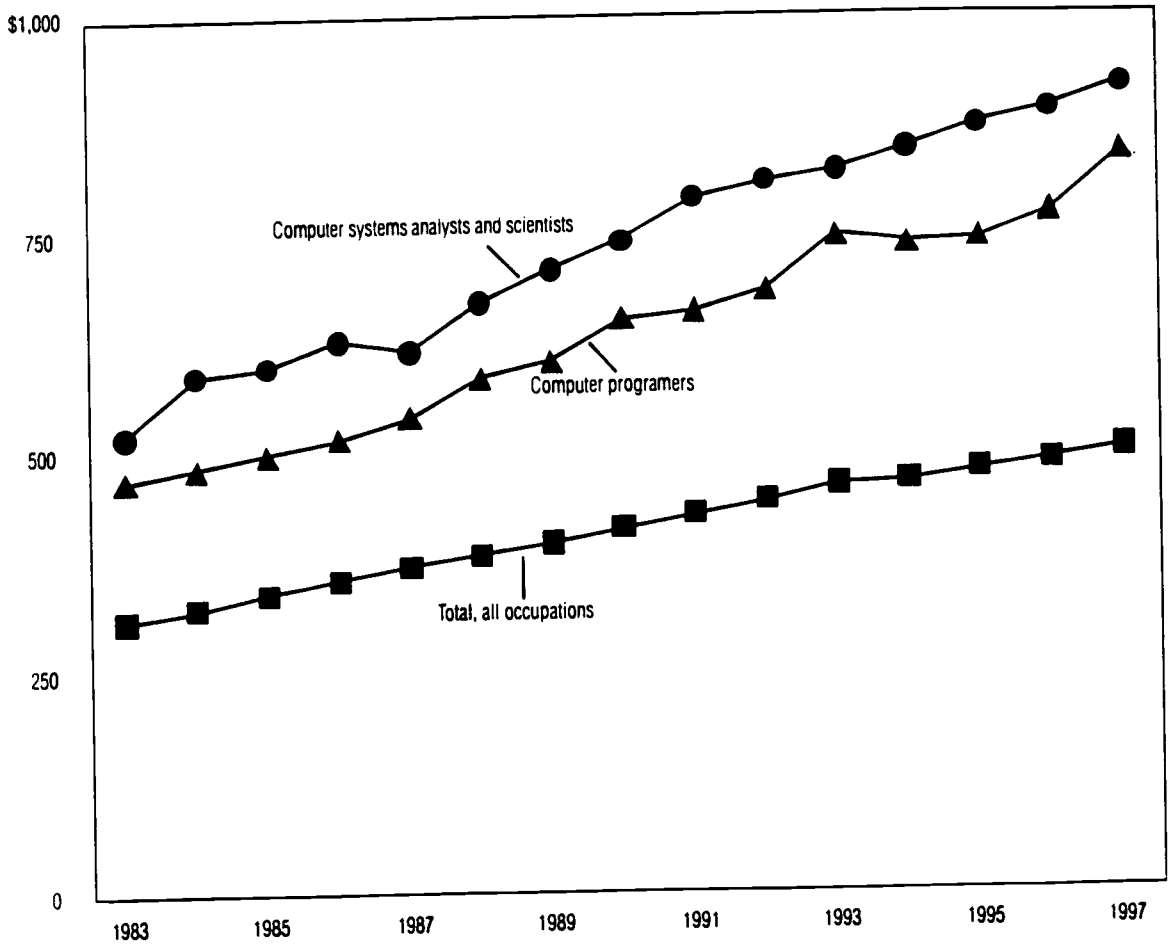
Earnings

One key indicator of strong demand within a field or occupation is a significant increase in its relative wages. Historically, workers in the computer field have been paid higher salaries than workers in other fields. Data from the Current Population Survey (CPS) show that, since the early 1980s, median weekly earnings for computer systems analysts and scientists and computer programmers have been consistently higher than the average for all workers. (See chart 4.) However, the same is true for all professional specialty occupations. Annual increases in weekly earnings for computer occupations have been comparable to wage increases for all professional specialty occupations.

