
Computer Software Engineers

(O*NET 15-1031.00, 15-1032.00)

Significant Points

- Computer software engineers are one of the occupations projected to grow the fastest and add the most new jobs over the 2006-16 decade.
- Excellent job prospects are expected for applicants with at least bachelor's degree in computer engineering or computer science and with practical work experience.
- Computer software engineers must continually strive to acquire new skills in conjunction with the rapid changes that occur in computer technology.

Nature of the Work

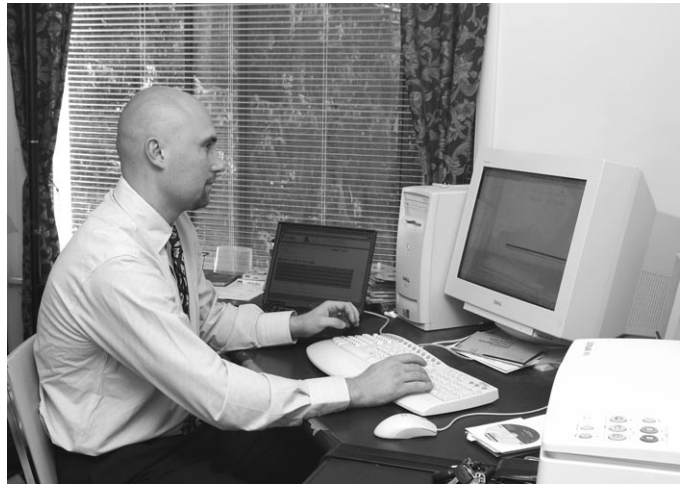
Computer software engineers apply the principles of computer science and mathematical analysis to the design, development, testing, and evaluation of the software and systems that make computers work. The tasks performed by these workers evolve quickly, reflecting new areas of specialization or changes in technology, as well as the preferences and practices of employers. (A separate section on computer hardware engineers appears in the engineers section of the *Handbook*.)

Software engineers can be involved in the design and development of many types of software, including computer games, word processing and business applications, operating systems and network distribution, and compilers, which convert programs to machine language for execution on a computer.

Computer software engineers begin by analyzing users' needs, and then design, test, and develop software to meet those needs. During this process they create the detailed sets of instructions, called algorithms, that tell the computer what to do. They also may be responsible for converting these instructions into a computer language, a process called programming or coding, but this usually is the responsibility of *computer programmers*. (A separate section on computer programmers appears elsewhere in the *Handbook*.) Computer software engineers must be experts in operating systems and middleware to ensure that the underlying systems will work properly.

Computer applications software engineers analyze users' needs and design, construct, and maintain general computer applications software or specialized utility programs. These workers use different programming languages, depending on the purpose of the program. The programming languages most often used are C, C++, and Java, with Fortran and COBOL used less commonly. Some software engineers develop both packaged systems and systems software or create customized applications.

Computer systems software engineers coordinate the construction, maintenance, and expansion of an organization's computer systems. Working with the organization, they coordinate each department's computer needs—ordering, inventory, billing, and payroll recordkeeping, for example—and make suggestions about its technical direction. They also might set up the organization's intranets—networks that link computers



Computer software engineers design, create, and modify computer applications and systems.

within the organization and ease communication among various departments.

Systems software engineers also work for companies that configure, implement, and install the computer systems of other organizations. These workers may be members of the marketing or sales staff, serving as the primary technical resource for sales workers. They also may help with sales and provide customers with technical support. Since the selling of complex computer systems often requires substantial customization to meet the needs of the purchaser, software engineers help to identify and explain needed changes. In addition, systems software engineers are responsible for ensuring security across the systems they are configuring.

Computer software engineers often work as part of a team that designs new hardware, software, and systems. A core team may comprise engineering, marketing, manufacturing, and design people, who work together to release a product.

Work environment. Computer software engineers normally work in clean, comfortable offices or in laboratories in which computer equipment is located. Software engineers who work for software vendors and consulting firms frequently travel overnight to meet with customers. Telecommuting is also becoming more common, allowing workers to do their jobs from remote locations.

Most software engineers work at least 40 hours a week, but about 17 percent work more than 50 hours a week. Software engineers also may have to work evenings or weekends to meet deadlines or solve unexpected technical problems.

Like other workers who spend long hours typing at a computer, software engineers are susceptible to eyestrain, back discomfort, and hand and wrist problems such as carpal tunnel syndrome.