The rising earning potential of information technology workers has received considerable attention, as salary increases are reported to be larger in the past year than in previous years. A *Computerworld* magazine salary survey identified an increase of 10 percent or more from 1996 to 1997 in 11 of 26 positions surveyed. These included entry-level positions for systems analysts and programmers—and also for web-

Chart 4

Median weekly earnings of wage and salary workers, 1983-97



masters, which made the survey for the first time. As you might expect, people with skills that are in great demand command the highest salaries.

CPS data also show greater wage increases from 1995 to 1997 than in the past for certain computer-related occupations. This increase reflects a tightening labor market and growing demand for computer professionals in all industries. Median weekly earnings for computer programmers increased from $743 to $840, and for computer systems analysts and scientists from $872 to $918. For all occupations, the increase was from $479 to $503.

According to the National Association of Colleges and Employers salary report, 1998 starting salary offers to computer science graduates in April averaged $40,843 annually—an increase of 9.8 percent from offers extended in September 1997. As table 4 shows, starting salary offers for bachelor's degree graduates in other computer-related fields were also up.

Table 4
Starting salary offers for bachelor's degree graduates in selected computer fields

	April 1998	September 1997
Hardware design and development	$43,312	$41,081
Computer engineering	42,436	40,093
Software design and development	41,890	39,630
Computer programming	39,301	35,613
Systems analysis and design	39,257	36,597
Management information systems (MIS)	38,564	35,228

Source: National Association of Colleges and Employers

However, the increase in starting salaries was not limited to graduates of computer fields. In business disciplines, for example, offers to accounting majors rose by about 10.8 percent from September 1997 to an average of about $33,425; graduates in economics and finance received starting salary offers averaging about $35,219, an increase of 12.4 percent over the average September 1997 offers. Noncomputer engineering disciplines also fared better, with civil engineering majors seeing offers of about $35,705, an increase of 8.1 percent, and mechanical engineering majors getting offers averaging $40,750, an increase of 6.4 percent.

As expected, starting salaries increase with education. Starting salary offers for master's degree candidates in computer science averaged $52,190 in April, while offers for computer engineering master's candidates averaged $50,650. Starting salaries for doctoral degree candidates varied.

Along with field of study and education level, earnings variation depends on factors such as the type and location of the job. For example, *Computerworld* magazine notes that pay in cities such as New York and Los Angeles is higher than the national average for certain positions.

Higher starting salary offers are not the only way firms compete for computer professionals. Stronger competition forces companies to be more creative with benefits to attract and retain talented workers. The most significant benefits are financial ones and include bonuses, profit sharing, or funds for ongoing training. Other companies provide perks such as relaxed working environments, flexible hours, child and elder care, and onsite services ranging from fitness centers to car washes.

Preparing for an IT Career

Most employers still place a premium on some formal college education, and a bachelor's degree is a prerequisite for many jobs. In fact, the majority—68 percent—of computer systems analysts and scientists and computer programmers held a bachelor's degree or higher in 1997. However, many information technology jobs may require a 2-year degree or less. For example, employers now commonly require bachelor's degrees for programmers, although some programmers qualify for jobs with 2-year degrees or certificates. A Ph.D., or at least a master's degree, in computer science or engineering is usually required for computer scientist jobs in research laboratories or academic institutions.

The level of education and type of training employers require depend on employers' needs. One factor affecting these needs is changes in technology. As demonstrated by the current demand for workers with skills related to the Internet or World Wide Web, employers often scramble to find workers capable of implementing "hot" new technologies. Another factor driving employers' needs is the time frame in which a project must be completed.

There are many ways workers enter computer-related occupations. Obviously, someone staffing a help-desk needs skills and training that differ from those of a computer engineer designing chips or a webmaster responsible for creating and maintaining a Web page. The following is an overview of some education and training options available.