Training, Other Qualifications, and Advancement

Most employers prefer applicants who have at least a bachelor's degree and experience with a variety of computer systems and technologies. In order to remain competitive, computer software engineers must continually strive to acquire the latest technical skills. Advancement opportunities are good for those with relevant experience.

Education and training. Most employers prefer applicants who have at least a bachelor's degree and broad knowledge of, and experience with, a variety of computer systems and tech-

nologies. The usual college major for applications software engineers is computer science or software engineering. Systems software engineers often study computer science or computer information systems. Graduate degrees are preferred for some of the more complex jobs. In 2006, about 80 percent of workers had a bachelor's degree or higher.

Academic programs in software engineering may offer the program as a degree option or in conjunction with computer science degrees. Because of increasing emphasis on computer security, software engineers with advanced degrees in areas such as mathematics and systems design will be sought after by software developers, government agencies, and consulting firms.

Students seeking software engineering jobs enhance their employment opportunities by participating in internships or co-ops. These experiences provide students with broad knowledge and experience, making them more attractive to employers. Inexperienced college graduates may be hired by large computer and consulting firms that train new employees in intensive, company-based programs.

Certification and other qualifications. Systems software vendors offer certification and training programs, but most training authorities say that program certification alone is not sufficient for the majority of software engineering jobs.

People interested in jobs as computer software engineers must have strong problem-solving and analytical skills. They also must be able to communicate effectively with team members, other staff, and the customers they meet. Because they often deal with a number of tasks simultaneously, they must be able to concentrate and pay close attention to detail.

As technology advances, employers will need workers with the latest skills. Computer software engineers must continually strive to acquire new skills if they wish to remain in this dynamic field. To help keep up with changing technology, workers may take continuing education and professional development seminars offered by employers, software vendors, colleges and universities, private training institutions, and professional computing societies. Computer software engineers also need skills related to the industry in which they work. Engineers working for a bank, for example, should have some expertise in finance so that they understand banks' computer needs.

Advancement. As with most occupations, advancement opportunities for computer software engineers increase with experience. Entry-level computer software engineers are likely to test designs. As they become more experienced, engineers may begin helping to design and develop software. Eventually, they may advance to become a project manager, manager of information systems, or chief information officer, especially if they have business skills and training. Some computer software

engineers with several years of experience or expertise find lucrative opportunities working as systems designers or independent consultants.

Employment

Computer software engineers held about 857,000 jobs in 2006. Approximately 507,000 were computer applications software engineers, and about 350,000 were computer systems software engineers. Although they are employed in most industries, the largest concentration of computer software engineers—more than 29 percent—is in computer systems design and related services. Many computer software engineers also work for establishments in other industries, such as software publishers, government agencies, manufacturers of computers and related electronic equipment, financial institutions, insurance providers, and management of companies and enterprises.

An increasing number of computer software engineers work as independent consultants on a temporary or contract basis, many of whom are self-employed. About 17,000 computer software engineers were self-employed in 2006.

Job Outlook

Job prospects should be excellent, as computer software engineers are expected to be among the fastest-growing occupations through the year 2016.

Employment change. Employment of computer software engineers is projected to increase by 38 percent over the 2006 to 2016 period, which is much faster than the average for all occupations. This occupation will generate about 324,000 new jobs, over the projections decade, one of the largest employment increases of any occupation.

Employment growth will result as businesses and other organizations adopt and integrate new technologies and seek to maximize the efficiency of their computer systems. Competition among businesses will continue to create incentive for sophisticated technological innovations, and organizations will need more computer software engineers to implement these changes.

Demand for computer software engineers will also increase as computer networking continues to grow. For example, expanding Internet technologies have spurred demand for computer software engineers who can develop Internet, intranet, and World Wide Web applications. Likewise, electronic data-processing systems in business, telecommunications, government, and other settings continue to become more sophisticated and complex. Implementing, safeguarding, and updating computer systems and resolving problems will fuel the demand for growing numbers of systems software engineers.

New growth areas will also continue to arise from rapidly evolving technologies. The increasing uses of the Internet, the

Projections data from the National Employment Matrix

Occupational Title	SOC Code	Employment, 2006	Projected employment, 2016	Change, 2006-2016	
				Number	Percent
Computer software engineers	15-1030	857,000	1,181,000	324,000	38
Computer software engineers, applications	15-1031	507,000	733,000	226,000	45
Computer software engineers, systems software	15-1032	350,000	449,000	99,000	28

NOTE: Data in this table are rounded. See the discussion of the employment projections table in the *Handbook* introductory chapter on *Occupational Information Included in the Handbook*.

proliferation of Web sites, and mobile technology such as wireless Internet have created a demand for a wide variety of new products. As individuals and businesses rely more on handheld computers and wireless networks, it will be necessary to integrate current computer systems with this new, more mobile technology.

In addition, information security concerns have given rise to new software needs. Concerns over “cyber security” should result in businesses and government continuing to invest heavily in software that protects their networks and vital electronic infrastructure from attack. The expansion of this technology in the next 10 years will lead to an increased need for computer engineers to design and develop the software and systems to run these new applications and integrate them into older systems.

As with other information technology jobs, outsourcing of software development to other countries may temper somewhat employment growth of computer software engineers. Firms may look to cut costs by shifting operations to foreign countries with lower prevailing wages and highly educated workers. Jobs in software engineering are less prone to being offshored than are jobs in other computer specialties, however, because software engineering requires innovation and intense research and development.

Job prospects. As a result of rapid employment growth over the 2006 to 2016 decade, job prospects for computer software engineers should be excellent. Those with practical experience and at least a bachelor’s degree in computer engineering or computer science should have the best opportunities. Employers will continue to seek computer professionals with strong programming, systems analysis, interpersonal, and business skills. In addition to jobs created through employment growth, many job openings will result from the need to replace workers who move into managerial positions, transfer to other occupations, or leave the labor force. Consulting opportunities for computer software engineers also should continue to grow as businesses seek help to manage, upgrade, and customize their increasingly complicated computer systems.

Earnings

In May 2006, median annual earnings of wage-and-salary computer applications software engineers were \$79,780. The middle 50 percent earned between \$62,830 and \$98,470. The lowest 10 percent earned less than \$49,350, and the highest 10 percent earned more than \$119,770. Median annual earnings in the industries employing the largest numbers of computer applications software engineers in May 2006 were as follows:

Software publishers.....	\$84,560
Computer systems design and related services	78,850
Management, scientific, and technical consulting services	78,850
Management of companies and enterprises	78,580
Insurance carriers	74,230

In May 2006, median annual earnings of wage-and-salary computer systems software engineers were \$85,370. The middle 50 percent earned between \$67,620 and \$105,330. The lowest 10 percent earned less than \$53,580, and the highest 10 percent earned more than \$125,750. Median annual earnings in the industries employing the largest numbers of computer systems software engineers in May 2006 are as follows:

Research and development in the physical, engineering, and life sciences.....	\$97,220
Scientific research and development services	97,180
Computer and peripheral equipment manufacturing	93,240
Software publishers.....	87,450
Computer systems design and related services.....	84,660
Data processing, hosting, and related services.....	78,270

According to the National Association of Colleges and Employers, starting salary offers for graduates with a bachelor’s degree in computer engineering averaged \$56,201 in 2007. Starting salary offers for graduates with a bachelor’s degree in computer science averaged \$53,396.

According to Robert Half Technology, starting salaries for software engineers in software development ranged from \$66,500 to \$99,750 in 2007. For network engineers, starting salaries ranged from \$65,750 to \$90,250.

Related Occupations

Other workers who use mathematics and logic extensively include computer systems analysts, computer scientists and database administrators, computer programmers, computer hardware engineers, computer support specialists and systems administrators, engineers, commercial and industrial designers, statisticians, mathematicians, and actuaries.

Sources of Additional Information

Additional information on a career in computer software engineering is available from the following organizations:

► Association for Computing Machinery (ACM), 2 Penn Plaza, Suite 701, NY 10121-0701.

Internet: <http://www.acm.org>

► Institute of Electronics and Electrical Engineers Computer Society, Headquarters Office, 1730 Massachusetts Ave. N.W., Washington, DC 20036-1992.

Internet: <http://www.computer.org>

► National Workforce Center for Emerging Technologies, 3000 Landerholm Circle S.E., Bellevue, WA 98007.

Internet: <http://www.nwcet.org>

► University of Washington Computer Science and Engineering Department, AC101 Paul G. Allen Center, Box 352350, 185 Stevens Way, Seattle, WA 98195-2350.

Internet: <http://www.cs.washington.edu/WhyCSE>