Bachelor's or higher degree. Computer hardware engineers usually need a bachelor's degree in computer engineering or electrical engineering,

whereas software engineers more likely hold a degree in computer science. For systems analyst or database administrator positions, many employers seek applicants who have a bachelor's degree in computer science, information science, or computer information systems. In addition to the 24,404 bachelor's degrees awarded in computer and information science in 1994-95, 2,345 degrees were awarded in computer engineering and 6,166 in business information systems, according to the National Center for Education Statistics.

Computer engineering programs emphasize hardware and may be offered as a degree option or in conjunction with electrical and electronics engineering. As a result, graduates of a computer engineering program from a school or college of engineering often find jobs designing and developing computer hardware or related equipment, even though they also have the skills required for developing systems or software. Computer engineers usually possess strong programming skills, but they do more program analysis and problemsolving than code writing.

For computer science, however, there is more variation in where the department falls within an institution. Some may be part of a school or college of liberal arts while others may be within colleges of natural or applied sciences. The computer science department might also be affiliated with schools, colleges, or departments of engineering rather than with those of arts and sciences. Unless the program is part of the engineering department, the focus is on software, and graduates may work in areas of software engineering.

Management information systems programs are usually part of the business school or college. These programs differ considerably from computer science programs, emphasizing business and management oriented coursework and business computing courses. The objective of these programs is to develop hardware and software capabilities for solving fundamental business problems. Graduates of these programs may work as business systems analysts or programmer/analysts or in areas such as end-user support.

Two-year or associate degrees. Most community colleges and many independent technical institutes offer an associate degree in computer science or a related technology field. Some IT jobs may be better suited to the technical training these programs offer. "The information systems field is becoming very skills-based," says Jennifer Koss, a self-employed computer consultant. "You see a lot more people today without a typical 4-year degree." According to data from the National Center for Education Statistics, there were about 10,000 associate degrees awarded in computer science in 1994-95 and another 7,000 in business information and data processing services.

The role and objectives of a community college differ from those of most 4-year institutions. "Since most funding comes from local sources, community colleges have to be very community aware," says Margaret Rivera, Services Director for the American Association of Community Colleges. Both credit and noncredit courses and programs are often geared toward developing skills needed by local businesses.

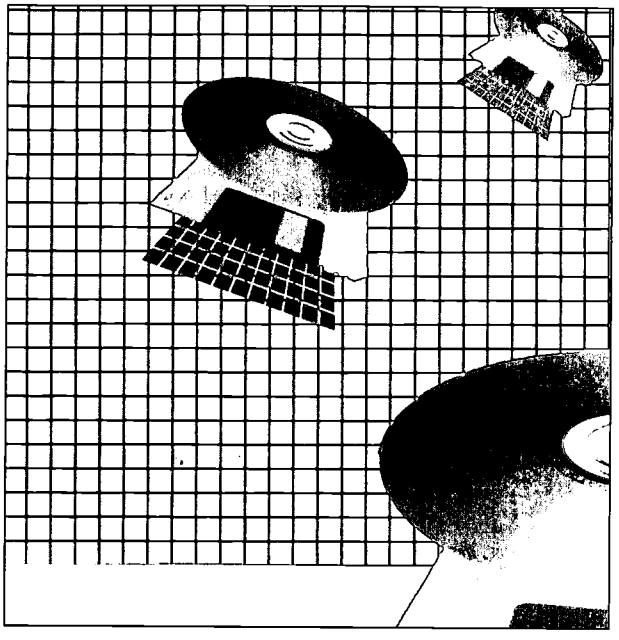
Other institutions, such as technical or proprietary schools and private training institutes or organizations, may also provide credit for coursework and grant associate degrees. Like community colleges, their programs may be more geared toward meeting the needs of local businesses and may be more occupation specific than those designed for a 4-year degree.

Other awards, diplomas, and certificates. In addition to the bachelor's and associate degrees awarded in 1994-95, nearly 30,000 nondegree awards were bestowed in computer and information sciences, according to data from the National Center for Education Statistics. That number includes almost 19,000 awards from programs lasting 1 year or less and another 11,000 from programs of 1 to 4 years. About 12,000 more were granted in business information and data processing services.

Many of the specialized diploma or certificate programs are designed to supplement or upgrade skills. These types of programs are for individuals who have no prior experience, hold an associate or bachelor's degree, or need technical skills for changing careers. The award is a sign of proficiency in a particular technology.

Technological advances come so rapidly in the computer field that continual study is necessary to keep skills up to date. "Most of what we work with today didn't exist when we were in college, so you must learn as you go," says Koss. The burden to keep skills updated falls on the worker.

Individuals interested in changing careers or developing a particular skill or area of expertise often return to a 2-year community college, technical school, or private training organization for additional training or re-training. Continuing education is usually offered by employers, hardware and software vendors, colleges and universities, and private training institutions. Additional training may come from professional development seminars offered by professional computing societies. But training can be expensive. Therefore, those seeking to upgrade or update skills should always research their training options carefully.



Background/experience. Companies often seek individuals who have a background in the firm's industry or are familiar with its business. Many people develop advanced computer skills in one occupation and then transfer those skills into a computer occupation. For example, a financial analyst proficient in computers might become a systems analyst while a computer programmer might move into a systems analyst job.

Workers who shift into new or different computer careers usually have—or get—training in a high-tech field. Cindy Brault was a computer science major who switched to accounting her sophomore year in college. She changed majors because, she says, computer science entailed "too much by-yourself kind of work." After working as an accountant for 4 years, Brault decided to do something different. Her background provided accounting information systems knowledge, enabling her to work as a consultant before landing her current job as a product analyst for a large company. Brault calls her previous occupation an asset. "Having experience with the types of software you are developing enables you to know what the users are thinking and what they prefer."

The Bottom Line

Opportunities abound in the field of information technology. The job market for computer-related occupations is booming, and demand for computer professionals is projected to remain strong through the year 2006. A degree in computer science or a related technical field is perhaps the easiest ticket into the field. But the data also show that individuals with the right experience and training can work in a computer-related occupation regardless of their formal education.

For More Information

This article is one of many sources for learning about careers in information technology. A related article by Gary Steinberg, "Jobs Associated With the Internet," is in the summer 1997 *OOQ*.

Visit your local library for books, periodicals, Internet, and other references on computers and computer-related occupations. Research employment opportunities by checking out traditional sources of job vacancies, such as the newspaper classified ads, or browsing Internet job and resume sites. In addition to listing job vacancies and soliciting resumes on their Web sites, many potential employers provide background information about the company.

The library or your school counseling office should have a copy of the BLS *Occupational Outlook Handbook, 1998-99 Edition.* It describes the duties, working conditions, training, job outlook, earnings, and more for about 250 occupations. The *Handbook* is accessible online at **www.bls.gov/ocohome.htm** Or, you may buy it from the Superintendent of Documents; see the order card at the back of this issue.

The following organizations also have information on computing careers, education and training, and professional development:

Association for Computing Machinery (ACM)
1515 Broadway
New York, NY 10036
www.acm.org

Institute of Electrical and Electronics Engineers (IEEE)
1828 L St. NW., Suite 1202
Washington, DC 20036
www.ieee.org OOQ

U.S. Department of Education
Office of Educational Research and Improvement (OERI)
National Library of Education (NLE)
Educational Resources Information Center (ERIC)

NOTICE

Reproduction Basis

☐ This document is covered by a signed "Reproduction Release (Blanket)" form (on file within the ERIC system), encompassing all or classes of documents from its source organization and, therefore, does not require a "Specific Document" Release form.

☑ This document is Federally-funded, or carries its own permission to reproduce, or is otherwise in the public domain and, therefore, may be reproduced by ERIC without a signed Reproduction Release form (either "Specific Document" or "Blanket").